US Army Corps
of Engineers
Alaska District

Draft Integrated Feasibility Report,
Draft Environmental Assessment and
Draft Finding of No Significant Impact

Petersburg Navigation Improvements
Petersburg, Alaska

September 2018

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Prepared by
U.S. Army Corps of Engineers
Alaska District

26 September 2018

DRAFT FINDING OF NO SIGNIFICANT IMPACT

In accordance with the National Environmental Policy Act of 1969, as amended, the U.S. Army Corps of Engineers, Alaska District (Corps) has assessed the environmental effects of the following action:

Petersburg Navigation Improvements, Petersburg, Alaska

The Alaska District will deepen South Harbor in Petersburg, Alaska in order to enable safe navigation. The existing condition poses a navigational hazard for the deeper drafting vessels that call on the South Harbor. The dredging project is divided into four dredging units according to depth; ranging from minus 9 feet mean lower low water (MLLW) to minus 19.25 feet MLLW. The total volume of material that will be excavated from the South Harbor is approximately 82,720 CY. The sediment will be placed in the Frederick Sound Disposal Area in accordance with the site selection study and Ocean Dumping Permit issued by the US EPA under Section 103 of the Marine Protection, Research and Sanctuaries Act (MPRSA). Project depth would be achieved through the use of an excavator mounted on a barge in order to dislodge the consolidated clay underlying the granular sediment. Incorporating the following mitigation measures into the recommended plan will help to minimize adverse impacts that could occur on local fish and wildlife resources, including Endangered Species Act-listed species, marine mammals, and Essential Fish Habitat.

- The Federal action shall cease in-water construction between March 15 and June 15 during peak herring spawn activities, juvenile salmon outmigration and rearing activities, and when Steller sea lion and humpback whale feeding and abundance is expected to be greatest in the project area.
- To minimize the danger to marine mammals from project-related vessels, speed limits (e.g. less than 8 knots) shall be imposed on vessels moving in and around the project area.
- Project-related vessels and barges shall not be permitted to ground themselves on the bottom during low tide periods, unless there is a human safety issue requiring it.
- A construction oil spill prevention plan shall be prepared.
- A scow barge will be loaded so that enough freeboard remains to allow for safe movement of the barge and its material to the offloading site to be identified.

This action has been evaluated for its effects on several significant resources, including fish and wildlife, vegetation, wetlands, threatened or endangered species, marine resources, and cultural resources. No significant short-term or long-term adverse effects were identified.

This Corps action complies with the National Historic Preservation Act, the Endangered Species Act, the Clean Water Act, the Magnuson-Stevens Fishery Conservation and Management Act, and the National Environmental Policy Act. The completed environmental assessment supports the conclusion that the action does not constitute a major Federal action significantly affecting the quality of the human and natural environment. An environmental impact statement is therefore not necessary for the Alaska District’s proposed alterations to the Corps’ project at the South Harbor in Petersburg, Alaska.

Phillip J. Borders Colonel, U.S. Army Commanding	Date

EXECUTIVE SUMMARY

Petersburg, South Harbor is a vital facility for the economy of Petersburg, which hosts one of the most productive fishing fleets in Alaska, three major seafood processing plants, and several small custom processors. Petersburg lies approximately halfway between Juneau and Ketchikan in Southeast Alaska and lacks road access. Water accessibility is key to providing goods and services to the community and sustaining the economy as well as the subsistence way of life.

Insufficient depths and existing marine infrastructure within the Petersburg harbor system cause transportation inefficiencies and limit access for commercial fishing and subsistence activities, creating economic inefficiencies for the region and Nation. Currently, ocean going commercial fishing vessels are forced to wait for sufficient tides to operate in and around the harbor system; which is approximately 93 percent commercially utilized. The purpose of this study is to determine the feasibility of constructing navigation improvements to reduce vessel delays due to insufficient depths and improve overall access to the Petersburg harbor system.

This study evaluated a number of alternatives based on economic, engineering, environmental, and other factors. Alternative 3 maximizes the net National Economic Development benefits and has been selected as the preferred plan. The non-Federal Sponsor (Petersburg Borough) supports this plan which is dredging South Harbor and disposing of the material in-water. The plan will reduce transportation inefficiencies within the harbor system and create access for commercial fishing and subsistence activities during more of the tidal cycle.

The preferred plan has a construction cost of $7.96 million and an annual operations and maintenance cost of $95,000. National Economic Development benefits are $1.4M and the benefits to cost ratio is 2.77 for the preferred plan.

The Petersburg Borough will be required to pay the non-Federal share of 10 percent of the costs assigned to general navigation improvement features of the project as specified by the Section 107 Authority and 100 percent of the local service facilities. The non-Federal Sponsor will pay an additional 10 percent toward general navigation features over a period not to exceed 30 years. This may be accomplished through crediting for Lands, Easements, Real Estate, and Rights-Of-Way's (LERR) provided or through direct payments. The estimated non-federal share of construction is $3.35 million and the federal share of construction is $4.61 million.

PERTINENT DATA

Recommended Plan	
Alternative 3: South Harbor Dredging Only	
Dredge South Harbor; Four areas identified ranging from -9 ft to -19.25 ft MLLW	
Dredge Volume	82,740 CY

Economics	
Item	**Total ($)**
Total Annual NED Cost	$394,000
Total Annual NED Benefit	$1,092,000
Net Annual NED Benefits	$698,000
Benefit/Cost Ratio	2.77

Project Costs			
Description	**Total Cost <20 Feet**	**Federal Share 90%**	**Non-Federal Share 10%**
Mobilization/Demobilization	$1,327,000	$1,194,000	$133,000
Dredging-In-water disposal			
Navigation Buoys	$20,000	$18,000	$2,000
Marker Buoys	$10,000	$9,000	$1,000
Dredge Entrance Channel to -19.25 ft MLLW (GNF)	$2,159,000	$1,943,000	$216,000
Dredge Maneuver Channel to -18 ft MLLW (LSF)	$1,349,000	$0	$1,349,000
Dredge Commercial slips to -18 ft MLLW (GNF)	$99,000	$89,000	$10,000
Dredge Subsistence slips to -10 ft MLLW (LSF)	$525,000	$0	$525,000
Dredge sump area to -9 ft MLLW (LSF)	$77,000	$0	$77,000
Surveys			
Hydrographic Surveys for Harbor	$186,000	$167,000	$19,000
Hydrographic Surveys for Disposal Area	$36,000	$32,000	$4,000
PED	$1,400,000	$1,260,000	$140,000
SIOH	$746,000	$671,000	$75,000
Subtotal Construction Costs:	$7,934,000	$5,383,000	$2,551,000
LERR Administrative Costs	$24,000	$0	$24,000
Total Project First Cost:	**$7,958,000**	**$5,383,000**	**$2,575,000**
10% over time adjustment (less LERR)	$772,000		$772,000
Final Allocation of Costs	**$7,958,000**	**$4,611,000**	**$3,347,000**

Annual Project Costs			
Item	**Federal ($)**	**Non-Federal ($)**	**Total ($)**
Annual Maintenance and Operations Costs	$95,000	$-	$95,000

LIST OF ACRONYMS AND ABBREVIATIONS

ADEC	Alaska Department of Environmental Conservation
ADFG	Alaska Department of Fish and Game
C	Celsius
CAR	Coordination Act Report
C-MAN	Coastal Marine Automated Network
CFR	Code of Federal Regulations
COL	Colonel
USACE/Corps	U.S. Army Corps of Engineers
CWA	Clean Water Act
CY	Cubic Yards
DPS	Distinct Population Segment
EFH	Essential Fish Habitat
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ER	Engineer Regulations
ESA	Endangered Species Act
etc.	Et Cetera
FAA	Federal Aviation Administration
F	Fahrenheit
FMP	Fishery Management Plan
FONSI	Finding of No Significant Impact
FR/EA	Feasibility Report and Environmental Assessment
FWCA	Fish and Wildlife Coordination Act
ft	feet
GNF	General Navigation Feature
HTRW	Hazardous, Toxic, and Radioactive Wastes
IDC	Interest During Construction
kg	Kilograms
lbs	Pounds
LERR	Lands, Easements, Real Estate, and Rights-Of-Way
LPP	Locally Preferred Plan
LSF	Local Service Facilities
mg	Milligrams
MBTA	Migratory Bird Treaty Act
MHHW	Mean Higher High Water
MHW	Mean High Water
MLLW	Mean Lower Low Water

MLW	Mean Low Water
MMPA	Marine Mammal Protection Act
MPRSA	Marine Protection, Research and Sanctuaries Act
MSL	Mean Sea Level
MTL	Mean Tide Level
N/A	Not Applicable
NED	National Economic Development
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
O&M	Operation and Maintenance
OCT	Opportunity Cost of Time
OMRR&R	Operation, Maintenance, Repair, Replacement, and Rehabilitation
PAL	Planning Aid Letter
PC	Partial Compliance
PED	Preconstruction Engineering and Design
R	Republican
S&A	Supervision and Administration
SHPO	State Historic Preservation Officer
TSP	Tentatively Selected Plan
U.S.	United States
USCG	United States Coast Guard
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

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1. INTRODUCTION

1.1 Project & Study Authority

This feasibility study is being conducted under authority granted by Section 107 of the River and Harbor Act of 1960, as amended (33 U.S.C. 577) which states in part:

> *The Secretary of the Army is authorized to allot from any appropriations hereafter made for rivers and harbors not to exceed $50,000,000 for any one fiscal year for the construction of small river and harbor improvement projects not specifically authorized by Congress which will result in substantial benefits to navigation and which can be operated consistently with appropriate and economic use of the waters of the Nation for other purposes, when in the opinion of the Chief of Engineers such work is advisable, if benefits are in excess of the cost….Not more than $10,000,000 shall be allotted for the construction of a project under this section at any single locality and the amount allotted shall be sufficient to complete the Federal participation in the project under this section.*

1.2 Scope of Study

This study examines the feasibility and environmental effects of implementing navigation improvement measures in South Harbor at Petersburg, Alaska. U.S. Army Corps of Engineer Regulation (ER) 1105-2-100, "Planning Guidance Notebook" defines the contents of feasibility reports for navigation improvement measures. Engineer Regulation 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. It also complies with the requirements of the Council on Environmental Quality regulations for implementing the National Environmental Policy Act of 1969 (42 United States Code 4321 et seq.).

The Alaska District, U.S. Army Corps of Engineers (USACE) is primarily responsible for conducting studies for navigation improvements at Petersburg. The studies that provide the basis for this report were conducted with the assistance of many individuals and agencies, including the Petersburg Borough, the U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), Alaska Department of Fish and Game (ADFG), Alaska Department of Environmental Conservation (ADEC), Alaska Department of Natural Resources (ADNR), U.S. Environmental Protection Agency (EPA), Alaska State Historic Preservation Office (SHPO), and many members of the interested public who contributed information and constructive criticism to improve the quality of this report.

1.3 Study Location

Petersburg is located on the northwest end of Mitkof Island in Southeast Alaska. It is between the shores of Frederick Sound and Wrangell Narrows, two of the many tidal channels among the hundreds of islands and passages of Southeast Alaska's Alexander Archipelago. It lies midway between Juneau and Ketchikan, approximately 120 miles from either community (Figure 1). The Petersburg Harbor System encompasses three harbors, North, Middle and South Harbor. North Harbor is an existing USACE dredge area. South Harbor is the focus of this study. It is a vital facility for the economy of Petersburg, which hosts one of the most productive fishing fleets in Alaska, three major seafood processing plants, and several small custom processors.

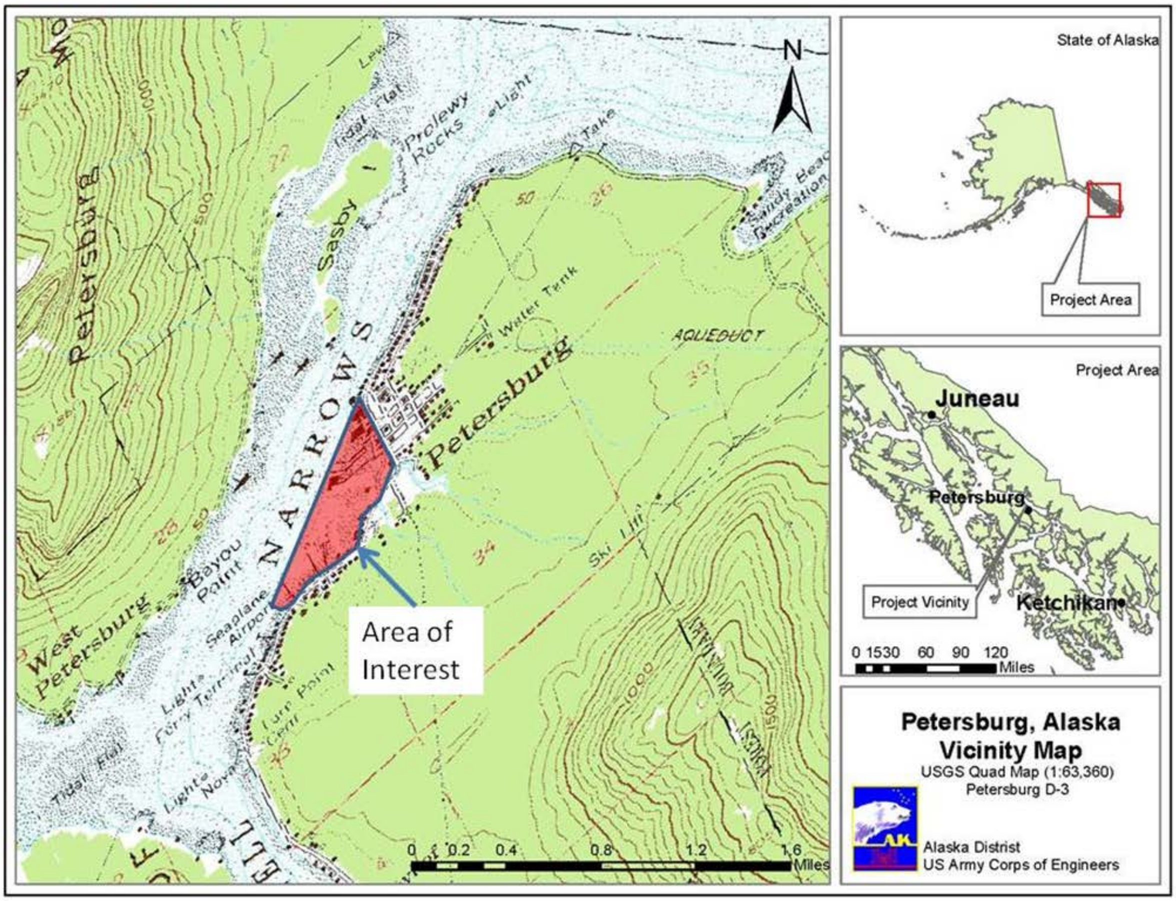

Figure 1. Petersburg Navigation Improvements Location & Vicinity

1.4 Congressional District

This study has been cost-shared, with 50 percent of the study funding provided by the Petersburg Borough, acting as the non-Federal partner. The study area is in the Alaska Congressional District, which has the following Congressional delegation:

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

1.5 Non-Federal Sponsor

The Petersburg Borough is the non-Federal sponsor and has stated its' intention to cost-share in a federally-constructed navigation improvement project. The Federal Cost Sharing Agreement (FCSA) for this Study was signed on 27 September 2017. This agreement creates a Federal and non-Federal partnership with the objective to effectively serve both local and national interests. The feasibility phase is conducted at a 50/50 cost share under Section 105(a) of the Water Resources Development Act (WRDA) of 1986.

1.6 Related Reports and Studies

USACE, A Study of Dredging Means and Disposal Methods in Eighteen Alaskan Small Boat Harbors, September 30, 1977.

USACE, Technical Memorandum, Chemical and Physical Data Pertaining to Placement of Dredged Harbor Sediment at Petersburg Landfill, September 2011.

USACE, May 2001, report titled "Final Chemical Data Report, Petersburg North Harbor Maintenance Dredging, Petersburg, Alaska, USACE, May 2001.

USACE, Chemical Data Report, Petersburg Small Boat Harbor Sediment Study, Petersburg Small Boat Harbor, Petersburg, Alaska, P#2 138810 NPDL# 11-051. June 2011.

USACE, ERDC TN-DOER-E21. 2005. Silt Curtains as a Dredging Project Management Tool, current velocity limits for silt curtains, September 2005.

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

2.1 Problem Statement

The problem statement developed for the study is as follows:

Insufficient depths and existing marine infrastructure within the Petersburg harbor system cause transportation inefficiencies and limit access for commercial fishing and subsistence activities, creating economic inefficiencies for the region and Nation.

2.2 Purpose and Need

Petersburg lacks road access and is only accessible via water and air. Water accessibility is key to providing goods and services to the community and sustaining the economy as well as the subsistence way of life. Currently, ocean going commercial fishing vessels are forced to wait for sufficient tides to operate in and around the harbor system; which is approximately 93 percent commercially utilized. The tidal spectrum in Petersburg ranges in depths from -4 feet to +19 feet MLLW, causing economic inefficiencies and hazards to the growing fleet. There is a federal project in the North Harbor; but there is no federal project in Middle Harbor, South Harbor, or Scow Bay. The purpose of this study is to determine the feasibility of constructing navigation improvements to reduce vessel delays due to insufficient depths and improve overall access to the Petersburg harbor system.

2.3 Opportunities

The following opportunities have been identified:

- Improve access for commercial and subsistence vessels
- Reduce life and human safety risks
- Increase regional economic activities
- Increase regional employment opportunities
- Reduce damage to catch and dead-loss, which is caused by delays and contamination.

Catch and dead loss refers to fish, crab or other species caught by commercial fishermen that may die in transit to the processing facility due to increased wait times and inability to access the facility during low tidal stages. Contamination refers to catch sitting in the hold for extended periods of time in stagnant water affecting the quality of the meat.

2.4 National Objectives

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

2.5 Study Objectives

The Petersburg Navigation Improvements Feasibility Study has two primary planning objectives. They are listed below without respect to priority as they will need to be addressed to arrive at an effective solution:

- Improve access to the Petersburg Harbor system:
    - Entrance channel & maneuvering basin
    - Moorage areas
    - Public access facilities
- Reduce vessel delays due to insufficient depths within the harbor system

2.6 Study Constraints

Dredging will need to be conducted outside of marine mammal migrations, spawning events and major fishing seasons to avoid impacts to fishing activities and environmentally sensitive species. Please see section 7.1.5 for more information on mitigation measures for this study.

2.7 National Evaluation Criteria

Federal Principles and Guidelines establish four criteria for evaluation of water resources projects. 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

In addition to the above criteria used for all potential USACE water resources development projects, a study specific criteria to be considered is potential conflicts with dredging during peak fishing seasons or during spawning or migration.

3. BASELINE CONDITIONS\AFFECTED ENVIRONMENT*

3.1 Physical Environment

3.1.1 Temperature & Precipitation

Petersburg falls within the southeast maritime climate zone, characterized by cool summers, mild winters and heavy rain throughout the year. Summer temperatures range from 57-63° F. Winter temperatures range from 36 to 49° F. Average annual precipitation is 109 inches, and average annual snowfall is 77 inches (Table 1).

Table 1. Monthly Climate Summary Petersburg, Alaska Period of Record: 1981-2010 (Provided by the National Climate Data Center)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	36.2	38.3	42.4	49.5	56.5	61.9	64.0	63.2	57.0	48.9	40.4	36.3	49.6
Average Min. Temperature (F)	26.0	27.1	29.6	34.1	40.4	46.3	49.2	48.2	44.0	38.1	30.9	27.2	36.8
Average Total Precipitation (in)	11.48	7.36	8.45	6.04	5.92	4.94	5.21	7.20	13.65	15.71	12.22	11.05	109.23
Average Total Snowfall (in)	21.9	16.1	16.9	0.7	0.0	0.0	0.0	0.0	0.0	0.6	9.1	11.4	76.7

3.1.2 Ice Conditions

Petersburg is ice free year round.

3.1.3 Sediments

Sediment Transport. The primary input for upland sediments is sediment load moving downstream in Hammer Slough through Middle Harbor and then northwest into North Harbor (USACE 1977). The estimated rate of deposition from Hammer Slough is 200 CY per year. A smaller unnamed stream entering Wrangell Narrows south of Hammer Slough may also contribute to the sediment accumulation in South Harbor since majority of the sediment from

Hammer Slough is thought to move north into Middle and North Harbors. The report also notes that the input of marine derived sediments results primarily from tidal flood and ebb currents moving through the Wrangell Narrows at an average mid-channel rate of 3.7 and 3.4 knots, respectively. Mid-channel velocities can reach as high as 8 knots. No separate estimate of the rate of deposition or erosion of sediments resulting from Wrangell Narrows influence is available, nor is a combined estimate of the rate of fresh water and marine deposition or erosion available.

Sediment Quality. The Alaska District collected sediment samples in April 2018 in order to characterize the physical and chemical properties of the dredged material and newly exposed surface. The boring locations are shown in Figure 2. Boring was performed using a vibracore device. Sediment samples were taken throughout the vertical cross section of the dredge footprint, from the soil surface to post construction depth or refusal. The physical characteristics of the sediment are displayed in Table 2. The chemical properties of the sediments were compared to the screening levels for in water placement described in the Seattle District's Dredged Material Management Plan (DMMP) and for terrestrial placement described in the ADEC cleanup levels for soil. The sediments did not exceed the thresholds of unconfined placement in either the marine or terrestrial environments (Appendix A).

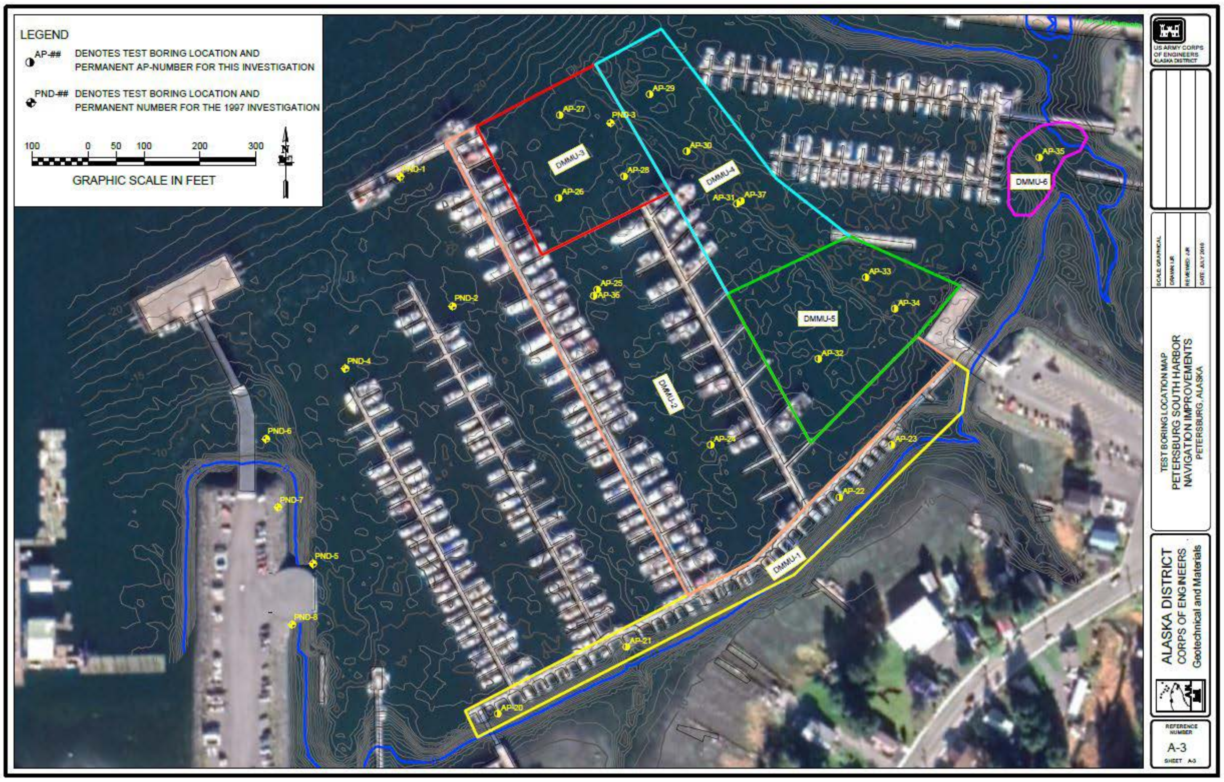

Figure 2. Map Showing the Test Boring Locations in South Harbor

Table 2. Summary of Geotechnical Laboratory Test Results

Petersburg Borehole Location Coordinates					
Permanent Number	Field Number	Nothing	Easting	Elevation	Description
AP-20	TB-01	1,817,642.97	2,826,372.56	-11.47	Soil Boring
AP-21	TB-02	1,817,765.92	2,824,601.81	-7.48	Soil Boring
AP-22	TB-03	1,818,037.87	2,826,982.26	-11.61	Soil Boring
AP-23	TB-04	1,818,133.56	2,827,076.04	-8.78	Soil Boring
AP-24	TB-05	1,818,127.47	2,826,752.87	-16.54	Soil Boring
AP-25	TB-06	1,818,416.00	2,826,549.72	-16.26	Soil Boring
AP-26	TB-07	1,818,582.83	2,826,480.58	-16.49	Soil Boring
AP-27	TB-08	1,818,733.54	2,826,482.73	-15.69	Soil Boring
AP-28	TB-09	1,818,621.90	2,826,597.73	-16.70	Soil Boring
AP-29	TB-10	1,818,771.36	2,826,643.27	-12.36	Soil Boring
AP-30	TB-11	1,818,667.77	2,826,709.42	-13.52	Soil Boring
AP-31	TB-12	1,818,572.53	2,826,799.04	-16.08	Soil Boring
AP-32	TB-13	1,818,289.92	2,826,944.85	-18.07	Soil Boring
AP-33	TB-14	1,818,438.07	2,827,029.39	-14.82	Soil Boring
AP-34	TB-15	1,818,381.12	2,827,081.44	-16.23	Soil Boring
AP-35	TB-16	1,818,656.37	2,827,339.60	-3.48	Soil Boring
AP-36	TB-6A	1,818,404.61	2,826,543.46	-16.94	Soil Boring
AP-37	TB-12A	1,818,577.16	2,826,806.75	-15.30	Soil Boring

3.1.4 Wind

The wind speeds presented in Table 3 and Table 4 were developed by Air Force Combat Climatology Center using historical wind speeds from the Five Finger Coastal-Marine Automated Network (C-MAN) at the Five Finger lighthouse (Figure 3). The Five Fingers data represents unobstructed wind speeds.

Figure 3. Location of C-MAN Station Used for Wind Data

Table 3. North Wind Speed Extremal Analysis

One-Hour Sustained Wind (Knots) EXTREME VALUE ANALYSIS										
Five Finger AK Buoy - NORTH WIND										
55.27 N 133.63 W Elevation = 7 meters PERIOD OF RECORD: 1985-2013										
QUANTILES	0.1	0.2	0.5	0.8	0.9	0.95	0.98	0.99	0.999	0.9999
RETURN PERIOD (YRS)	1.1	1.25	2	5	10	20	50	100	1000	10000
VARIATE 1 Hour Sustained Winds	37.0	37.6	41.2	50.3	58.0	66.0	77.0	85.4	114.0	143.1

Note: The return period is the average elapsed time between occurrences of an event with a certain magnitude or greater.

Table 4. South Wind Speed Extremal Analysis

One-Hour Sustained Wind (Knots) EXTREME VALUE ANALYSIS										
Five Finger AK Buoy - SOUTH WIND										
55.27 N 133.63 W Elevation = 7 meters PERIOD OF RECORD: 1985-2013										
QUANTILES	0.1	0.2	0.5	0.8	0.9	0.95	0.98	0.99	0.999	0.9999
RETURN PERIOD (YRS)	1.1	1.25	2	5	10	20	50	100	1000	10000
VARIATE 1 Hour Sustained Winds	39.8	40.1	42.9	50.8	57.7	65.1	75.2	83.1	110.0	137.5

Note: The return period is the average elapsed time between occurrences of an event with a certain magnitude or greater.

3.1.5 Water Quality

Despite some localized legacy hydrocarbon and metals contamination within South Harbor, the water quality is unimpaired due to the moderate to high velocity currents transiting the area and the overall higher water quality in Frederick Sound and Wrangell Narrows. Water movement within the Petersburg Harbor basins is heavily influenced by strong tidal currents within Wrangell Narrows. The current at flood tide runs to the southwest at an average rate of 3.7 knots, then reverses during ebb tide to an average rate of 3.4 knots; the maximum recorded current is 6.1 knots. Since most structures within the harbors are on pilings, there is little to impede water driven by these currents from flowing through the exposed harbor basins. Heavy ripple marks seen in some of the bottom sediments attest to the strong currents within the harbors. On the other hand, the harbors experience very little wave action.

3.1.6 Water Level

Water level increase is typically a result of wave set up, storm surge, inverted barometer effects, and tide. Relative sea level rise is a longer term change in water level which needs to be considered when designing for a navigation improvements project.

Wave Setup. Wave setup is the water level rise at the coast caused by breaking waves. The features of this project extend beyond the area of breaking waves so wave set up was not considered in the calculations for the Petersburg Navigation Improvements project.

Storm Surge. Petersburg experiences low pressure events that could contribute to storm surge, but the water is too deep to stack up and cause a significant surge. A rise in the water elevation due to surge has not been a problem reported at Petersburg, so no storm surge was used in the calculations for the project.

Inverted Barometer. A high pressure system decreases sea level, and conversely, low atmospheric pressure results in sea level rise. Generally, a 1 millibar change in pressure results in a 1 cm change in the water surface. To compensate for a lowered water level due to a high pressure system the lowest astronomic tide was used when determining the dredge depth.

Tide. The mean higher high tide of 16.07 feet was used for the high water elevation.

Sea Level Rise. USACE requires that planning studies and engineering designs over the project life cycle, for both existing and proposed projects consider alternatives that are formulated and evaluated for the entire range of possible future rates of sea-level change (SLC), represented by three scenarios of “low,” “intermediate,” and “high” sea-level change. The SLC “low” rate is the historic SLC. Sea Level rise equations and calculations can be found in Appendix B.

3.1.7 Tides

Petersburg’s semi-diurnal tidal range is approximately 16 feet. The extreme tidal range is 23.8 feet with a mean range of 13.8 feet. Petersburg lies within a two-layered estuarine circulation system common in Southeast Alaska. It is a seasonal phenomenon beginning during spring thaw with an increase in freshwater discharge. The freshwater flows seaward along the surface (of the ocean) and is replaced by saline water intruding at greater depths. During fall and winter, storms and reduced runoff combine to thoroughly mix the layers and destroy the system (USACE, 1989).

The tidal parameters in Table 5 were determined using National Oceanic and Atmospheric Administration published data for Turn Point (approximately 1 mile southwest of Petersburg) published June 2009 for the tidal epoch 1983-2001. There was no reported highest observed water level and no lowest observed water level.

Table 5. Tidal Parameters – Petersburg

Parameter	Elevation (ft)
Highest Astronomical Tide	19.69
Mean Higher High Water	16.07
Mean Sea Level (MSL)[1]	8.34
Mean Tide Level (MTL)[2]	8.34
Mean Lower Low Water (MLLW)	0.00
Lowest Astronomical Tide	-4.15

[1] MSL The arithmetic mean of hourly heights observed over the National Tidal Datum Epoch. Shorter series are specified in the name; e.g. monthly mean sea level and yearly mean sea level.

[2] MTL The arithmetic mean of mean high water and mean low water.

3.1.8 Currents

The mid-channel current velocities approximately 300 yards from the face of the docks are reported to be as high as 7 knots (USACE 1977). Velocities within the harbor are estimated to be much less, but were not numerically quantified within USACE 1977. The estimated current for South Harbor in Petersburg is as follows: average maximum flood tide 3.2 knots, average maximum ebb tide 2.1 knots (Tides & Currents software Version 3.7.0.117). The highest fetch during maximum tides is reported to be approximately one-half mile.

3.1.9 Rivers and Creeks in the Project Vicinity

Hammer Slough feeds into the Petersburg Harbor system between Middle and South Harbor. This slough appears to be the main supply of sediment that settles in the harbors. The frequency of infilling for this project is assumed to be similar to the USACE dredging in the North Harbor (Figure 4). The North Harbor was originally dredged in 1971, and again 42 years later in 2013. Maintenance dredging in 2013 removed approximately 27,000 cubic yards of material.

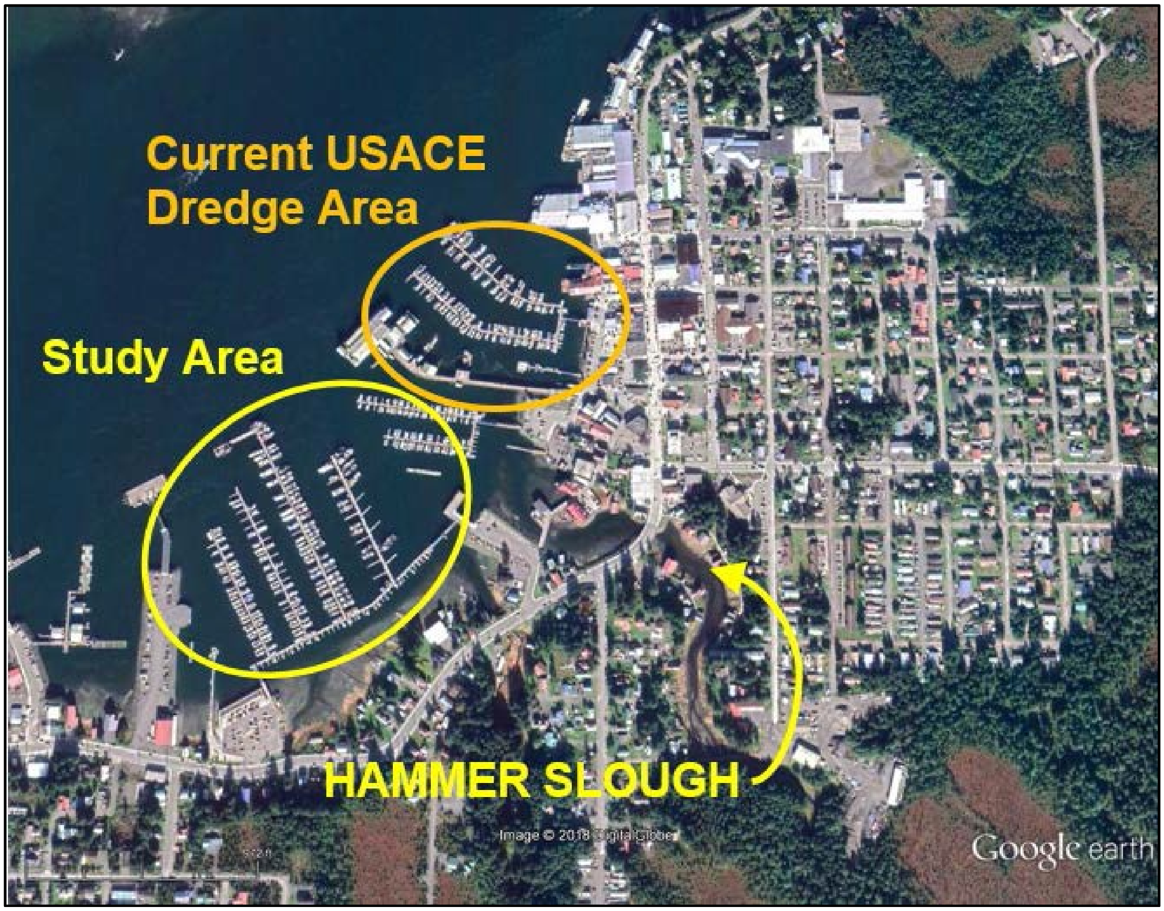

Figure 4. Location of Hammer Slough, Current USACE Dredge Area and Study Area

3.2 Biological Resources

Biological resources in the vicinity of the Petersburg South Harbor are typical of Southeast Alaska. Habitat within the proposed dredge footprint has been impacted since the Harbor basin was dredged in 1982 with full construction completed in 1984. Substrate located within the proposed dredging footprint consists mostly of sand and silt and is located in an area of the Harbor that is largely exposed and thus experiences high wave energy. There is not a breakwater or other energy reducing structure to protect the Harbor due to its location in Wrangell Narrows. The following section identifies biological resources occurring in the study area. The project area can be viewed as 3 distinct areas for purposes of environmental analyses; proposed area for reorganizing the floats, proposed area where dredging may occur, and potential in-water disposal locations.

Reorganizing floats and dredging activities, as proposed, would occur within the existing harbor footprint. Reorganizing existing floats would require mobilization of equipment within the harbor and has the potential to minimally impact various species that could occur at the surface, within the water column, or within the benthic environment. Potential impacts would be limited to activities such as shifting vessel traffic, equipment mobilization, and possibly repositioning float anchors.

Disposal of dredge material, was originally proposed to occur in Scow Bay which is located approximately 2.5 miles south of South Harbor. The history of this area is explained in depth in Section 3.3.3.2 as a part of the feasibility study effort. However, during the study, alternatives considering the use of Scow Bay as a disposal site were removed due to a fiscal constraint identified by the non-Federal Sponsor explained in Section 5.4. In addition, one alternative was not economically justified (Appendix C). During the ongoing planning and stakeholder coordination, potential open-water disposal sites were identified in Thomas Bay and Frederick Sound. Further analyses indicated that the site in Frederick Sound had been used before as a disposal option. As a result, Thomas Bay and Frederick Sound were carried forward as a potential open-water disposal sites for purposes of NEPA analyses.

3.2.1 Birds

Dredge and Float Reorganization Footprint. During USACE's November 2017 site visit, several species of migratory ducks were observed in the study area; including oldsquaw (*Clangula hyemalis),* mallards (*Anas platyrhynchos),* Barrow's goldeneye (*Bucephala islandica),* bufflehead (*Bucephala albeola),* common merganser (*Mergus merganser),* and surf scoters (*Melanitta perspicillata)*. Kingfishers (*Megaceryle alcyon*), bald eagles (*Haliaeetus leucocephalus*), crows (*Corvus sp.),* and large gulls (likely herring gulls) were observed in the area.

Many species, such as common raven, northwestern crow, and gulls are consistently present across seasons. Shorebirds exhibit some degree of seasonality, with higher numbers occurring during spring migration and reduced numbers during the winter months. Waterfowl can also be found in and around the Petersburg area. Sea ducks, divers, and puddle ducks can all be found throughout Southeast Alaska depending on the season.

The bald eagle is the only raptor directly associated with the marine environment in the Petersburg area; however, merlin (*Falco columbaris*) and northern harrier *(Circus hudsonius*) could frequent the Petersburg area as they have been found around Sitka (FAA, 2009). Bald eagles typically hunt fish in near shore and open water, snatch alcids, seabirds, and gulls flushed from the water or land, and scavenge carrion washed into the intertidal zones.

The USFWS lists marbled murrelets (*Brachyramphus marmoratus*) as a species of high concern in Alaska (USFWS, 2006). They are also listed as being of high concern in North America and endangered globally, according to the USFWS Alaska Seabird Information Series. The Queen Charlotte goshawk (*Accipiter gentilis laing*), peregrine falcon (*Falco peregrinus*), olive- sided flycatcher (*Contopus cooperi*), and Townsend's warbler (*Setophaga townsendi*) are listed as special species of concern by ADFG and may also exist in the study area.

3.2.2 Marine Fish

Dredge and Float Reorganization Footprint Aggregations of juvenile fish, possibly herring, were observed amongst the flotsam entrained in the boat slips on C and D float (Figure 6). No fish were filmed underwater. The proposed study footprint does not contain essential fish habitat for any Federally managed fish species. Coho salmon (*Oncorhynchus kisutch)* are reported to be present in the Hammer Slough adjacent to the South Harbor and pink salmon (*Oncorhynchus* *gorbuscha*) are believed to spawn in Hammer Slough. All five Pacific salmon species may be found in the marine waters off the coast of Alaska. Salmon fry outmigrating from the fresh waters near the proposed study area are likely present in April and May while adult salmon returning to spawn transit the area in June through October.

In-water Disposal Location. The proposed disposal locations in Thomas Bay and Frederick Sound lie within the textual descriptions of Essential Fish Habitat (EFH) (Appendix D) for the following fisheries:

Gulf of Alaska Groundfish EFH
Big Skate
Longnose Skate
Octopus
Sharks
Shallow Water Flatfish Complex,

Bering Sea / Aleutian Islands Groundfish EFH
Octopus (Bering Sea)
Forage Fish Complex
Sharks (Bering Sea)
Squid Complex

3.2.3 Marine Mammals

Dredge and Float Reorganization Footprint. Three Steller's sea lions (*Eumetopia jubatus)* and a single Northern sea otter (*Enhydra lutris*) were observed during the November 2017 site visit to the proposed dredge footprint. Humpback whales (*Megaptera novaeangliae*) frequent the Wrangell Narrows, particularly in the late spring and summer. Killer whales (*Orcinus orca*), Pacific white-sided dolphins (*Lagenorhynchus obliquidens*), harbor porpoises (*Phocoena phocoena),* and harbor seals (*Phoca vitulina*) are present in the area at various times throughout the year.

All marine mammals are protected under the Federal Marine Mammal Protection Act (MMPA), while the Steller's sea lion and humpback whale are also protected under the Endangered Species Act (ESA). The humpback whale and Steller sea lion (both the eastern distinct and western distinct populations) are protected under the ESA.

Killer Whale. In general, it is likely that transients and resident populations of killer whales use Frederick Sound habitats when seeking foraging opportunities. They are known to cruise the open water portions of Frederick Sound and transit channels to inner Frederick Sound, probably feeding on salmon. Although their visits to inner Frederick Sound do not appear to be frequent, the habitats within the project area likely provide important prey or other attributes important for this species.

Harbor Seals. Near Petersburg, harbor seals congregate and pup in Leconte Bay. Dozens of isolated mother-pup pairs are found in Leconte Bay between May and June. Near the end of July, mothers and pups separate and additional seals enter the bay. It is not uncommon to see hundreds of seals dotting the icebergs during this time. Harbor seals can be found throughout Frederick Sound.

Northern Sea Otter. Sea otters in the Southeast Alaska stock are not listed as “depleted” under the MMPA or listed as “threatened” or “endangered” under the ESA. However, all northern sea otters are listed by the State of Alaska as a species of special concern under their listing program. A Species of Special Concern is any species or subspecies of wildlife or population of mammal native to Alaska that has entered a long-term decline in abundance or is vulnerable to a significant decline due to low numbers, restricted distribution, dependence on limited habitat resources, or sensitivity to environmental disturbance. In general, northern sea otters are widely distributed in Southeast Alaska. During spring surveys around Japonski Island (FAA 2009) (90 miles northwest of Petersburg), a total of 45 sea otters were observed; however, several sightings were likely repeat sightings of the same individuals.

Pacific white-sided dolphins. These sociable dolphins are generally found in temperate waters of the North Pacific, where they feed on a variety of small schooling fish such as anchovies and hake. Despite their distribution largely in deep, offshore waters they are also found over the continental shelf and very near shore in some areas.

Harbor porpoise. Harbor porpoises are commonly found in bays, estuaries, harbors, and fjords less than 650 feet deep in northern temperate and subarctic waters. They feed on demersal and benthic species, mainly schooling fish and cephalopods.

Other Marine Mammals. The following marine mammal species have been observed in Southeast Alaska and may occur near Petersburg on an infrequent to rare basis: Dall’s porpoise (*Phocoenoides dalli)*, gray whale (*Eschrichtius robustus*), harbor porpoise (*Phocoena phocoena*), minke whale (*Balaenoptera acutorostrata*), fin whale (*Balaenoptera physalus*), sperm whale (*Physeter macrocephalus*), and pygmy sperm whale (*Kogia breviceps*). Based upon available information, these species are unlikely to rely upon habitats in the project area, but may travel within the vicinity of Petersburg (FAA, 2009).

In-water Disposal Location. Table 6 lists the marine mammals that may occur in the proposed in-water disposal locations:

Table 6. Marine Mammals that may be Present in Thomas Bay and Frederick Sound

Common name	Species name	Regulatory protection
Harbor Seal	Phoca vitulina	MMPA
Dall's Porpoise	Phocoenoides dalli	MMPA
Harbor Porpoise	Phocoena phocoena	MMPA
Killer Whale	Orcinus orca	MMPA
Minke Whale	Balaenoptera acutorostrata	MMPA
Pacific White Sided Dolphin	Lagenorhynchus obliquidens	MMPA
Humpback Whale	Megaptera novaeangiae	ESA

3.2.4 Marine Invertebrates & Associated Habitat

Dredge and Float Reorganization Footprint. The study footprint is not heavily used by invertebrates, likely due to a combination of environmental conditions including minimal structure, exposure to hydraulic energy, vessel traffic, nature of the substrate, and low primary productivity. Underwater video taken in November of 2017 captured footage of some red sea urchins (*Strongylocentrotus franciscanus)* and a small Tanner crab (presumed *Chionoecetes opilio*) in the DMMU landward of the mainwalk float depicted in Figure 9, Section 3.3.3.1. Seaward of the mainwalk float green sea urchins (*Strongylocentrotus droebachiensis*) and some anemones (*Metridium sp.*) were observed clinging to the sparse structure present. The areas farther from land beneath the C and D floats are home to sea cucumbers (presumed *Cucumeria frondosa japonica*), more green sea urchins, and sea anemones. Evidence of bivalve mollusks was present in the form of shell litter.

In-water Disposal Site. The benthic invertebrate populations within Thomas Bay and Frederick Sound are not documented. However, it is well documented that invertebrate abundance decreases with proximity to the glaciers in fjords due to higher rates of alluviation as seen inGlacial fjords in Norway. Sedimentation rates in similar environments in Norway have been recorded with depositional rates of 1-2 cm per year^{-1}, with less apparent turbidity than Thomas Bay (Renaud et al., 2006). As a result, for this analyses the assumption is made that benthic habitat in the proposed open-water disposal sites may be less than ideal to support robust marine invertebrate composition.

3.2.5 Federal & State Threatened & Endangered Species

The following NMFS-managed ESA species may occur in the project area: humpback whale (endangered); Steller sea lion (threatened eastern population and endangered western population). The Pacific herring Southeast Alaska Distinct Population Segment (DPS) was a NMFS Candidate species following the 2008 initiation of a status review. In April, 2014 NMFS determined the Southeastern DPS of Pacific Herring did not warrant listing under the ESA. No USFWS-managed ESA species exist in the project area. A brief summary about each species' presence in the Petersburg Harbor area follows.

Humpback whale. Humpback whales were listed as endangered under the ESA in 1970, depleted under the MMPA in 1972, and endangered under the State of Alaska Endangered Species list. This species travels through and forages in Frederick Sound throughout the year but is most abundant in spring and summer months. Local boaters have observed humpback whales in the project area "lounging," or resting in Frederick Sound.

In 2016, NMFS recognized the existence of 14 DPSs of humpback whale, whereas they had been previously listed under the ESA as a single endangered species worldwide. In the 2016 decision, NMFS classified four of the DPSs as endangered, one as threatened, and the remaining nine unwarranting of protection under the ESA. Three DPSs of humpback whales occur in waters off the coast of Alaska: the Western North Pacific DPS, which is an endangered species under the ESA, the Mexico DPS, which is a threatened species, and Hawaii DPS, which is not protected under the ESA. Whales from these three DPSs overlap to some extent on feeding grounds off Alaska.

The two DPSs of humpback whale likely to be encountered in Southeast Alaska and Northern British Columbia are the unlisted Hawaii DPS and threatened Mexico DPS. Humpback whales in the study area are expected to be represented by the unlisted Hawaii DPS 93.9% of the time and the threatened Mexico DPS 6.1% of the time. (NMFS 2016)

Steller Sea Lion, Eastern and Western Distinct Population Segments. In 1997 the NMFS recognized two Distinct Population Segments: the western DPS and eastern DPS. The segment of the population west of 144° W longitude was listed as "endangered," while the segment of the population east of this delineation remained listed as "threatened." The eastern DPS has recovered to the point that it is no longer considered threatened and the western DPS is recovering in much of its range, but remains endangered due to sharp declines in the Western and Central Aleutians. The study area lies within the range of the unlisted eastern DPS, and within the overlap range of the endangered western DPS.

There is no critical habitat designated within the Corps' study area for the western and eastern populations. However, there is one major eastern Steller sea lion haulout approximately 15 miles southwest of Sitka Harbor at Biorka Island. Eastern Steller sea lions occur in Frederick Sound throughout the year, but are in much higher numbers during the spring herring season. Banded western Steller sea lions have been observed within Southeast Alaska eastern Steller sea lion critical habitat: the Kaiuchali Island haulout and the Biali Rocks rookery. From 2001 to 2006, 274 total sightings of western Steller sea lions were recorded in Southeast Alaska; however, these sightings likely represented 66 individuals repeatedly observed: Of the 66 western animals seen in Southeast Alaska, only two tagged western Steller sea lions have been observed at haulouts near Sitka Sound (FAA, 2009).

3.2.6 Essential Fish Habitat

NMFS authority to manage EFH is directly related to those species covered under Fishery Management Plans (FMPs) in the United States. USACE's maintenance dredging action is within an area designated as EFH for two FMPs—Gulf of Alaska (GOA) Groundfish and Alaska Stocks of Pacific salmon. These two FMPs include species or species complexes of groundfish and invertebrate resources and all Pacific salmon species. Species with established FMPs are listed in Table 7.

Table 7. Species with established Fisheries Management Plans in the Project Area

Gulf of Alaska Groundfish	Alaska Stocks of Pacific Salmon
Skates (Rajidae)	Chinook
Pacific cod	Coho
Walleye Pollock	Sockeye
Thornyheads	Chum
Pacific ocean perch	Pink
Rougheye rockfish	
Yelloweye rockfish	
Rex sole	
Dover sole	
Flathead sole	
Sablefish	
Atka mackerel	
Shortraker rockfish	
Northern rockfish	
Dusky rockfish	
Yellowfin sole	
Arrowtooth flounder	
Rock sole	
Alaska plaice	
Sculpins (Cottidae)	
Sharks	
Forage fish complex	
Squid	
Octopus	

See Appendix D for a description of GOA Groundfish resources. No EFH "habitat areas of particular concern" are in the USACE project area.

Near-shore habitats in proximity to the harbor are expected to be used by juvenile salmonids during their early marine life history. According to the ADFG, approximately six streams in the Petersburg area are used by Chinook, coho, pink, and sockeye salmon. Juvenile salmon from these streams may use the near-shore project area during their spring outmigration, feeding along marine shorelines, gaining size and swimming ability before moving into more offshore waters. Young-of-the-year (all fish less than 1 year old) coho and sockeye salmon may also be found along the shoreline.

Rocky and mixed-soft shorelines provide a prey base of gammarid amphipods and harpacticoid copepods. Near-shore waters also harbor a myriad of predators on juvenile salmonids, including larger fish (e.g., rockfish and other salmonids), piscivorous birds (e.g., grebes, cormorants, herons), and marine mammals (seals, sea lions, and humpback whales). To avoid these predators, juvenile salmonids benefit from the presence of shoreline complexity (e.g., large wood, rocks, and kelp beds) that provide escape and hiding spaces. Offshore kelp beds in proximity to the harbor may provide an abundance of larval fish that are favored prey of juvenile pink and coho salmon. Both juvenile and adult salmon have been known to use kelp beds, but the association has not been well documented. Larval, juvenile, and adult life stages of several rockfish species could occur in and in proximity to the USACE project area.

Larval, juvenile, and adult life stages of several flatfish species are expected to occur on soft and mixed bottom habitats. EFH species of flatfish may be present in the project area, particularly common species such as yellowfin sole and rock sole. Several taxa of EFH sculpin are expected to occur in both rocky and mixed bottom habitats in the project area. It is conceivable that all life stages of sculpin are likely present. EFH forage species such as eulachon, capelin, and Pacific sand lance could also occur as they are also known to be abundant in the Sitka area.

Pacific herring are not included in the Gulf of Alaska Groundfish FMP and are not an EFH species; however, they serve an important ecological role within Frederick Sound. Pacific herring provide an abundant, high energy food source for a wide variety of fishes, mammals, and birds. Herring are also commercially important and support a roe fishery in Southeast Alaska that remains one of the largest and most valuable roe fisheries in Alaska.

All stages of herring are found in the HPC and are central to the area’s marine food web. The largest herring stock in Southeast Alaska migrates to Sitka Sound each spring for an annual spawning event, spanning several days to several weeks from mid-March to late-April. Based on ADFG surveys over the last 30 years, herring spawning areas have been highly variable, but observed on marine vegetation around the perimeter of the Sitka Airport. Herring spawn from the intertidal zone down to about −40 feet MLLW, targeting areas with substantial macroalgae concentrations. Egg deposition can occur on all species of kelp as observed in the Sitka area, particularly *Macrocystis* and *Saccharina*, but herring also use eelgrass, *Fucus spp.ationtioniigation*, coralline algae, red algae, and hard rocky substrates.

Additional Essential Fish Habitat information can be found in Appendix D.

3.3 Socio-Economic Conditions

3.3.1 Population

An estimated 3,196 residents lived in the Petersburg Borough in 2016. This represents a population increase of 8.4 percent since 2010 and a decrease of 0.9 percent since 2000. It should be noted that Petersburg has many transient workers during the fish processing season who are not counted by the U.S. Census, so these population estimates can be considered conservative. Table 8 displays racial demographics for the Petersburg Borough, State, and Nation.

Table 8. Population by Race

	Petersburg Borough	Alaska	United States
Total	3,196	736,855	318,558,162
White alone	74.8%	65.6%	73.3%
Black or African American alone	2.3%	3.3%	12.6%
American Indian and Alaska Native alone	7.5%	14.1%	0.8%
Asian alone	4.4%	6.0%	5.2%
Native Hawaiian and Other Pacific Islander alone	0.6%	1.2%	0.2%
Two or more races	8.3%	8.5%	3.1%
Hispanic or Latino	10.4%	6.7%	17.3%
White alone, not Hispanic or Latino	67.0%	62.0%	62.0%

Source: 2012-2016 American Community Survey 5-Year Estimates, Census Bureau

3.3.2 Employment & Income

Historically, the Petersburg economy has been based primarily on fishing and timber harvesting. Current primary employment sectors include government and fishing. The community is currently experiencing a continuation of a 10-year trend in declining population that mimics most communities in Southeast Alaska, but is contrary to the trend for the State overall. Employment and real growth in commercial sectors are trends that also go against trends for the State overall. In 2016, approximately 79 percent of the Petersburg Borough population was 16 years old and older. Of that population, 69.2 percent was in the labor force. The unemployment rate for the borough was 9.1 percent, above both the State of Alaska at 7.8 percent and the United States at 7.4 percent.[1] Table 9 lists occupational data for the Petersburg Borough, the State and Nation.

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[1] U.S. Census Bureau, 2012-2016 American Community Survey 5-Year Estimates

Table 9. Civilian Labor Force by Occupation

	Petersburg Borough	Alaska	United States
Civilian employed population 16 years old and older	1,632	357,098	148,001,326
OCCUPATION			
Management, business, science, and arts occupations	471 / 28.9%	132,669 / 37.2%	54,751,318 / 37.0%
Service occupations	199 / 12.2%	62,844 / 17.6%	26,765,182 / 18.1%
Sales and office occupations	268 / 16.4%	79,782 / 22.3%	35,282,759 / 23.8%
Farming, fishing, and forestry occupations	242 / 14.8%	3,668 / 1.0%	1062331 / 0.7%
Construction, extraction, maintenance, and repair occupations	182 / 11.2%	37,664 / 10.5%	12,440,120 / 8.2%
Production, transportation, and material moving occupations	270 / 16.5%	40,471 / 11.3%	18,542,291 / 12.2%

Source: 2012-2016 American Community Survey 5-Year Estimates, Census Bureau

In 2016, the median household income in Petersburg was $63,940, below the State of Alaska median income of $74,444 and above the national median income of $55,322. The mean household income was $82,803. Table 10 shows the number of households in Petersburg Borough, the State, and Nation and the percentage of each by their respective incomes.

Table 10. Family Income

	Petersburg Borough	Alaska	United States
Total Households	1,237	250,235	117,716,237
Less than $10,000	5.0%	3.7%	7.0%
$10,000 to $14,999	6.1%	3.4%	5.1%
$15,000 to $24,999	10.1%	7.1%	10.2%
$25,000 to $34,999	7.9%	7.0%	9.9%
$35,000 to $49,999	7.8%	11.4%	13.2%
$50,000 to $74,999	21.3%	17.9%	17.8%
$75,000 to $99,999	11.9%	14.8%	12.3%
$100,000 to $149,999	15.6%	19.2%	13.5%
$150,000 to $199,999	9.8%	8.8%	5.4%
$200,000 or more	4.5%	6.8%	5.7%

Source: 2012-2016 American Community Survey 5-Year Estimates, Census Bureau

3.3.3 Marine Infrastructure & Facilities

As one of Alaska’s major commercial fishing communities, there are multiple marine facilities around Petersburg that provide general moorage and other services to the fishing fleet. The majority of Petersburg Borough residents live on Mitkof Island and most of the commercial fish landings take place in Petersburg. This analysis focuses on facilities in Petersburg Harbor and Scow Bay where insufficient depths and marine infrastructure result in transportation inefficiencies for the commercial, subsistence, and recreational vessels utilizing these facilities. As stated above, Petersburg can be accessed by air and by water. It is on the mainline state ferry route and has ferry terminals on the north and south ends of Mitkof Island (Figure). The state-owned James A. Johnson Airport has a runway for scheduled jet service and small plane charter services. Lloyd R. Roundtree Seaplane Base (on the Wrangell Narrows) allows for float plane services.

Harbor facilities include a petroleum wharf, barge terminals, three boat harbors (i.e. the “Petersburg harbor system”) with moorage for approximately 700 boats, a boat launch, and a boat haul-out. Freight arrives by barge, ferry, or cargo plane. Remote areas of the Borough are served by small state-owned boat docks at Papke's Landing in the Wrangell Narrows, on Kupreanof Island at the City of Kupreanof, and in Hobart Bay. Boat launch ramps are located on the south end of Mitkof Island at Banana Point, Blaquerie Point, and Woodpecker Cove. The state owned Mitkof Highway carries traffic north and south and is paved or chip sealed for 28 miles between the South Mitkof Ferry Terminal and the airport.

Figure 5. Mitkof Island

3.3.3.1 Petersburg Harbor System

The Petersburg Harbor System is comprised of three contiguous areas along the downtown waterfront: the North Harbor between Icicle Seafoods and Ocean Beauty Seafoods; the Middle Harbor located south of Ocean Beauty Seafoods; and the South Harbor that extends between Middle Harbor and the drive-down dock (Figure 6).

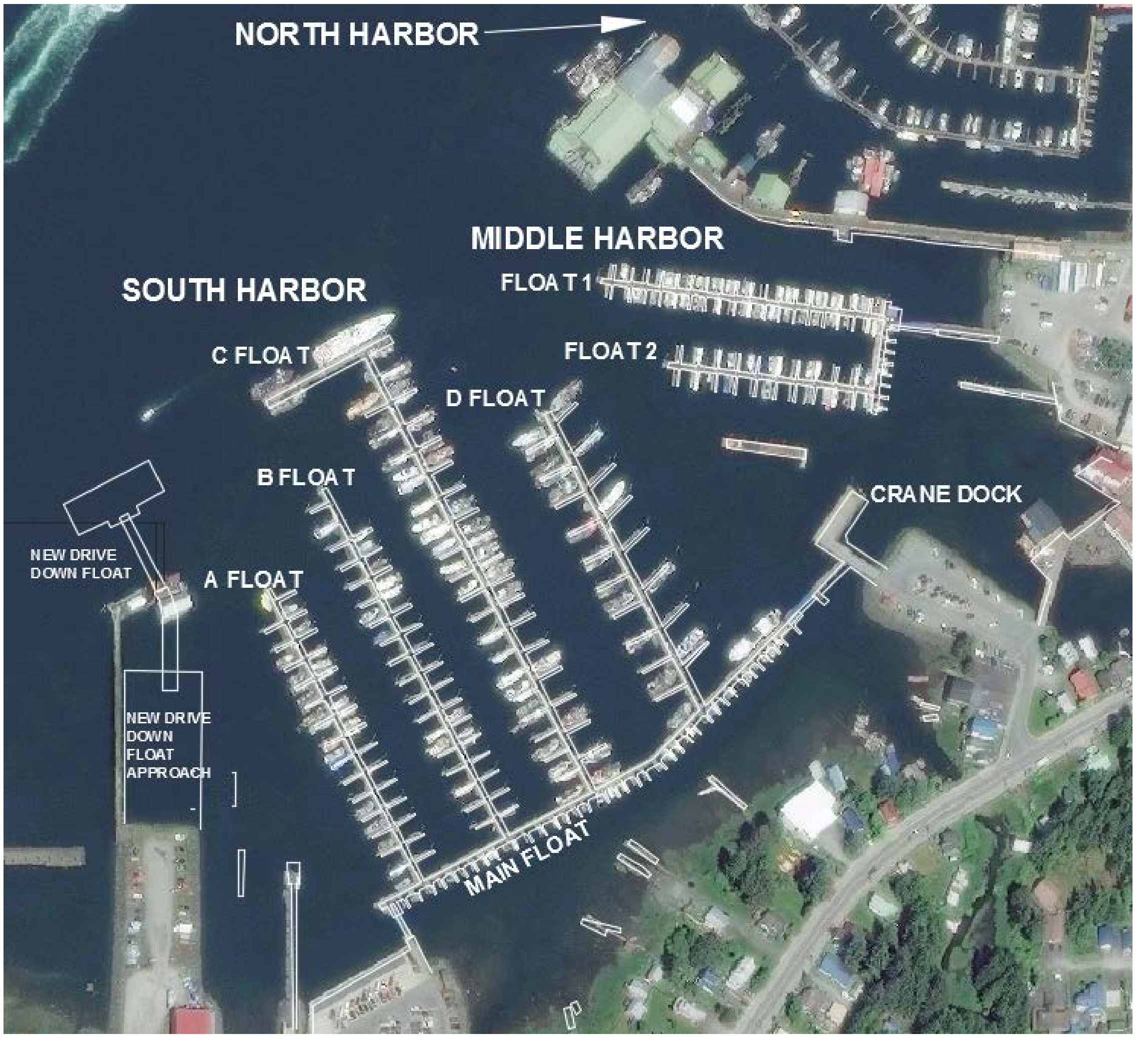

Figure 6. Petersburg Harbor System

Petersburg's harbors were primarily developed to serve the regional commercial fishing industry. In addition to the floating docks, it is home to three major fish processors and two small processors, a U.S. Coast Guard (USCG) mooring station, a sea-plane base, a fuel dock, and various public and private marine services. The harbor is also home to a substantial recreational fishing fleet that generally uses slips during the summer season and hauls out during the off-season. In recent years, tourism, yachts, and mini-cruise ship calls have contributed to Petersburg harbors' activity.

North Harbor. Petersburg North Harbor is bounded to the north by the Icicle Seafoods processing plant and to the south by the Ocean Beauty Seafoods processing plant and pier (Figure 7). Trident Seafoods also operates a small processing plant within North Harbor. The North Harbor has two main floats with a connecting float that joins them. These floats support approximately 120 berths ranging in length from 18 to 75 feet. Several longer mooring positions are used for transient vessels along the outside margin of the end floats.

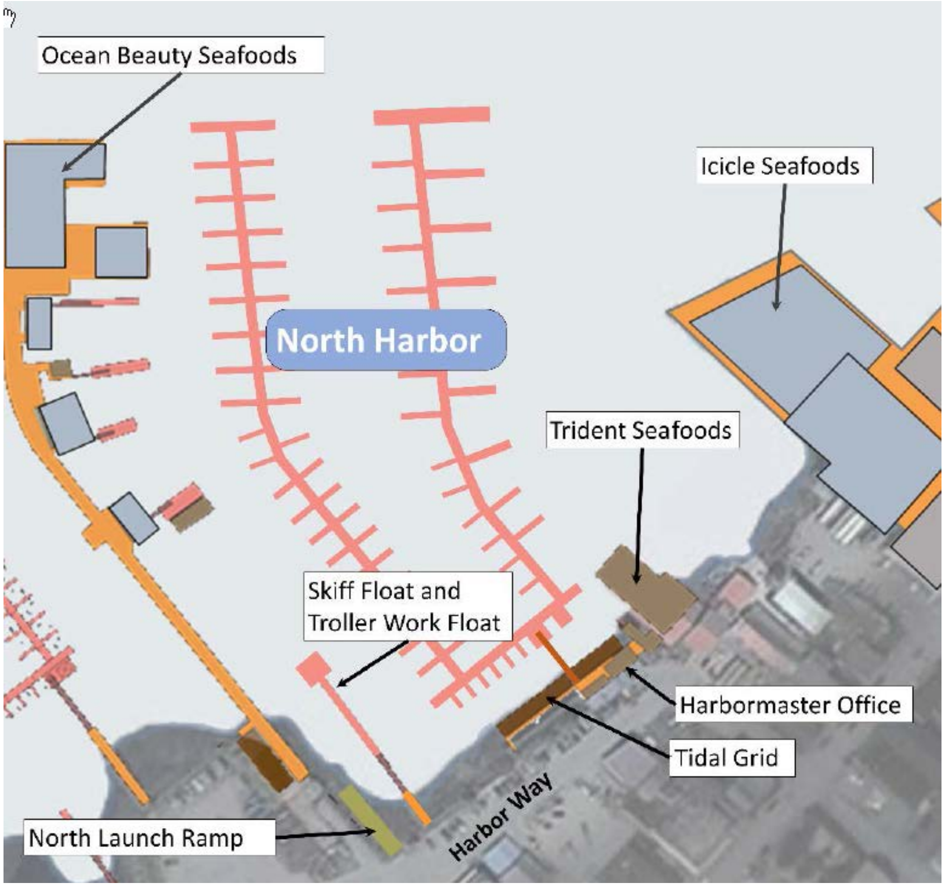

Figure 7. North Harbor

In addition to the processing plants and berths, the North Harbor has a 136-foot skiff float for Borough residents arriving by small vessels from Kupreanof Island and other surrounding communities. It also has a tidal grid of staked timbers for maintenance of commercial vessels up to 42 feet in length. The tidal grid is approximately 200 feet long and is primarily used for cleaning boat hulls below waterline. The North Harbor launch ramp, a timer ramp at the south side of the North Harbor requires periodic maintenance. It is too short to launch boats at low tide and there is no adjacent dedicated trailer parking.

Prior to 2013, the last major renovation of North Harbor was performed in 1965 when more than 1,700 lineal feet of log float was removed and replaced with more than 17,000 square feet of polystyrene floats. In 2013, the existing headwalk float, both mainwalk floats, all stall ("finger") floats, and the transient float were removed, along with all existing timber pile. An existing steel gangway, 215 lineal feet of existing timber deck, and 37 lineal feet of existing catwalk adjacent to the harbor office, as well as four existing boat grid sleepers and their associated support piles were also removed. The entire slip area in North Harbor was dredged and a new approach dock, gangway, and float system was installed in a layout that increased the average north dock berth length.

Middle Harbor. Middle Harbor is bounded to the north by the Ocean Beauty Seafoods processing plant and to the south by the Petersburg Harbor crane dock (Figure 8). The Middle

Harbor has two mainwalks joined by a connecting float. These floats support approximately 137 berths ranging in length from 18 to 32 feet. In addition to the processing plant and berths, Middle Harbor has a 150-foot work float for maintenance of nets and gear. An 84-foot privately-owned boarding float is under lease to the ADFG. At the south end of Middle Harbor, the Petersburg Harbor Department maintains a 120-foot public crane dock for fishing boat gear change. Hammer Slough, a tidal drainage through the center of Petersburg, empties into the harbor between the ADFG float and the crane dock.

Prior to 2005, the last major renovation of Middle Harbor took place around 1975 when the skiff float in the adjacent North Harbor was extended to relieve grounding issues at low tides. The area around the exiting floats in Middle Harbor was also dredged to improve accessibility.

In 2005, the exiting headwalk float, both mainwalk floats, and all stall (“finger”) floats were removed, along with all existing pile. In addition, an existing gangway, and the seaward side of the existing timber approach dock (approximately 17 LF), and associated support piles were removed. A new gangway and float system was installed in a layout similar to that which had been removed.

In 2012, the bulkhead at the landward end of the existing timber approach trestle suffered a partial failure. Field-expedient repairs to the bulkhead to prevent continued loss of backfill, were executed by the Harbor Department. In 2015, a section of the mainwalk float was replaced due to damage incurred from a vessel strike. The remaining existing element of construction of immediate concern is the timber approach trestle, which will need to be either upgraded or replaced in the near future.

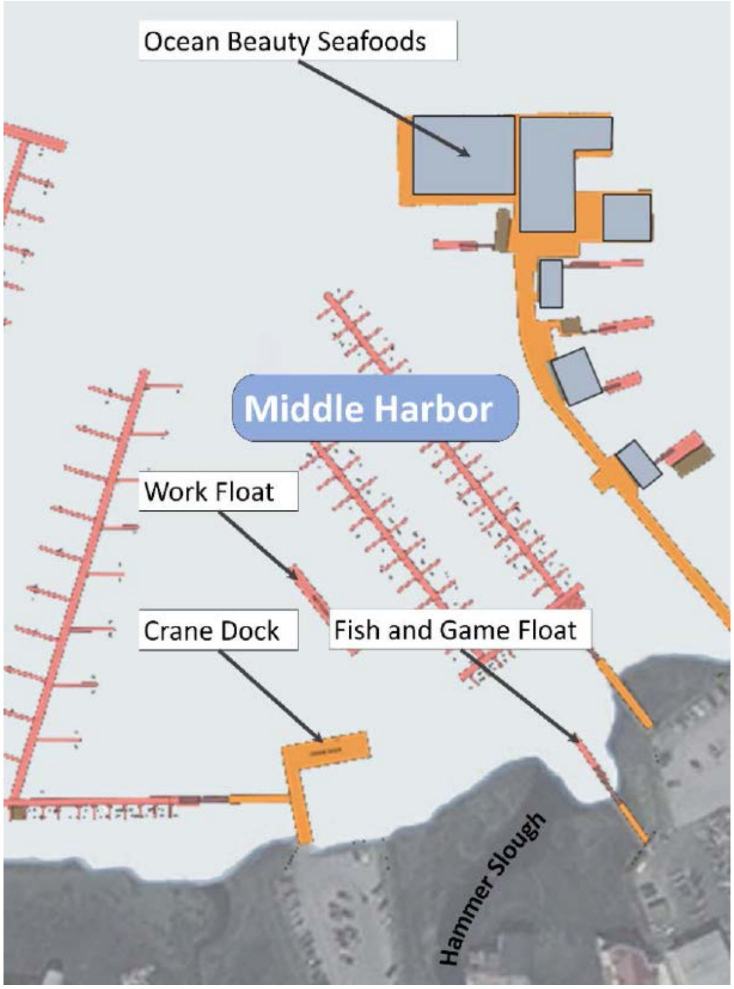

Figure 8. Middle Harbor

South Harbor. South Harbor is bounded to the north by the crane dock and to the south by the drive down dock (Figure 9. South Harbor South Harbor includes floats A, B, C, and D with a connecting float joining them. These floats support approximately 242 berths ranging in length from 40 to 100 feet. Several longer mooring positions for transient vessels and small cruise ships are available on the end of float C. On the land side of the South Harbor connecting float, 74 berths (20-foot fingers) have been constructed for skiffs and small boats on the order of 18 feet in length.

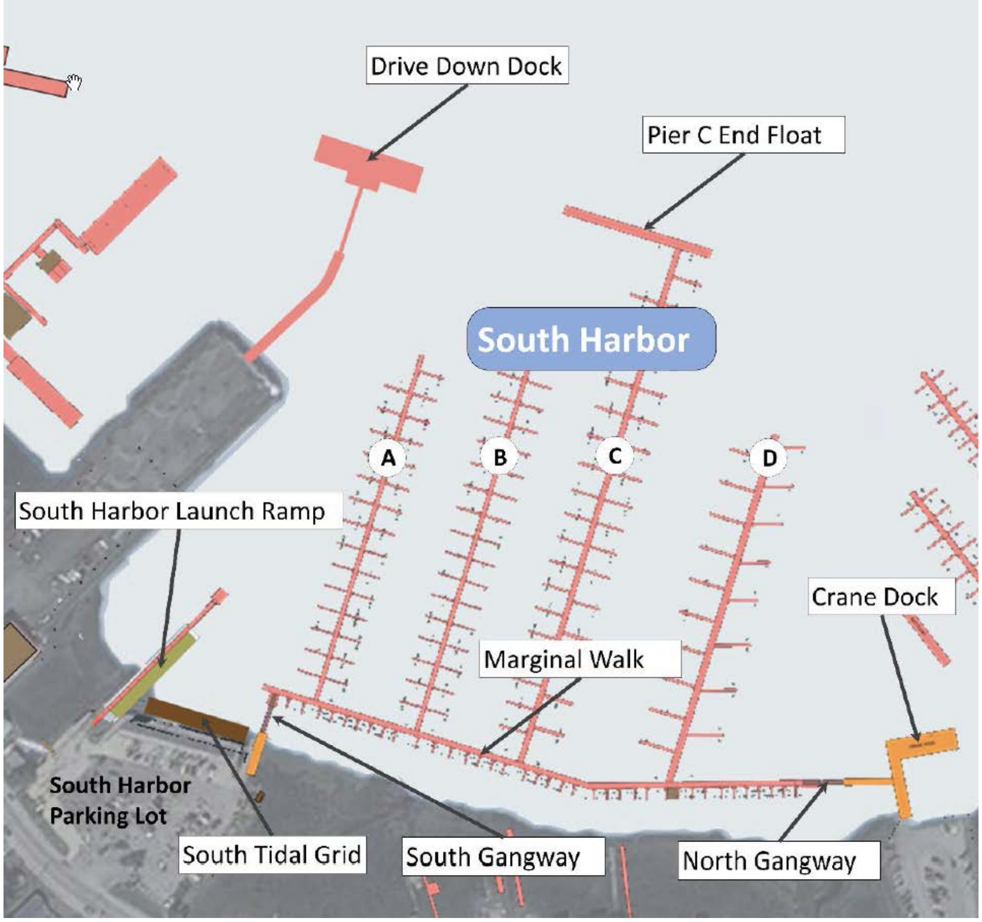

Figure 9. South Harbor

The South Harbor connecting float has two access gangways, one extending from the crane dock and one that connects to the South Harbor parking lot. Both gangways are elevated to allow small boats that berth along the back of the connecting float for egress at high tide. At the south end of the harbor, the Harbor Department maintains a single-lane concrete launch ramp and boarding float. This ramp is usable in all, but the most extreme tidal conditions. There is limited trailer parking adjacent to this ramp. South Harbor also has a 195-foot steel tidal grid located parallel to the parking lot that is designed to take larger vessels up to 100 feet in length.

South Harbor improvements constructed in 1984 include the current 12’ x 84’ access ramp approach and a 7.5’ x 65’ steel access ramp, mainwalk float A and float D, extension of mainwalk float B and float C with additional finger floats, 200 feet of new vessel repair grid, and upland harbor improvements. In 1999, mainwalk floats A, B, and C were replaced and additional finger floats added along each extension. The existing transient float was also installed at the end of mainwalk float C.

In 2000, approximately 850 LF of existing timber approach trestle and a timber dock, and approximately 400 LF of an existing fuel dock approach trestle were demolished. Dredging occurred over an area of roughly six acres at dredge depths ranging from less than seven feet to more than ten feet of material and a new approach dock was constructed for the fuel dock trestle.

The western (channel side) half of floats A, B, and C were reconstructed with new steel piles and timbers in 2003. In 2003, a new end float was added to the existing south launch to provide space for recreational and subsistence boaters to clean fish and load gear.

Many of the older existing vessel finger floats have begun to lose freeboard and it is anticipated that replacement of these finger floats may be necessary in the near term. Remaining areas of concern include existing finger floats, mainwalk float D, and the bearing of the exiting gangway onto the existing gangway landing float. On the landside of the South Harbor connecting float, the small berths are currently restricted by sedimentation and will require dredging to remain operational throughout the full tidal range. This dredging is also necessary to prevent the connecting float from grounding at low tides and damaging the connections to the main floats. At 65 feet in length, the north and south access ramps are too short to allow them to effectively operate for the normal Petersburg Harbor tidal range. In addition, the existing depths in South Harbor range from -8ft MLLW in the subsistence slips behind the main float to -17ft MLLW in the entrance channel.

3.3.3.2 Scow Bay

Scow Bay is an industrial district and small residential neighborhood located approximately 2.5 miles south of Petersburg’s downtown along the Mitkof Highway (Figure 10). It is not located within a census designated urban area and is considered a rural area (along with the entire Petersburg Borough).

The Scow Bay site was originally owned by the State of Alaska and used as an amphibious aircraft facility to serve the local population. The facility was abandoned once the State constructed a gravel airstrip in 1969 allowing wheeled planes to land in Petersburg. Currently, a portion of the site is used to store State of Alaska road maintenance equipment, but the remaining marine capital assets exceeded their life expectancy many years ago and no effort was made to maintain or repurpose these assets once the facility was deemed redundant.

The existing site is constrained in many ways. The existing haul-out ramp (former seaplane ramp) has a slope that is too shallow for launch and recovery by conventional boat trailers, though it is occasionally used in this capacity by local residents. Particularly, residents from nearby island communities utilize the ramp to gain access to the road system in Petersburg for employment opportunities as well as goods and services.

The site is used occasionally to haul commercial and recreational vessels of about 30 to 40 feet in length out of the water using a commercially-operated submersible hydraulic trailer for winter storage at a yard across the highway. One vessel at a time can be accommodated on the existing site for maintenance activities. The site is exposed to wind and wave action which limits the days when it is safe for vessels to use the ramp. The ramp is also too short for use throughout the tidal cycle (at low tide, the bottom of the ramp is dry) so the window of opportunity for haul outs is relatively small. Further, the site does not have infrastructure to address current federal environmental regulations restricting discharge of heavy metals, fuel, runoff, etc. into marine waters. This poses a risk to continued use of the site even for these limited activities.

In short, vessels utilizing the Scow Bay facilities are working with transportation infrastructure that is beyond its useful life, being used in ways never intended by its designers, does not meet environmental standards, provides no safety improvements, and is in disrepair.

Figure 2. Scow Bay

3.4 Cultural Resources

Cultural resources include precontact and historic sites, structures, districts, artifacts, or any other physical evidence of human activity considered important to a culture, subculture, or community for scientific, traditional, religious, or any other reason. They are limited, nonrenewable resources whose potential for scientific research (or value as a traditional resource) may be easily diminished by actions affecting their integrity. Numerous Federal and State laws and regulations require that possible adverse effects to cultural resources be considered during the planning and execution of Federal undertakings. These laws and regulations stipulate a process of compliance, define the responsibilities of the Federal agency proposing the action, and prescribe the relationship among other involved agencies (e.g., State Historic Preservation Officer (SHPO), the Advisory Council on Historic Preservation. In addition to NEPA, the primary laws that pertain to the treatment of cultural resources during environmental analysis are the National Historic Preservation Act of 1966 (NHPA), the Archaeological Resources Protection Act of 1979, the Antiquities Act of 1906, the American Indian Religious Freedom Act of 1978, and the Native American Graves Protection and Repatriation Act of 1990.

3.4.1 Precontact

Inhabitants of Southeast Alaska had some form of maritime adaptation since at least 9,000years ago as evidenced by exotic obsidian sourced from island sites hundreds of kilometers from where they were discovered. Excavations at Shuká Káa Cave (PET-0408) on Prince of Whales Island also demonstrate long term occupation of Southeast Alaska since at least 10,300 years ago (Kemp et al. 2007). The presence of marine fauna in midden materials also indicates maritime adaptation and the ability to travel distances over water. Additionally, the archaeological record has shown continuity in subsistence practices between the early and late periods of the regions' history through documentation of the use of salmon, fish, shellfish, the occasional bird, and both marine and terrestrial mammals. By and large, archaeological evidence from the region suggests that subsistence resource efforts were focused on intertidal and nearshore environments. By the end of the Pleistocene, sea levels reached modern levels. Although generally ice-free, some areas experienced intense glaciation into the Holocene, which impacted human settlement in more northern areas such as Yakutat (Moss 1998).

Southeast Alaska is the traditional territory of the Tlingit and the Haida. Much of what is known today has been reconstructed from ethnographic data, as the climatic conditions and acidic soils are not conducive to preservation of organic material. Moss (1998: 92) defines the cultural sequence of Southeast Alaska as: the Early Period (10000-5000 BP), the Middle Period (5000 BP-1500 BP), and the Late Period (1500 BP-AD 1741).

Early Period sites have been found to have relatively high percentages of debitage manufactured on site, and much of the obsidian has been sourced to Mt. Edziza and Suemez Island, indicating long-distance marine travel and trade (Moss 1998). Stone tool technology of this period is generally consistent between sites with a low frequency of bifacial tools compared to later components. Archaeological sites in the project vicinity that have deposits dating to the Early Period include Ground Hog Bay 2 (JUN-0037), Hidden Falls (SIT-0119), and Thorne River (CRG-0177). The Ground Hog Bay 2 site is located on the mainland shore of Icy Strait, its lowest deposit in Component III dates to 9200 BP (Moss 1998). Artifacts characteristic of Component III include obsidian biface fragments, a chert scraper, and chipped stone debitage (Davis 1990). Other artifacts characteristic of this period include microblade cores, microblades, hammerstones, bifaces, chopper, notches, scrapers, and utilized flakes (Moss 1998; Davis 1990). No faunal artifacts were recovered from the Ground Hog Bay 2 site but its location on a shoreward ridge suggest marine-based subsistence (Moss 1998).

The Hidden Falls site is located on Baranof Island. It dates to the Early Period, with Component I dating between 9500 and 8600 BP; it is the earliest evidence of a ground stone and bone industry in Southeast Alaska (Davis 1990). Artifacts recovered at the Hidden Falls site include debitage related to a microblade industry, split cobble and pebble tools, scrapers, gravers, burinized flakes, and biface tips. A single fishbone and two fragments of marine shell were also recovered which indicates marine-based subsistence patterns (Moss 1998).

The Thorne River site is located along the Thorne River on Prince of Wales Island. This site also dates to the Early Period; one component, containing a microblade industry primarily consisting of obsidian cores, is dated to 7600 BP. Artifacts recovered include a large amount of obsidian microblade cores sourced to Suemez Island. Overall, there is continuity between the microblade industries recovered at Ground Hog Bay 2, Hidden Falls, and the Thorne River sites. Assemblages across sites dating to the Early Period indicate a primarily marine-based pattern of subsistence and relatively widespread regional travel or trade to Mount Edziza 200 km to the

northeast in British Columbia, and Suemez Island located approximately 170 km southwest of Petersburg near the Dixon Entrance (Moss 1998).
Regional trends during the Middle Period include continuation of ground slate technology, the advent of wood stake fishing weirs, and an increase in the number and diversity of bone tools (especially unilaterally barbed ground bone points), stone knives, and hand mauls (Davis 1990; Moss 1998). Some of Southeast Alaska's earliest wood stake fish weirs date to at least 5000 BP, placing their development at the beginning of the Middle Period. Wood stake fish weirs dating to the Middle Period have been found in at least 18 archaeological sites in Southeast Alaska. Development of wood stake weir technology indicates mass salmon harvest. Components II and III of the Hidden Falls site also date to the MiddlePperiod: Component II dates to 4600-3200 BP and Component III to 3000-1300 BP. The artifact assemblage recovered from Component II consists of approximately 50 percent non-diagnostic flake industry, 39 percent ground stone, and 4 percent hammerstones and abraders. Ground stone items include slate points, polished planning adzes, serpentine beads, labrets, and segmented stones (Moss 1998). Sites associated with the Middle Period are generally associated with shell middens. Ground slate and wood stake fish weirs appear during the middle period. Remains of both terrestrial and marine animals indicate the use of a mixed marine subsistence pattern with fish and shellfish being the main staple (USDAFS 2005). Shell middens on Kuiu Island, 77 km west of Petersburg have been dated from 4200 BP to 2000 BP with the median age of sits being 1280 BP. The reported date ranges fall within the Middle and Late Periods of the northern Northwest Coast cultural sequence.

Moss (1998) described a great deal of cultural continuity between all three periods; the beginning of the Late Period occupation at 1500 BP Many late period sites were seasonally occupied into the historic period and many are known by their Tlingit, Haida, or Eyak names through oral histories. . The majority of Late Period sites are associated with the Tlingit but some have also been associated with the Haida and Eyak. Many of the sites were seasonally occupied, and some are still used today (Moss 1998). Characteristics of the Late Period include larger structures used for defensive purposes, copper tools, stone bowls and lamps, and an increased use of obsidian (Davis 1990). There are at least 26 sites dating to this period that are ethnographically known as “forts,” defensive sites situated on high rocks or islands near main villages. These forts signal an intensification of regional conflict (Moss 1998; Crowell and Howell 2013). Salmon appears to be the most important food resource during this period, but evidence of other species of fishes, birds, and marine and terrestrial mammals indicate that activity areas may not have been specialized for a single species (Moss 1998). Assemblages collected from the Pillsbury Point site (Yaicai Nu) (SIT-0132) further demonstrate diversification of subsistence practices, showing increased numbers of marine mammals including sea otter, seal, and harbor porpoise (de Laguna 1960; AHRS 2018). Sites indicating the most dramatic shift in subsistence patterns from marine to terrestrial are located in the northern boundary of Southeast Alaska. Overall, subsistence for all three periods has demonstrated the importance of nearshore and intertidal environments, with an emphasis on salmon beginning with the development of wood stake fish weirs during the Middle Period (Moss 1998).

3.4.2 Historic

On June 21, 1741, Captain Aleksei Chirikov and crew sailed into the vicinity of Yakobi Island in Southeast Alaska aboard the Sv. Pavel (Black 2004). Chirikov was under orders from the Empress of Russia, Anna Ioannovna, to sail to the Americas, explore, and make contact with any people they came across. After losing contact with two shore parties and lacking any additional small boats to reach shore, Chirikov decided to turn back, assuming the parties were either captured or killed by the local Tlingit (Black 2004). Contact with Westerners may not have occurred again until 1775, when Spanish explorer Bruno de Hezeta sailed into Sitka, accidently infecting the Sitka Tlingit with smallpox (de Laguna 1990). In the 1790s, Russian trade continued in the region, while plans for a permanent settlement were developed in response to British, American, Spanish, and French trade and exploration in the area. Between first Russian contact in Southeast Alaska in 1741 and 1790, numerous British and French trade vessels visited the region exploring and trading for furs. Between 1795 and 1798, Aleksandr Baranov, manager of the eastern area of the Shelikhov-Golikov Company, later renamed the Russian-American Company (RAC) in 1799, sailed in the vicinities of Sitka and Glacier Bay making contact with the Tlingit (Black 2004).

In 1794, settlers supported by the Shelikhov-Golikov Company, built a permanent camp at Yakutat, which served as a transshipment point for furs going to Kodiak Island and hunters headed to Southeast Alaska. In 1799, Vasilii Medvednikov was selected to head the new southeast settlement of the RAC. Medvednikov aboard the Orel sailed to Sitka with building material for the construction of a new outpost later named Novo-Arkhangel’sk (Davis 1990; Black 2004). In 1802, in response to competition for sea otters, subsistence, and other disagreements between the Unanagan working for the Russians and local Tlingit, Novo-Arkhangel’sk was destroyed during a retaliatory attack by the Tlingit. Baranov assembled a party of 300 kayaks and four other Russian vessels to retake Novo-Arkhangel’sk. During the trip, the party stopped at villages in Kake and Kuiu and ordered them burned (Black 2004). Upon arriving at Novo-Arkhangel’sk, the Russians attacked the Tlingit; after a fierce battle, peace negotiations were reached, resulting in the reoccupation of Sitka by the Russians. Sitka remained occupied by the Russians until the Treaty of Cession in 1867. De Laguna (1960:15) notes that ethnohistoric descriptions of Tlingit houses were often vague and stereotyped; the modern framehouse had replaced the traditional plank house early on during the contact period. Houses were generally built of timbers or planks of red cedar, spruce, and hemlock timber, roofed with heavy cedar bark or spruce shingles (ANHC 2011). Houses ranged in size from 35’ x 50’ to 40’ x 100’ with some measuring as large as 100’ x 75’, with each house holding between 20-50 individuals. Houses generally had a central fire pit and smoke hole in the roofs, faced the water, and were generally built in a single or double line depending on the size of the village (ANHC 2011).The Tlingit occupied both summer and winter villages, with sites located in sheltered bays with views of approaches and a suitable beach for a boat landing. Nineteenth century Tlingit settlements consisted of rows of large houses facing the water, with smokehouses, caches, and steam baths located inside or behind the houses (de Laguna 1990).

After the Treaty of Cession was signed in 1867, the War Department tasked the U.S. Army with administration of Alaska as a military district until 1877. Military occupation of Southeast Alaska continued to sour relations between the United States and Tlingit, often resulting in the use of military force. Between 1879 and 1884, the U.S. Navy was tasked with opening up settlements in Southeast Alaska for prospecting, mining, fishing, canning, and timber harvesting (Worl 1990). These activities, along with missionary and educational efforts and the expansion of Euromerican settlements and military establishments all reshaped the configurations of Tlingit culture (de Laguna 1960).

The salmon canning industry has traditionally been vitally important to the State of Alaska. During both World War I and II, canned Alaskan salmon served as a main food staple for those experiencing food shortages as a result of the war effort (Guimary 1983). The first canneries in Alaska originated in Sitka in 1878 (Worl 1990). Shortly after their introduction commercial success spread like wildfire, resulting in a large boom in the canning industry. By the late 1920s there were 159 canneries operating in Alaska (Guimary 1983). From the late 19th century into the early 20th century, mining, fishing, and canning in Southeast Alaska continued and encouraged the settlement of Euromericans in the region (Worl 1990).

In the 1890s, Norwegian fisherman began settling the area around Petersburg; the community has retained a distinctly Norwegian identity since its founding. Peter Buschmann founded the Icy Strait Packing Company cannery, sawmill, and dock in Petersburg by 1900 (Alaska 2018). The city was formed in 1910, and by 1930, a census counted 1,252 people lived in Petersburg.

3.4.3 Affected Environment

Dredge Footprint. A search of the Alaska Heritage Resources Survey (AHRS) shows two cultural resources within the dredging area of potential effect (APE; Table 11). These two known cultural resources, PET-200 and PET-529, are historic watercraft. They are still serviceable and afloat and could be moved to make room for dredging equipment as necessary. Because of this, PET-200 and PET-529 would not be affected by the proposed dredging action.

Table 11. Known Cultural Resources in the General Vicinity of South Harbor

AHRS No.	Site Name	NRHP Status	In APE
PET-119	Sons of Norway Hall (Fedrelandet Lodge No. 23)	Listed	No
PET-200	Ranger Boat Marine Vessel (M/V) *Chugach*	Listed	**YES**
PET-328	Petersburg Fisheries	Unevaluated	No
PET-513	Turn Point Fish Trap	Eligible	No
PET-529	Fishing Vessel (F/V) *Charles W.*	Listed	**YES**
PET-567	Indian Street Viaduct	Unevaluated	No
PET-569	Nelbro/Norquest Cannery	Unevaluated	No
PET-590	Boat Maintenance Shop	Not Eligible	No
PET-702	Petersburg Fishing Industry Historic District	Unevaluated	No

PET-119 is the Sons of Norway Hall, Fedrelandet Lodge No. 23. PET-119 is a white two-story frame structure built in 1912 on pilings. The structure is located just northeast of PET-567 (Indian Street Viaduct). PET-119 is the first Sons of Norway Lodge built in Alaska; it is a symbolic monument of the Norwegian-American pioneers in Petersburg. The Sons of Norway Hall is listed on the National Register of Historic Places (NRHP).

PET-200 is a 1925 wooden-hulled U.S. Forest Service (USFS) Ranger Boat Marine Vessel (M/V) *Chugach* (Sorenson 1990). The *M/V Chugach* is the last wooden-hulled ranger boat still in use by the USFS in Alaska. It is listed on the NRHP, the statement of significance on the NRHP nomination form lists the *M/V Chugach* as having significance in maritime history and naval architecture (Sorenson and Schley 1991).

PET-328 is known as Petersburg Fisheries, and is a large canning facility constructed in 1902. Petersburg Fisheries was built by Peter Buschman of the Icy Straits Packing Company. The cannery has changed hands several times since its initial construction: it was purchased by the Petersburg Packing Company in 1915, the Pacific American Fisheries in 1929, and then Petersburg Fisheries Inc. / Icicle Seafood's in 1965. PET-328's eligibility for the NRHP remains unevaluated.

PET-513 is known as the Turn Point Fish Trap. The site consists of hundreds of wooden stakes that are eroding out of the tide lines of a small creek that drains into the south side of the South Harbor. The site was identified during an expansion of the Mitkof Highway; a stake submitted for radiocarbon dating was determined to be approximately 2,000 years old (USDAFS 2005).PET-513 is considered eligible for the NRHP. PET-529 is the fishing vessel (F/V) *Charles W.* The *F/V Charles W.* is a wooden sailing schooner that was launched in 1907 and brought to Petersburg in 1925 to be modified and operated for shrimping. PET-529 is listed on the NRHP; the statement of significance on the nomination form lists the *F/V Charles W.* as having significance relating to maritime history and commerce in Petersburg, Alaska between 1925 and 1955 (Moulton 2005).

PET-567 is the Indian Street Viaduct, ADOT&PF Bridge No. 1159, also known as the Rasmus Bridge. The Indian Street Viaduct is a multiple-span treated timber stringer bridge. The bridge was constructed in 1945 and has been modified several times since 1984 to replace rotting planks and pilings (ADOT&PF 2017). PET-567's eligibility for the NRHP remains unevaluated.

PET-569 is the Nelson Brothers Cannery. The Cannery was built in 1949 and experienced hiatus in operations in 1954, 1971, and 1976 (Guimary 1983). In 1982 the building was purchased by the Packers of British Columbia, Vancouver, Canada. The structure is a two story wood frame building with metal roof and siding. PET-569's eligibility for the NRHP remains unevaluated.

PET-590 is a Boat Maintenance Shop located just south of Petersburg Harbor. The Boat Maintenance shop was constructed in the 1930's as a maintenance shop for wrecked ships. Modifications were made to the building in the 1960s when it was converted into a warehouse and living quarters. The roof was raised to allow for additional living space sometime in the 1980s. Due to the nature of the modifications, PET-590 has lost its historic integrity and is considered not eligible for the NRHP.

PET-702 is the Petersburg Fishing Industry Historic District. The district includes buildings located on the northeast side of the harbor along North Nordic Drive. The buildings are a mix of historic fishing industrial structures, historic company buildings, and two former bunkhouses. PET-702's eligibility for the NRHP remains unevaluated.

A search of the National Oceanic Atmospheric Administration (NOAA) wrecks and obstructions database shows no known wrecks or obstructions within the limits of the dredging area (Table 12; Figure 11). A search of the Bureau of Ocean Energy Management's (BOEM) 2011 shipwreck database provides no indication that any shipwrecks are within the proposed dredging APE (Table 13). Corps personnel conducted an underwater investigation with a waterproof camera and a remote-operated underwater vehicle at 12 locations in e South Harbor (Figures 12 and 13). A review of the footage shows a steel plate with bolts attached, cable, and rope at

Location 5; rope and cable at Location 6; a coffee mug at Location 7; and pipe and metal debris at Location 8.

Table 12. Wrecks and Obstructions in the Vicinity of Petersburg Harbor (NOAA 2018).

Type	Status	Narrative	Latitude	Longitude
Wreck	Visible	Always dry	56.813557	-132.993668
Wreck	Visible	Visible Wreck	56.813545	-132.993576
Wreck	Visible	Always dry	56.817669	-132.971664
Wreck	Visible	Always dry	56.818798	-132.969467
Wreck	Visible	Always dry	56.82283	-132.964508
Wreck	Visible	Always dry	56.822731	-132.963211
Wreck	Visible	Old derelict fishing boat on mud flats	56.823265	-132.963104
Wreck	Visible	Old derelict fishing boat on mud flats	56.812103	-132.961716
Wreck	Visible	Always dry	56.820763	-132.961273
Obstruction	Submerged	Two-fathom-two-foot sounding	56.825409	-132.940216
Obstruction	Submerged	Corps disposal area	56.827778	-132.918335
Obstruction	Submerged	Wooden ATON tower depth 3.71m	56.804085	-132.989243

Figure 11. NOAA Wrecks and Obstructions Database Map (Dredge footprint marked in red) (NOAA 2018).

Table 13. Shipwrecks in the Vicinity of Petersburg Harbor (BOEM 2011)

Name	Type	Year	Location	Narrative Summary
Bonnie Jean	Gas Screw	1922	Scow Bay	Foundered
Liberty Belle	Fishing Vessel	1924	South of Scow Bay	Hit reef
Flora	Gas Screw	1927	Standard Oil Dock, Petersburg	Fire, destroyed
Mission	Gas Screw	1927	Burnet Cannery	Burned
Mildred II	Gas Screw	1928	Off Turn Point, Petersburg	Fire, vessel consumed
Tum Tum	Gas Screw	1933	Petersburg	Burned
St. Martin	Gas Screw F/F	1937	Across from Scow Bay Cannery	Destroyed by fire
31-A-866	Fishing Vessel	1943	Herring Bay near Petersburg	Wrecked
Arab	Gas Screw	1945	Petersburg	Burned
Ronald	Gas Screw	1946	Vicinity of Horn Cliffs	Foundered and lost
Salvor	Oil Screw	1948	Near Petersburg	Burned
31-B-460	Fishing Vessel	1950	Petersburg	Sunk at dock
Odin	Gas Screw	1958	Petersburg	Burned
Lief H.	Fishing Vessel	1965	Channel Light No. 32A	Grounded and sank
Rose[1]	Tug	1977	Kupreanof Beach	Sank and abandoned
Sweetbriar	CG buoy tender	1993	Opposite Scow Bay	Stuck in mud, recovered
Loretta C	Longliner halibut	1998	Petersburg	Burned

[1] The tug *Rose* sank while moored at the Petersburg boat harbor on June 1, 1977 and later became a landmark along the Kupreanof Beach where she was abandoned.

Figure 12. Locations of Underwater Recordings (Google Earth Pro 2018).

Figure 13. Still Image of Typical Harbor Seafloor From Underwater Digital Video Recording

Scow Bay. Scow Bay is located approximately 2 miles south of the South Harbor project area. A search of the AHRS reveals one known cultural resource within the vicinity of Scow Bay (Table 14). PET-570 is a former salmon cannery construed in 1929 and closed in 1953. In 1959, Alma Wallen converted the former cannery to the Beachcomber Inn. The Beachcomber Inn is still in operation today. It is located approximately 1 mile south of the proposed disposal area in Scow Bay and would not be affected by this project. The beach around Scow Bay currently has a boat ramp and small breakwater. Given the heavy disturbance of the beach and presence of structures inland, the area appears to be used frequently and highly disturbed. It is unlikely that any unknown cultural resources exist that would be affected by in-water disposal of dredge material.

Table 14. Known Cultural Resources Within the General Vicinity of Scow Bay

AHRS No.	Site Name	NRHP Status	In APE
PET-570	Beachcomber Inn	Unevaluated	No

A search of the National Oceanic Atmospheric Administration (NOAA) wrecks and obstructions database shows no known wrecks or obstructions near the beach of Scow Bay (Figure 14; Table 15). A submerged obstruction is reported to the north of the bay and another obstruction that is visible at high water is located west of the bay. The obstruction to the north is reported as metal piles, and is most likely the remains of a dock. The obstruction visible at high water is reported as a raft with wire rope, and may be the remains of a barge or barge material that was dumped in the area. Neither reported obstruction occur directly within the vicinity of the proposed in-water disposal area at Scow Bay; however, they would need to be regarded for navigational reasons if in-water disposal of dredged material were to occur at Scow Bay. A search of the BOEM 2011 shipwreck database provides no indication that any shipwrecks are within the limits of Scow Bay (Table 16).

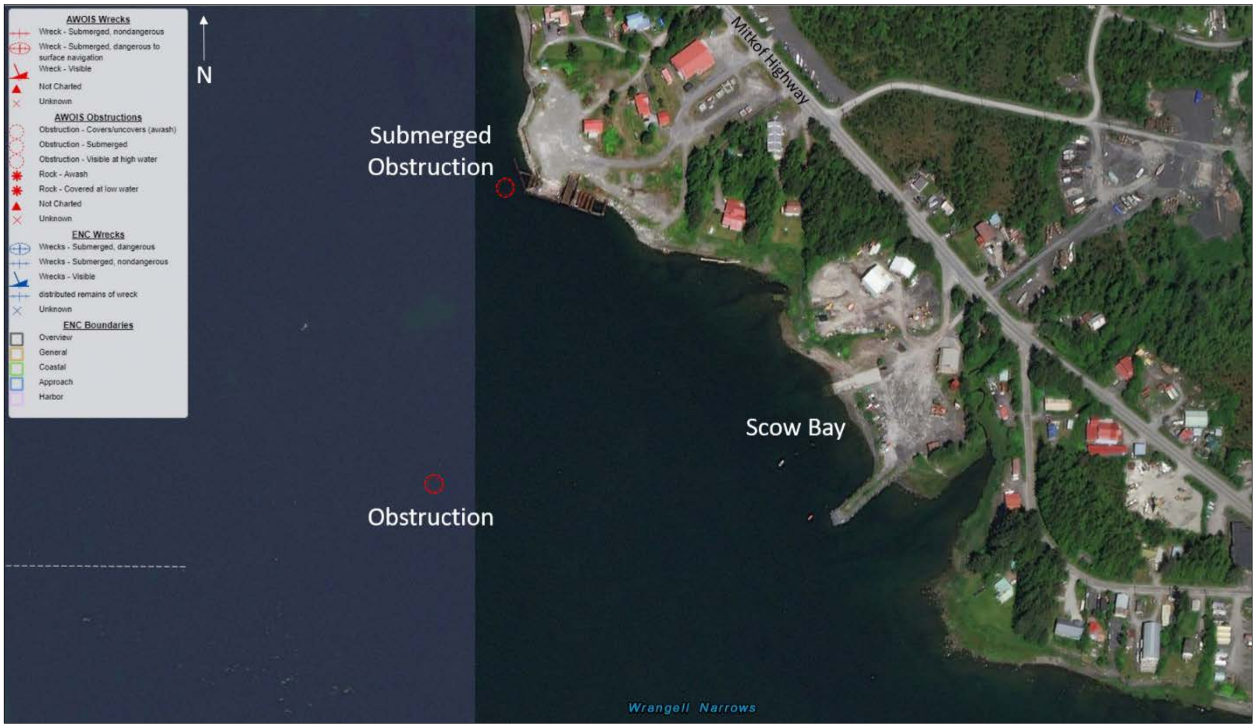

Figure 14. NOAA Wrecks and Obstructions Map-Scow Bay (NOAA 2018).

Table 15. Wrecks and Obstructions Listed in the Vicinity of Scow Bay (NOAA 2018)

Type	Status	Narrative	Latitude	Longitude
Obstruction	Submerged	Four metal piles	56.782372	-132.978058
Obstruction	Visible at High Water	Long raft and wire rope	56.780014	-132.979095

Table 16. Shipwrecks in the Vicinity of Scow Bay (BOEM 2011)

Name	Type[1]	Year	Location	Narrative Summary
Bonnie Jean	Gas Screw F/V	1922	In Scow Bay	Foundered
Liberty Belle	FV	1924	Just south of Scow Bay	Hit reef, attempted recovery
St. Martin	Gas Screw F/V	1937	Across from Scow Bay Cannery	Engine Fire, destroyed
Sweetbriar	CG Buoy Tender	1993	In Wrangell Narrows, opposite Scow Bay	Stuck in mud, recovered

[1] F/V- Fishing Vessel; CG- Coast Guard

In-water Disposal Locations. Thomas Bay is located approximately 13 miles northeast of Petersburg (Figure 15). Cultural resources reported within the general vicinity of the potential Thomas Bay in-water disposal APE include both precontact and historic resources located along the shores of Thomas Bay on Ruth Island (Table 17). None of the identified resources fall within the disposal APE. In 1978, archaeologist Katherine Arndt surveyed the west side of Ruth Island in search of the Gardner Shrimp Company Cannery which was in operation between 1916 and

1918. Arndt was unsuccessful in locating the cannery, it is possible that the remains of site PET-0424 (Ruth Island Camp) is associated with the cannery.

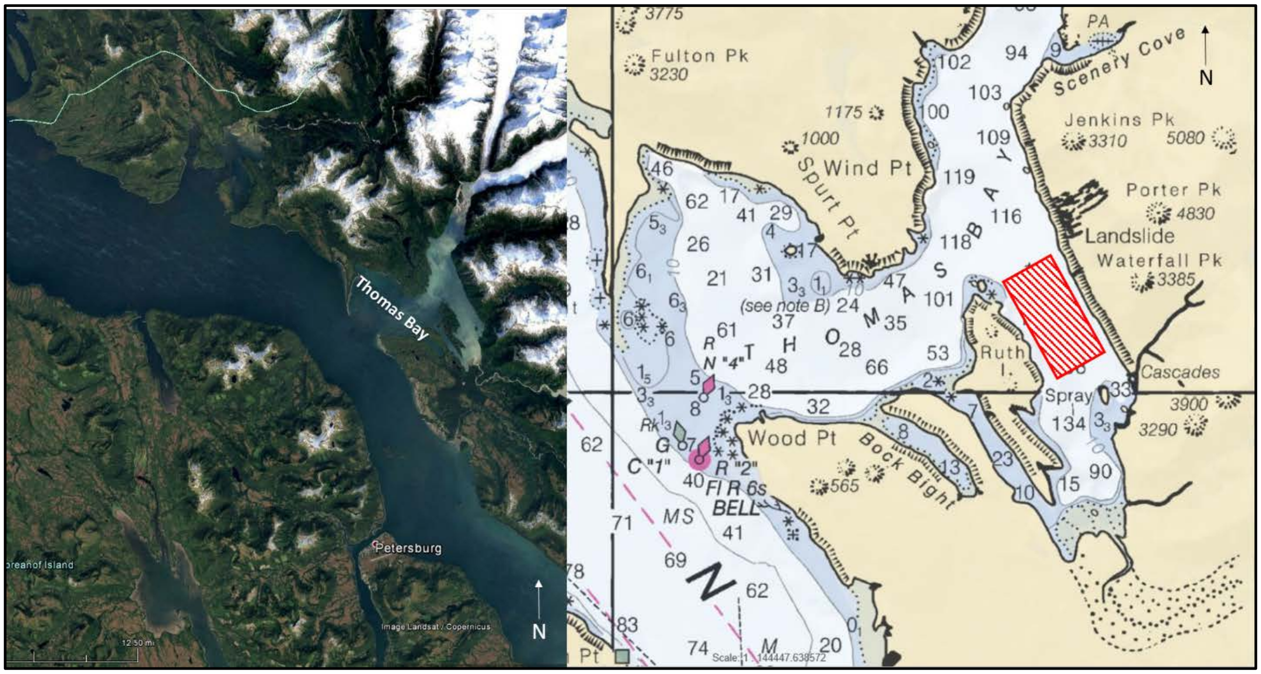

Figure 15. Vicinity Map of Thomas Bay (Potential in-Water Disposal Location marked in Red) (Google Earth Pro 2018; NOAA 2018b)

Table 17. Known Cultural Resources Within the General Vicinity of Thomas Bay

AHRS No.	Site Name	NRHP Status	In APE
SUM-007	Scenery Cove	Unevaluated	No
SUM-031	Porter Cove Cabin	Unevaluated	No
SUM-033	Cascade Creek Trappers Cabin	Not Eligible	No
SUM-034	Cascade Creek CCC Trail	Not Eligible	No
SUM-068	Duck Point Midden	Eligible	No
PET-424	Ruth Island Camp	Not Eligible	No
PET-426	Rock Shore Structures and Historic Mine	Not Eligible	No
PET-427	Bock Rock Alignment	Not Eligible	No

SUM-007 is a petroglyph site named Scenery Cove. The site was identified by a local informant in 1972 and has not been verified. The site's eligibility for the NRHP has not been evaluated. SUM-007 is located outside the in-water disposal area and would not be affected by the proposed action.

SUM-031 is the Porter Cove Cabin. The site was reported partially standing in 1997 by the U.S. Forest Service. The site's eligibility for the NRHP has not been evaluated. It is not located within the limits of the proposed in-water disposal area and therefore would not be affected by the action.

SUM-033 is the remains of a trespass cabin built in the 1930s by trapper Martin Marshall. The cabin was reported to be in an extreme state of decay in 1991 (AHRS 2018). The site is located on the east side of Thomas Bay, southeast of the proposed in-water disposal area. SUM-033 is considered to be not eligible for the NRHP.

SUM-034 is the Cascade Creek Trail. SUM-034 was constructed by the Civilian Conservation Corps (CCC) between 1933 and 1941. The trails connects the Thomas Bay coast with Swan Lake Falls. SUM-034 is considered to be not eligible for the.

SUM-068 is the Duck Point Midden site. Two test units were excavated by the U.S. Forest Service in 1996. Results of radiometric analysis dated lower deposits to around 110 BP or A.D. 1670. The Duck Point Midden is considered eligible for the NRHP; however, the site is located outside the limits of the in-water disposal area and would not be affected by the proposed disposal actions.

PET-424 is the Ruth Island Camp located on the southern end of Ruth Island. The site contains debris that are believed to be less than or about 50 years old. The site is located on a spit 1 to2 meters above a grassy estuary. Debris include a lumber platform, iron bathtub, a sheet of black rubber, and log posts potentially used for boat launching at high water. The site is considered not eligible for the NRHP.

PET-426 is the Rock Shore Structures and Historic Mine. The site is located on the east side of Thomas Bay and is southeast of the proposed in-water disposal area. The site consists of historic structures and a mine shaft dating to the 1920s and 1930s. PET-426 is considered to be not eligible for the NRHP.

PET-427 is known as the Bock Rock Alignment; the site is composed of a serpentine-shaped rock alignment located on the south side of Bock Bight. The site has not be verified as a cultural feature and may instead have been created by glacial activity. PET-427 is considered not eligible for the NRHP.

A search of the NOAA wrecks and obstructions database revealed four obstructions in the form of rocks at the entrance to Thomas Bay and one submerged wreck in the northeast portion of Thomas Bay (Figure 16; Table 18 and 19). The submerged wreck is located in Scenery Cove just south of Baird Glacier. All reported wrecks and obstructions are outside the limits of the proposed in-water disposal area. A search of the BOEM 2011 shipwreck database reports two wrecks at the entrance to Thomas Bay. An unnamed and unverified wreck is reported near the entrance of the bay; this wreck has not been verified and may not exist. The second wreck is that of the *Kilamey* and is reported to have wrecked at Wood Point along the southern opening of the bay. No wrecks were reported within the vicinity of the proposed in-water disposal area.

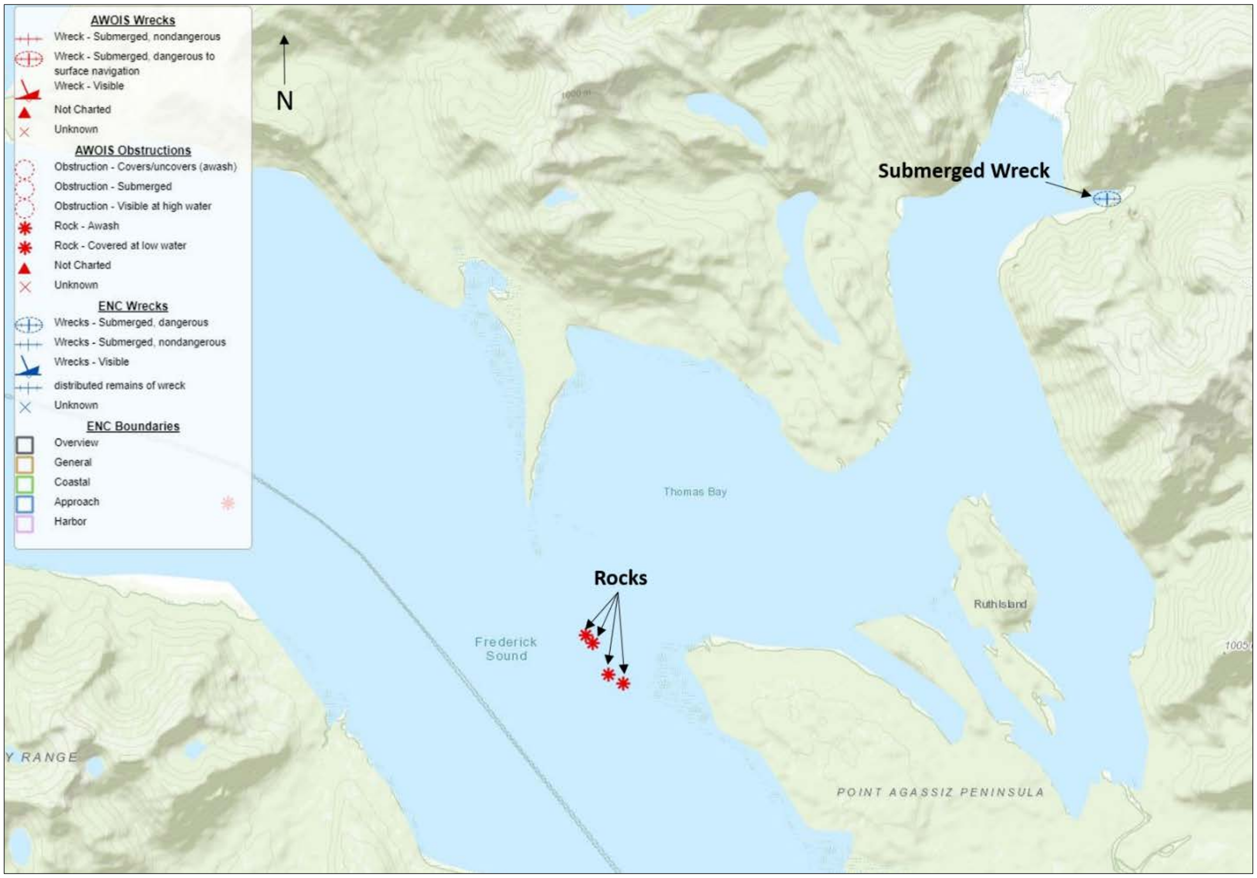

Figure 16. NOAA (2018) Wrecks and Obstructions Map- Thomas Bay
(Wrecks marked in blue and rocks in red)

Table 18. Wrecks and Obstructions Listed in Vicinity of Thomas Bay (NOAA 2018)

Type	Status	Narrative	Latitude	Longitude
Obstruction	Covered at Low Water	Rock	56.986319	-132.967403
Obstruction	Covered at Low Water	Rock	56.988131	-132.972439
Obstruction	Covered at Low Water	Rock	56.994114	-132.977919
Obstruction	Covered at Low Water	Rock	56.995519	-132.980233
Wreck	Always submerged	Dangerous Wreck	57.078170	-132.7989035

Table 19. Shipwrecks in the Vicinity of Thomas Bay (BOEM 2011)

Name	Type	Year	Location	Narrative Summary
Unknown	3-mast, Russian Gun Boat	1840	Entrance to Thomas Bay?	Sank, has not been verified.
Kilamey	Gas Screw F/V	1918	Wood Point, Thomas Bay	Foundered, 3 men lost
Evelyn Berg	Steamer	1937	Vandeput Spit, Thomas Bay	Stranded, not a total loss

Frederick Sound. Frederick Sound is located approximately 2.5 miles east of Petersburg (Figure 20). The potential in-water disposal area in Frederick Sound is an active disposal site. Cultural resources reported within the general vicinity of the potential Frederick Sound in-water disposal APE include both precontact and historic resources located along the shores of Frederick Sound on Mitkof Island (Table 20). None of the identified resources fall within the disposal APE. EPA coordination is on-going to determine the potential to use this area for in-water disposal. Recent underwater photography was collected for this area and is being analyzed. If EPA decides that this area is available for the disposal of material associated with this project, additional analysis will take place.

Table 20. Known Cultural Resources within the General Vicinity of Frederick Sound

AHRS No.	Site Name	NRHP Status	In APE
PET-027	Sandy Beach Petroglyph Site	Eligible	No
PET-386	Handtroller Camp	Unevaluated	No
PET-387	Tate Cabin and Midden	Unevaluated	No
PET-388	Petersburg Boy Scout Camp	Unevaluated	No
PET-519	Sandy Beach Midden	Eligible	No
PET-520	Sandy Beach CCC Shelters	Not Eligible	No

PET-027 is a petroglyph site on Sandy Beach. The site was first reported by Keithahn in 1966. In addition to multiple petroglphys, six fish traps have been identified in the intertidal zone. Three of the fish traps have been radiocarbon dated, producing dates ranging from 2090±60 BP to 1860±90 BP. The site has been determined to be eligible for the NRHP (AHRS 2018). PET-027 is located outside the in-water disposal area and would not be affected by the proposed action.

PET-386, the Handtroller Camp, was identified in 1994 by Charles Mobley. The only recorded structure at this site is a rock-lined hearth that protrudes from the ground not far from a few other rocks likely brought up from shore to weigh down a tent. The site's eligibility for the NRHP has not been evaluated (AHRS 2018). It is not located within the limits of the proposed in-water disposal area and therefore would not be affected by the action.

PET-387 is the Tate Cabin and Midden. The site consists of the remains of a wood-frame hunting cabin and a nearby precontact midden. The cabin was used by Ida Sather from 1925-1933, Flora Tate from 1933-1941, and the Nickerson family from 1941-1945. A radiocarbon date of 1210±60 BP was obtained from the midden. Although Mobley suggested that both the cabin and midden were eligible, the site's eligibility for the NRHP has not been formally evaluated (AHRS 2018). It is not located within the limits of the proposed in-water disposal area and would not be affected by the proposed action.

PET-388 is the Petersburg Boy Scout Camp. This camp site was used by local boy scouts in the 1920s; however, no structures were built at the site and no cultural remains were identified by Charles Mobley in 1994. The camp's eligibility for the NRHP has not been evaluated (AHRS 2018). It is not located within the limits of the proposed in-water disposal area and would not be affected by the proposed action.

PET-519 is the Sandy Beach Midden. This site was first identified by the U.S. Forest Service in 2003, and consists of a buried shell midden scattered along a 60 m by 5 m area of the beach. This site has been determined to be eligible for the NRHP (AHRS 2018). The Sandy Beach Midden is located outside the in-water disposal area and would not be affected by the proposed action.

PET-520 consists of the remains of the Civilian Conservation Corps (CCC) Shelters at Sandy Beach. This site was identified by the U.S. Forest Service in 2003. The CCC program in Petersburg constructed two shelters between 1939 and 1940 near the beachfront; however, all that remains of the original shelter components are two cobble and cement cooking hearths and chimneys. The site was determined to be not eligible for the NRHP due to lack of integrity (AHRS 2018).

A search of the NOAA wrecks and obstructions database revealed two obstructions and no submerged wrecks in the general vicinity of the in-water disposal area. One of the obstructions is identified as a submerged shoal, and the other is identified as the USACE disposal area itself (NOAA 2018). A search of the BOEM 2011 shipwreck database reports two wrecks in the general vicinity of Petersburg. The *Roald*, a gas screw, foundered on January 18, 1946 near the Horn Cliffs, east of Petersburg, and sank. The *31-B-360* sank at the dock in Petersburg on February 20, 1950 (BOEM 2011). No wrecks were reported within the proposed in-water disposal area.

Section 106 Consultation. Formal consultation with tribes and interested parties will occur one year prior to the start of construction.

3.4.4 Subsistence Activities

Subsistence Fishing. For season dates, species, and locations applicable to the Petersburg area, see ADFG 2010 – 2011 Subsistence and Personal Use Statewide Fisheries Regulations, Southeastern Alaska Area, related State laws applicable to Native Corporation and Native allotment lands, and USFWS Subsistence Management Regulations for the Harvest of Wildlife and Federal Public lands in Alaska, July 1, 2010 – June 30, 2012. Subsistence data for Petersburg, Alaska noted that salmon made up 22.92 percent of the fish subsistence harvest (NOAA, 2005).

Subsistence Hunting. For season dates, species, and locations applicable to the Petersburg area, see ADFG Regulations for Tier I and Tier II Hunting in Unit 3 and Cultural and Subsistence Harvests in Unit 3, related State laws applicable to Native Corporation and Native allotment lands, and USFWS Subsistence Management Regulations for the Harvest of Wildlife and Federal Public lands in Alaska, July 1, 2010 – June 30, 2012. Subsistence data for Petersburg, Alaska noted that marine mammals did not figure significantly into the composition of the subsistence diet. Of the subsistence diet, 28.95 percent is from terrestrial mammals and 1.80 percent from birds and egg’s. Foraging for marine invertebrates and vegetation made up 19.49 percent and 4.36 percent, respectively (NOAA, 2005).

4. FUTURE WITHOUT PROJECT CONDITIONS

The expected without-project conditions form the basis of evaluation against which with-project conditions are compared.

4.1 Physical Environment

The basic nature of the area is not expected to significantly change over the 50-year period of analysis. The area could continue to experience a reduction in relative sea level rise due to isostatic rebound. Information on relative sea level rise in Southeast Alaska can be found in Appendix B.

4.2 Economic/Political Conditions

As stated above, approximately 93 percent of vessels utilizing Petersburg harbor facilities are commercial fishing vessels.[2] South Harbor is used primarily by commercial boaters, while most of the shoreline slips in the inland mooring area are used by subsistence and recreational boaters. Depth constraints are expected to affect all commercial fishing vessels moored on D Float (38 vessels) and the north half of C Float (36 vessels), as well as approximately 74 subsistence vessels moored on the main float shown in Figure 6.

An approximate tide of -1 foot MLLW was stated by harbor users as the limit of safe navigation within these portions of South Harbor.[3] Tides lower than -1 foot MLLW are assumed to cause delays for vessels moored in these areas while entering and exiting South Harbor. While all 74 commercial fishing vessels and 74 subsistence vessels would be affected if entering or exiting the harbor during low tide events, not all vessels use the harbor daily due to the different types of fisheries accessed from Petersburg.

A range of scenarios was evaluated based on the percent of commercial and subsistence vessels expected to be impacted by depth constraints during low tide cycles. The most conservative scenario assumes 25 percent of vessels would be affected during each low tide event, which likely results in an underestimation of potential benefits. Given that most vessels run multiple gear types and essentially fish year round, it is likely that a larger portion of vessels would be affected during each low tide cycle and would therefore benefit from the proposed navigation improvements.

4.3 Benefit Categories

4.3.1 Vessel Operating Costs

Vessel operating costs (VOCs) are based on fixed and variable costs associated with operation. Most fixed costs are calculated as a percentage of vessel investment cost, but may also include fees associated with fishing licenses and the cost of fuel, repairs and maintenance, and hourly wages paid to crew members as applicable. Potential benefits associated with reducing VOCs have a present value of approximately $11.1 million and an average annual savings of $410,000 over the period of analysis. In addition to these potential savings, opportunities exist for vessels

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[2] Petersburg Harbormaster, Glorianne Wollen, October 4, 2017.

[3] Based on discussions with Petersburg harbormaster and local fishermen, October 5, 2017.

that currently utilize haul-out facilities and moorage at other harbors in the region, but could call on Petersburg if facilities were built at Scow Bay. When these additional opportunities are considered, potential VOC savings have a present value of $46.5 million and an average annual savings of $1.7 million. Table 21 shows potential VOC savings by area of use.

Table 21. Future Without-Project Condition: Vessel Operating Costs

Potential Benefit by Area	Present Value	AAEQ Value	% of Total
South Harbor Only	$11,061,000	$410,000	24%
Scow Bay Only	$35,471,000	$1,314,000	76%
Total	$46,532,000	$1,724,000	100%

4.3.2 Opportunity Cost of Time

Opportunity cost of time (OCT) is the value of time which could otherwise be spent pursuing additional work or leisure activities. The value of time saved is based on methodology described in ER 1105-2-100. This analysis assumed that captains and crews in Petersburg would elect to use these saved hours as work time.[4] Assuming four crew members per vessel, the hourly OCT per vessel is about $300. Based on delay hours and OCT, the total annual OCT value per vessel is approximately $15,000. Appendix C explains how OCT was calculated.

Over the period of analysis, these potential OCT savings have a present value cost of approximately $30.8 million, with average annual savings of $1.1 million. Like with VOCs, additional opportunities exist for vessels that currently utilize haul-out facilities and moorage at other harbors in the region, but could call at Petersburg if facilities were built in Scow Bay. When these additional opportunities are considered, potential OCT savings have a present value of $44.7 million, equating to average annual savings of $1.7 million. Table 22 shows potential OCT savings by area of use.

Table 22. Future Without-Project Condition: Opportunity Cost of Time

Potential Benefit by Area	Present Value	AAEQ Value	% of Total
South Harbor Only	$30,792,000	$1,141,000	69%
Scow Bay Only	$13,915,000	$515,000	31%
Total	$44,707,000	$1,656,000	100%

4.3.3 Subsistence

Depth constraints during low tide cycles cause delays for subsistence users and inhibit access to subsistence resources. Reducing delays and improving access for these users is expected to result in VOC and OCT savings as well as an increase in subsistence harvests. The value of foregone subsistence harvest expected to occur without navigation improvements is based on subsistence data and harvest replacement values from the ADFG Division of Subsistence. Potential benefits associated with reducing delays for subsistence vessels and improving subsistence harvesting opportunities have a present value of $4.6 million and an average annual potential benefits of $172,000 over the period of analysis (Table 23).

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[4] Based on Petersburg harbor office records of slip assignments and fishing permits by vessel.

Table 23. Future Without-Project Condition Potential Subsistence Benefits

Potential Benefits	Present Value	AAEQ Value	% of Total
Opportunity Cost of Time	$2,172,000	$80,000	46%
Vessel Operating Costs	$1,833,000	$68,000	40%
Foregone Subsistence Harvest	$638,000	$24,000	14%
Total	$4,643,000	$172,000	

4.3.4 Labor Resource Underutilization.

USACE policy provides guidance on the NED benefit evaluation procedure for unemployed or underemployed labor resources (Appendix C). Given socioeconomic and employment characteristics in the Petersburg Borough, an opportunity exists to utilize unemployed or underemployed labor resources during project construction. Absent Federal investment, these potential benefits are considered a foregone opportunity to utilize unemployed or underemployed labor resources in the region, and have a present value of approximately $13.9 million, with average annual values of $515,000.

4.4 Biological Environment

Under Future-Without Project Conditions, biological resources (Section 3.2) identified in the Petersburg area are not anticipated to change from current seasonal timelines.

4.5 Summary of the Without Project Condition

The Without Project Condition forms the basis for impacts under the No Action Alternative. Given the nature of the area, it is unlikely that the future without project condition will differ greatly from the existing condition. Table 24 summarizes the Future Without-Project Conditions.

Table 24. Summary of Future Without-Project Conditions

Category	Present Value	AAEQ Value	Percent of Total
Commercial Fishing	$91,239,000	$3,380,000	83%
Opportunity Cost of Time	$44,707,000	$1,656,000	41%
Vessel Operating Costs	$46,532,000	$1,724,000	42%
Subsistence	$4,643,000	$172,000	4%
Opportunity Cost of Time	$2,172,000	$80,000	2%
Vessel Operating Costs	$1,833,000	$68,000	2%
Foregone Subsistence Harvest	$638,000	$24,000	1%
Labor Resource Inefficiencies	$13,909,000	$515,000	13%
Total	$109,791,000	$4,067,000	100%

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 is a feature or activity that can be implemented at a specific location to address one or more of the objectives. A feature is a “structural” element that requires construction or on-site assembly. An activity is defined as a “non-structural” action.

5.2 Plan Formulation Criteria

Measures were screened during the charette using the criteria found in section 2.7. Each measure was evaluated against the general metric whether the design would address the major mechanisms causing the vessel delays due to insufficient depths within the Petersburg Harbor System. Specific engineering design criteria used to develop the measures is presented in Appendix B.

5.3 Management Measures

Using the criteria listed in section 2.7, the project delivery team evaluated the following structural and non-structural measures. These measures were combined to form the alternatives outlined in section 5.4.3.

5.3.1 Non-structural Measures

Non-structural measures are those measures that reduce the consequences of vessel delays and utilize current available resources. These measures could include, rearranging the configuration of the float system, moving larger vessels with deeper drafts to slips in deeper water and shallower vessels to shallower slips and using navigation markers to identify areas that are shallow within entrance channels and maneuvering basins.

5.3.2 Structural Measures

Structural measures are generally those measures that reduce the probability of vessel delays due to insufficient depths and improve access to the harbor system. These measures could include dredging or building a new harbor to accommodate the growing fleet.

5.4 Alternative Plans Screening

Four alternative plans and no-action were developed using the measures explained above. Initial screening of alternatives determined them all to be valid for further evaluation. However, two alternatives were removed from further consideration after cost and economic analysis was completed, but before environmental sampling took place (Sections 6.2-6.4). Alternative 4 was removed due to the fiscal constraint identified by the non-Federal Sponsor. Alternative 5 was not economically justified. Table 25 lists these alternatives.

6. COMPARISON & SELECTION OF PLANS*

6.1 Detailed Alternative Plans Descriptions

Four alternatives were evaluated along with the future without-project condition (No Action).

Table 25. Alternative Descriptions

Alternative	Description
1	No Action
2	Non-Structural Reorganization of Petersburg Harbor System
3	South Harbor Dredging Only
4	South Harbor Dredging with Haul-out Area at Scow Bay
5	South Harbor Dredging and New Harbor at Scow Bay

1. **No Action.** The Harbor depth will remain the same and all vessels in the Petersburg harbor system will remain in their assigned slips. If no action is taken, insufficient depths within the harbor system will continue to cause transportation delays and limit access for commercial fishing and subsistence activities, creating economic inefficiencies to the region and Nation. The study objectives would not be met and no project benefits or opportunities would be realized.

2. **Non-Structural Reorganization of Petersburg Harbor System.** This non-structural alternative would result in removal of all boats in the harbor system. The float layout and depth in each slip would be evaluated and boats drafting less water would be assigned to shallower slips. Larger vessels with deeper drafts would be moved to slips with deeper depths. This alternative would not address depth in the entrance channel or maneuvering basin, which is a study objective, so some vessel delays would still occur during low tides.

3. **South Harbor Dredging Only.** Dredging in South Harbor will take place in order to address vessel delays due to insufficient depth within the harbor system. The assumed project depths are -19.25 feet Mean Lower Low Water (MLLW) in the maneuvering channel, -18 feet MLLW in between C and D floats, -10 feet MLLW landward of the main float, and -9 feet MLLW behind floats 1 and 2 (Figure 4). A 1 foot over dredge allowance will be added to these depths. Disposal of dredge spoils will be evaluated to determine least cost alternative in accordance with current guidance. This alternative assumes in-water disposal in either Thomas Bay or Frederick Sound. Optimization of disposal locations will take place in the Design and Implementation (D&I) phase after environmental sampling is completed summer 2019. This alternative meets the study objectives of improving access to the Petersburg Harbor system and reducing vessel delays due to insufficient depths within the harbor system.

4. **South Harbor Dredging with Haul-out Area at Scow Bay.** This alternative includes all features of Alternative 3 plus the installation of a vessel haul-out area at Scow Bay. This alternative would provide the infrastructure (a concrete ramp) for hydraulic trailers (provided by private sector) to transport commercial and recreational vessels from the water onto the uplands to access services at adjacent work and storage yards. This alternative meets the study objectives and provides additional opportunities for development of marine infrastructure in Scow Bay. In addition to providing the benefits estimated for Alternative 3, this alternative would result in additional transportation cost savings to vessels that currently utilize haul-out facilities at other harbors in the region.

5. **South Harbor Dredging with Haul-out Area and New Harbor Scow Bay.** This alternative includes all features of Alternative 4 plus the installation of a new harbor at Scow Bay to accommodate excess demand for vessels seeking permanent and transient moorage at Petersburg.

The existing 400-foot breakwater would be extended out to 800-ft total length to protect the float system and harbor entrance from wave action. Three rows of stalls supporting up to 32’, 42’, and 60’ vessels, respectively, would be constructed along with an outer slip area for transient moorage. Like Alternative 4, this alternative also meets the study objectives and provides additional opportunities to vessels that currently utilize haul-out facilities and moorage at other harbors in the region. However, additional benefits beyond those estimated for Alternative 4, such as benefits associated installing moorage in Scow Bay, were not evaluated in this analysis, as they were considered to exceed the scope of this study.

6.1.1 Without-Project Conditions

Absent Federal action to provide navigation improvements at Petersburg, the transportation inefficiencies, forgone harvest opportunities, and underutilization of labor resources described above are expected to continue throughout the period of analysis. These adverse impacts incurred as a result of current and expected future conditions have a present value of approximately $110 million with an average annual value of $4.1 million over the period of analysis. As previously stated, Table 12 shows the Without-Project Conditions.

6.1.2 With-Project Conditions

Each alternative provides a varying degree of reduction to the inefficiencies described in the Without-Project Conditions section. All structural alternatives that involve dredging in South Harbor (Alternatives 3, 4, and 5) are expected to provide the same level of benefits in terms of transportation cost savings (measured as time and vessel operating cost savings) and increases in subsistence harvests. For these alternatives, a range of benefit scenarios is considered based on the percent of commercial fishing and subsistence vessels expected to benefit from reduced depth constraints and delays. All potential benefits estimated for each scenario in the Without-Project Conditions section are expected to be realized for Alternatives 3, 4, and 5. It is important to note that the non-structural alternative (Alternative 2) would not address depth constraints in the entrance channel or maneuvering basin, so only a portion of the potential benefits identified in the Without-Project Conditions section would be realized. As such, the “low” benefit scenario is considered most appropriate for Alternative 2.

Alternatives 4 and 5, which involve developing new marine facilities at Scow Bay, are expected to produce additional transportation savings to vessels that currently utilize haul-out facilities at other harbors in the region, but would shift to Scow Bay with a project. While these additional benefits are considered in this analysis, any additional benefits that would result from adding moorage at Scow Bay were considered to be beyond the scope of this study.

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 risk contingencies were included to account for uncertain items such as sediment characterization and dredged material disposal methods. Interest during construction assumes a 2-year construction window. Initial estimates of operations and maintenance are based on the cost of the 2013 North Harbor dredging effort at Petersburg and the estimated volume of dredge material for South Harbor. Maintenance dredging is assumed to occur in 30 years. For those alternatives that include a breakwater and/or moorage floats (Alternatives 4 and 5), it is assumed the floats and 15 percent of breakwater armor rock would be replaced in 30 years.

The combination of project first costs, interest during construction, and operations and maintenance costs form the total investment cost and was used to determine the average annual equivalent cost of each alternative. Project costs were developed without escalation and are in 2018 dollars. Table 26 displays the ROM costs for each alternative.

Table 26. ROM Costs by Alternative

Cost Description	Alt. 2	Alt. 3	Alt. 4	Alt. 5
LERRS	N/A	$24,000	$24,000	$24,000
Mobilization & Demobilization	$1,658,000	$1,328,000	$1,784,000	$2,024,000
Remove/Replace Floats	$34,318,000	N/A	N/A	N/A
Breakwater & Slope Protection	N/A	N/A	$585,000	$6,959,000
South Harbor Dredging & Disposal		$4,460,000	$7,663,000	$5,466,000
Haul-Out Ramp	N/A	N/A	$3,134,000	$3,134,000
Navigation Aids	N/A	N/A	N/A	$59,000
Dredge Material Confined Disposal Facility	N/A	N/A	$24,149,000	$24,149,000
Scow Bay Harbor Facilities & Utilities	N/A	N/A	N/A	$19,874,000
Remaining Construction Items	N/A	N/A	N/A	$2,140,000
PED	$2,966,000	$1,400,000	$4,686,000	$7,372,000
SIOH	$3,928,000	$746,000	$2,497,000	$3,928,000
Project First Cost	$42,869,000	$7,958,000	$44,522,000	$69,962,000
IDC	$587,000	$109,000	$1,230,000	$1,933,000
OMRR&R	$18,997,000	$2,565,000	$5,614,000	$22,436,000
Total Investment	$62,453,000	$10,632,000	$51,366,000	$94,331,000

6.2.1 Total Average Annual Equivalent Costs

Average annual costs were developed by combining the initial construction costs with the annual Operations and Maintenance costs for each potential alternative using the FY18 Federal Discount Rate of 2.750 percent along with a period of analysis of 50 years (Table 27).

Table 27. Average Annual Cost Summary by Alternative

Cost Description	Alt 2	Alt 3	Alt 4	Alt 5
AAEQ Investment	$1,610,000	$299,000	$1,695,000	$2,663,000
AAEQ OMRR&R	$704,000	$95,000	$208,000	$831,000
Total AAEQ Cost	$2,314,000	$394,000	$1,903,000	$3,494,000

6.3 With-Project Benefits

Each alternative provides a certain amount of relief from existing and expected future inefficiencies. The differences between the expected level of inefficiencies absent Federal action (without-project condition) and those that will occur under the various with-project conditions are benefits that accrue to the project and form the basis for selecting a recommended plan.

Total annual project benefits were determined at FY18 price levels by calculating the average annual reduction in transportation costs and increase in subsistence harvests. Benefits realized through the use of otherwise unemployed or underemployed labor resources during project construction were also calculated. Benefits are discounted to the FY18 price level using the Federal discount rate of 2.750 percent over a 50-year period of analysis.

Table 28 and Table 29 show the present value and average annual value of benefits for each alternative. Note that these tables summarize benefits for the "most likely" scenario considered, and that numbers may differ slightly from than those shown in subsequent tables due to variations in Monte Carlo simulation results.

Table 28. Present Value of Benefits by Alternative

Category:	Alt 2	Alt 3	Alt 4	Alt 5
Commercial Fishing	$31,390,000	$31,390,000	$68,429,000	$68,429,000
Opportunity Cost of Time	$23,094,000	$23,094,000	$33,530,000	$33,530,000
Vessel Operating Costs	$8,296,000	$8,296,000	$34,899,000	$34,899,000
Subsistence	$3,482,500	$3,482,500	$3,482,500	$3,482,500
Opportunity Cost of Time	$1,629,000	$1,629,000	$1,629,000	$1,629,000
Vessel Operating Costs	$1,375,000	$1,375,000	$1,375,000	$1,375,000
Increased Subsistence Harvest	$478,500	$478,500	$478,500	$478,500
Labor Resources	$8,522,000	$1,582,000	$8,851,000	$13,909,000
Total	$43,394,500	$36,454,500	$80,762,500	$85,820,500
Total, Monte Carlo Simulation	$35,644,957	$29,478,196	$74,540,288	$79,597,833

Table 29. Annual Benefits by Alternative

Category:	Alt 2	Alt 3	Alt 4	Alt 5
Commercial Fishing	$1,163,000	$1,163,000	$2,535,000	$2,535,000
Opportunity Cost of Time	$855,000	$855,000	$1,242,000	$1,242,000
Vessel Operating Costs	$307,000	$307,000	$1,293,000	$1,293,000
Subsistence	$129,000	$129,000	$129,000	$129,000
Opportunity Cost of Time	$60,000	$60,000	$60,000	$60,000
Vessel Operating Costs	$51,000	$51,000	$51,000	$51,000
Increased Subsistence Harvest	$18,000	$18,000	$18,000	$18,000
Labor Resources	$316,000	$59,000	$328,000	$515,000
Total	$1,607,000	$1,350,000	$2,992,000	$3,179,000
Total, Monte Carlo Simulation	$1,320,000	$1,092,000	$2,761,000	$2,948,000

6.4 Net Benefits of Alternative Plans

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. Table 30 summarizes project costs, benefits, and the benefit cost ratio by alternative. The plan that reasonably maximizes net benefits is Alternative 3, the South Harbor Dredging Only alternative.

Alternative 4 meets the study objectives and provides additional opportunities for development of marine infrastructure in Scow Bay, resulting in higher net benefits than Alternative 3. In addition to providing the benefits estimated for Alternative 3, this alternative would produce additional transportation cost savings to vessels currently utilizing haul-out facilities at other harbors in the region. However, the non-Federal Sponsor identified a fiscal constraint that removed Alternative 4 from further consideration. Alternative 4 required a significant non-Federal Sponsor LSF contribution due to the construction of a contained disposal facility for creating uplands. Alternatives 2 and 5 were found to have negative net annual benefits and are not cost effective.

Table 30. Summary of Costs and Benefits by Alternative

Alternative	PV Benefits[1]	AAEQ Benefits	PV Costs	AAEQ Costs	Net Annual Benefits	Benefit-Cost Ratio
1	N/A	N/A	N/A	N/A	N/A	N/A
2	$35,645,000	$1,320,000	$62,453,000	$2,313,000	-$993,000	0.57
3	$29,478,000	$1,092,000	$10,631,000	$394,000	$698,000	2.77
4	$74,540,000	$2,761,000	$51,366,000	$1,903,000	$858,000	1.45
5	$79,598,000	$2,948,000	$51,366,000	$1,903,000	-$546,000	0.84

Note: This table shows benefits for the “most likely” benefit scenario considered, which was estimated through Monte Carlo simulations. The BCR for Alternative 3 ranges from 1.2 to 4.5 based on the portion of vessels affected during low tide cycles.

6.5 Risk and Sensitivity Analysis

In the interest of further testing the sensitivity of project justification to uncertainty in parameters, future scenarios must be assessed. The analysis of these scenarios is intended to illustrate the effect of changes in different assumptions on project benefits and project justification.

Because of the inherent uncertainty surrounding the forecast of any growth in fisheries and related marine resources, a conservative "no growth" approach was taken in determining the future fleet in Petersburg. The fishing industry in Petersburg is considered strong and is expected to continue to support demand for moorage and other harbor facilities at Petersburg. Fisheries activities will continue to fluctuate as resource abundance varies, regulations change, or technical breakthroughs are made. Possible regulatory actions likely would result in an easing of catch regulations given the stability of the fisheries in the Southeast Alaska/Yakutat region, leading to an increase in fish harvests and demand for harbor facilities at Petersburg. The impact of growing foreign fisheries on the domestic fish export industry may cause prices for some exports to fall but, more likely, this would result in an overall increase in global demand for fish exports, also leading to an increase in harvests and demand for harbor facilities. At this time, however, not enough information is known to assign probabilities to any of these scenarios. They are simply intended to provide information to better understand the economic risks associated with the recommended plan.

A sensitivity analysis regarding expected project benefits was conducted based on the assumed percent of commercial fishing and subsistence vessels impacted by depth constraints during low tide cycles. This resulted in a range of benefit scenarios for each alternative. The most conservative scenario assumes 25 percent of vessels would be affected during each cycle, which likely results in an underestimation of benefits. Given that most vessels run multiple gear types and essentially fish year round, it is likely that a larger portion of vessels would be affected during each low tide cycle, and would therefore benefit from the proposed navigation improvements. The "mid" and "high" scenarios assume 50 percent and 100 percent of vessels would be impacted by depth constraints during low tide cycles. The "most likely" scenario is based on Monte Carlo simulations using @Risk, a Microsoft Excel add-in.

Under all scenarios considered, Alternative 3 is economically justified and reasonably maximizes net benefits, with a BCR ranging from 1.2 to 4.5, and net annual benefits of $95,000 to $1.4 million. Table 31 and 32 summarize the sensitivity analysis for Alternative 3, the proposed plan. Appendix C summarizes all of the results of the sensitivity analysis for the array of alternatives.

Table 31. Sensitivity Analysis: Summary for Alternative 3

Scenario	PV Benefits	AAEQ Benefits	PV Costs	AAEQ Costs	Net Annual Benefits	Benefit-Cost Ratio
Low	$13,9205,000	$489,000	$10,631,000	$394,000	$95,000	1.24
Mid	$24,831,000	$920,000	$10,631,000	$394,000	$526,000	2.34
Most Likely	$29,478,000	$1,092,000	$10,631,000	$394,000	$698,000	2.77
High	$48,078,000	$1,782,000	$10,631,000	$394,000	$1,388,000	4.53

Table 32. Sensitivity Analysis: Present Value Benefits, Alternative 3

Category:	Low	Mid	Most Likely	High
Commercial Fishing	$10,463,000	$20,927,000	$31,390,000	$41,853,000
Opportunity Cost of Time	$7,698,000	$15,396,000	$23,094,000	$30,792,000
Vessel Operating Costs	$2,765,000	$5,531,000	$8,296,000	$11,061,000
Subsistence	$1,160,000	$2,322,000	$3,482,500	$4,643,000
Opportunity Cost of Time	$543,000	$1,086,000	$1,629,000	$2,172,000
Vessel Operating Costs	$458,000	$917,000	$1,375,000	$1,833,000
Increased Subsistence Harvest	$159,000	$319,000	$478,500	$638,000
Labor Resources	$1,582,000	$1,582,000	$1,582,000	$1,582,000
Total	$13,205,000	$24,831,000	$36,454,500	$48,078,000
Total, Monte Carlo Simulation	$14,078,976	N/A	$29,478,196	$48,586,296

6.6 Summary of Accounts and Plan Comparison

The USACE Institute for Water Resources (IWR), the Louis Berger Group, and Michigan University developed the regional economic impact modeling tool called RECONS to provide estimates of regional and national job creation and retention and other economic measures such as income, value added, and sales. This modeling tool automates calculations and generates estimates of jobs and other economic measures such as income and sales associated with USACE's ARRA spending and annual Civil Works program spending. This is done by extracting multipliers and other economic measures from more than 1,500 regional economic models that were built specifically for USACE's project locations. These multipliers were then imported to a database and the tool matches various spending profiles to the matching industry sectors by location to produce economic impact estimates. The tool will be used as a means to document the performance of direct investment spending of the USACE as directed by the ARRA. The tool also allows the USACE to evaluate project and program expenditures associated with the annual expenditure by the USACE.

7. TENTATIVELY SELECTED PLAN*

7.1 Description of Tentatively Selected Plan

The proposed plan is Alternative 3: South Harbor Dredging Only. This plan is the largest acceptable project to the non-Federal Sponsor and was selected as the National Economic Development Plan. The assumed project depths are -19.25 feet Mean Lower Low Water (MLLW) in the maneuvering channel, -18 feet MLLW in between C and D floats, -10 feet MLLW landward of the main float, and -9 feet MLLW behind floats 1 and 2 (Figure 6). A 1 foot over dredge allowance will be added to these depths. Disposal of dredge spoils will be in-water in either Thomas Bay or Frederick Sound. This optimization of disposal locations will take place in the Design and Implementation (D&I) phase.

7.2 Plan Components (e.g. Basin, Breakwaters, Rip Rap)

The economic analysis generated the design vessel for this study. The design vessel is a hybrid of the National Geographic Sea Lion (length and beam) and a Seiner with a 12 foot draft. The characteristics of the design vessel is shown in Table 33.

Table 33. Design Ship Characteristics

Vessel Length (ft)	Design Beam (ft)	Design Draft (ft)
164	33	12

Moving vessels must maintain clearance between their hulls and channel bottom; accordingly, various navigational design parameters are analyzed. Design parameters such as squat, safety clearance, vertical motion due to waves, and water density effects are added to determine the minimum required under-keel clearance (Figure 17).

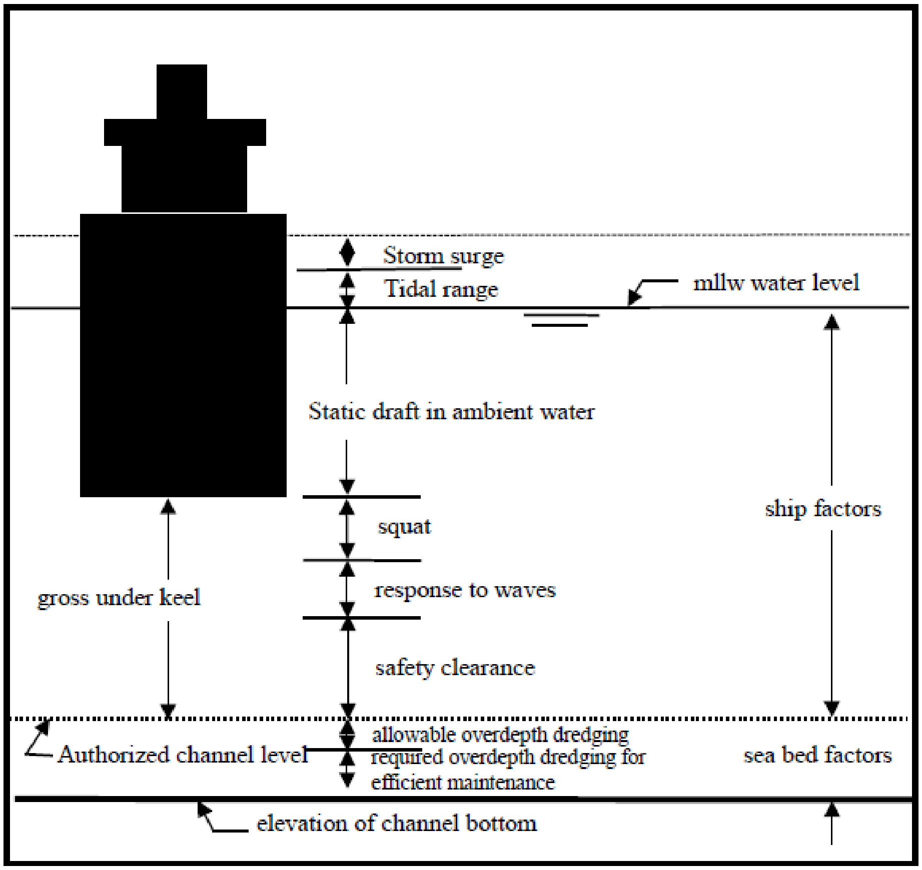

Figure 17. Under-Keel Clearance Parameters

The maneuvering channel depth to the crane dock was determined using the criteria listed in Table 34. The lowest astronomical tide is -4.15 feet MLLW which results in a depth of -19.25 feet MLLW which is usable 100% of the time.

Within the fairway area between floats C and D the squat and pitch, roll, and heave requirement is not necessary so required harbor depth reduces to -18 feet.

Table 34. Maneuvering Channel Criteria

Vessel Draft [ft]	12.0
Pitch, Roll, Heave [ft]	0.6
Squat [ft]	0.5
Tide Allowance [ft]	4.15
Safety Clearance	2.0
Total Depth Required (ft)	19.25

The dredge depth landward of the main float would reduce to -10 feet MLLW due to the reduced vessel draft of the smaller boats (approximately 3.5 feet). The local sponsor requested that a fourth area be included and dredged to -9 feet MLLW at the back of the Middle Harbor in order to trap the sediment accumulated from the Hammer Slough discharge (Figure 18). As explained in Section 3.1.3, Hammer Slough is a possible source of sedimentation for South Harbor and creating a sump to collect these sediments could reduce O&M for maintenance dredging. Figure 19 shows the same image as Figure 18 with designated GNF and LSF locations. The estimated dredge volume for each area is presented in Table 35.

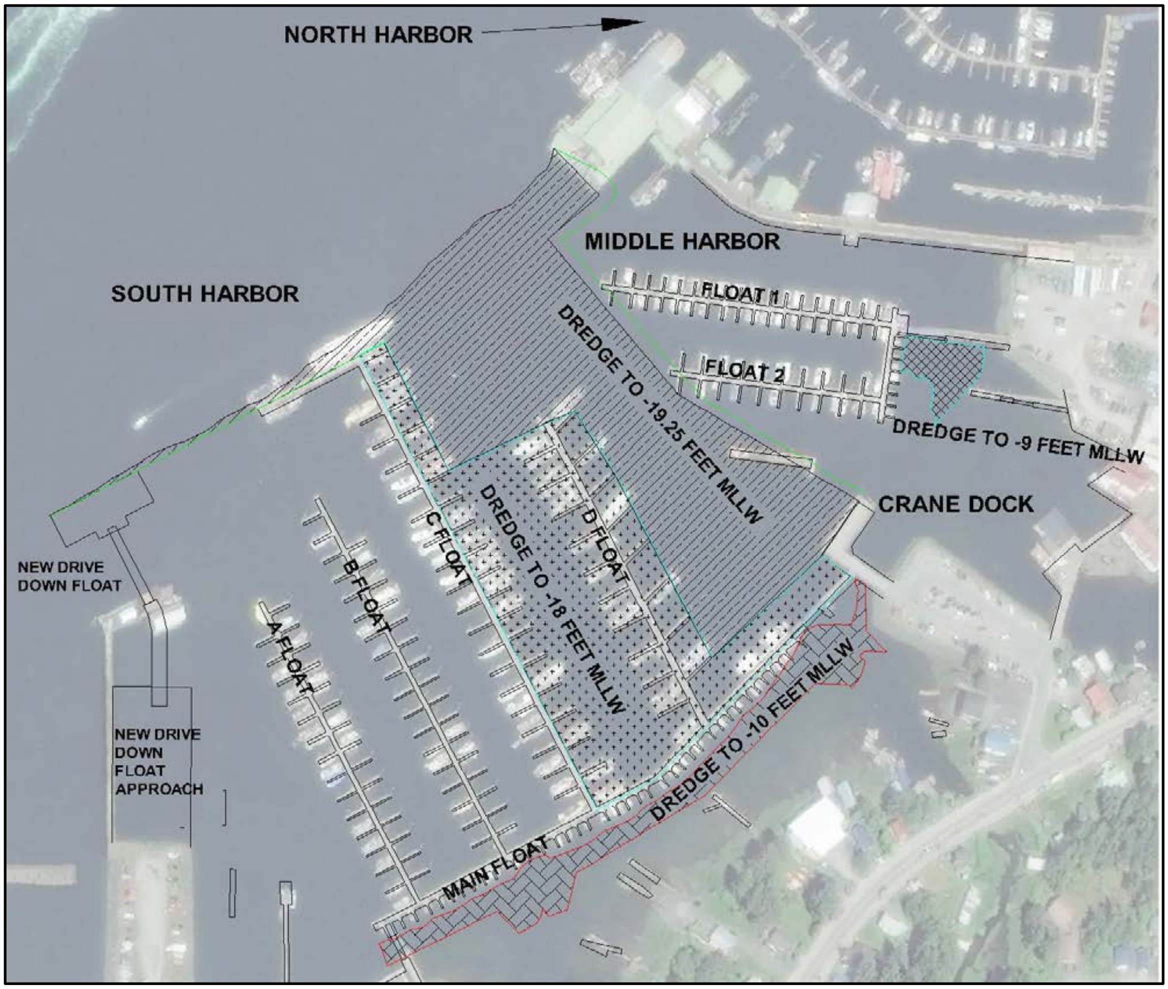

Figure 18. Dredge Areas by Depth (not drawn to scale)

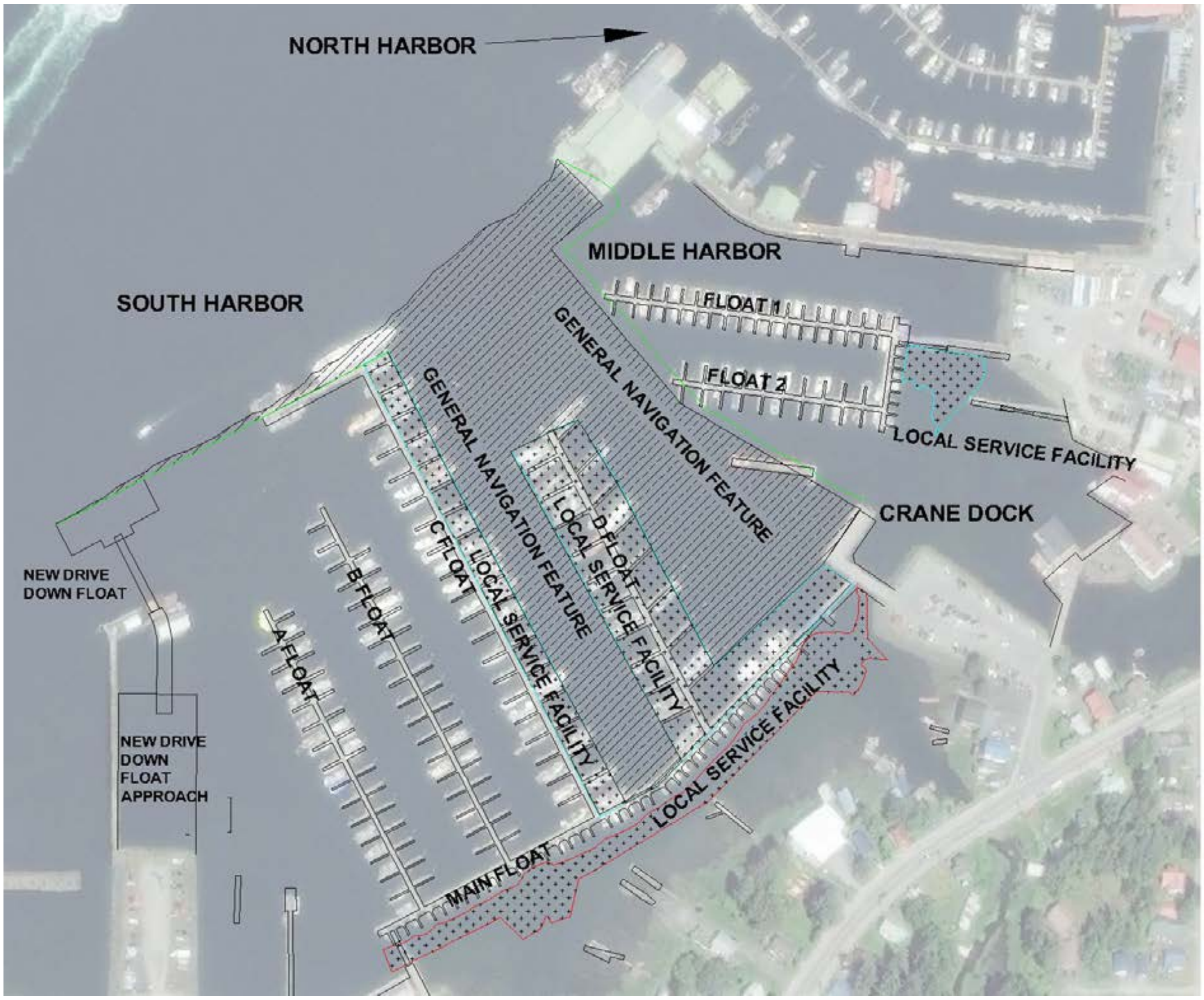

Figure 19. Dredge Areas by GNF and LSF (not drawn to scale)

Table 35. Dredge Volumes and Areas

Dredge Area	Dredge Depth [ft]	Dredge Volume [cy]	Dredge Area [sf]	One Foot Overdepth Allowance	Total Dredge Volume	GNF/LSF
Maneuvering Channel	-19.25	33,750	322,074	11,930	45,680	GNF
Between C and D Floats	-18	5,820	237,369	8,800	14,620	1,000 CY GNF/ 13,620 CY LSF
Landward of Main Float	-10	17,370	62,390	2,320	19,690	LSF
Behind Floats 1 and 2	-9	2,370	10,191	380	2,750	LSF
Total		59,310		23,410	82,740	

7.2.1 Disposal Method

Open Water Disposal. A determination on open water disposal will be made upon completion of the Section 404 (b) (1) evaluation in accordance with the Guidelines of the Clean Water Act to evaluate discharge of dredged material into waters of the United States (Appendix F). The Guidelines outline measures to avoid, minimize, and compensate for impacts. The areas being evaluated are Frederick Sound and Thomas Bay located approximately 2 and 20 miles from Petersburg, respectively (Figure 20).

Figure 20. Location of Petersburg, Thomas Bay, and Frederick Sound

In-water disposal is generally a more cost effective placement option due to the reduction in handling; sediments are placed on the barge by the dredge plant and transported to the disposal site and discharged directly into the water to settle on the ocean floor. This disposal method is subject to the requirements of the Dredged Material Management Program (DMMP) promulgated by the Corps, Seattle District (Alaska District does not have a regional management program).

The DMMP, also referred to as the User Manual, seeks to answer the following three questions:

1. Is the proposed dredged material suitable for open-water disposal?

2. Is the proposed dredged material suitable for in-water beneficial use?
3. Will the post-dredge surface (Z-layer or exposed substrate after pay is removed) meet anti-degradation standards when the project is finished?

To answer these questions, the DMMP uses a tiered approach to sediment characterization. There are four tiers of evaluation:

Tier 1: Site Evaluation and History

Tier 2: Chemical Testing

Tier 3: Biological Testing (bioassay and or bioaccumulation testing)

Tier 4: Special Studies

Every project is subject to a Tier 1 evaluation, which is a review of historical and ongoing sources of contamination, land use, and any previously collected data. Occasionally a suitability determination can be made using only Tier 1 information. For other projects, Tier 1 informs the characterization required in subsequent tiers. Tier 2 evaluation compares the results of chemical analysis to regional standards for sediment management; the Alaska District relies on the ADEC cleanup levels for placement in the terrestrial environment and the Seattle District's Dredged Material Management Plan (DMMP) screening levels for in-water placement. Tier 3 biological testing is invoked if chemicals of concern are present at concentrations that are of potential concern for human health or the environment. Time can be saved by compressing Tiers 2 and 3, that is, by conducting concurrent chemical and biological testing. Tier 4 testing is rarely required by the agencies or pursued by dredging proponents. If Tier 4 testing is needed, it is specially designed in coordination with the DMMP agencies. (DMMO, 2016)

The presence of functioning commercial and industrial activities at the South Harbor prevented the proposed project being screened at Tier I, so sediment was collected and analyzed to be compared to the Tier 2 thresholds established by the DMMP. The chemical concentrations in sampled sediments fell below the screening levels for in-water disposal, so the material is deemed chemically suitable for unconfined in-water placement. This does not relieve the Alaska District from responsibility for determining the physical suitability of the material; i.e., the placement of up to 83,000 CYs of sand, silt, and clay must not significantly degrade the surface of the in-water disposal site by substantially altering the physical characteristics of the seafloor. This requirement is intended to insure the placement of dredged material does not smother coral reefs, complex rocky bottoms, aquatic vegetation, or other sensitive and valuable habitat types.

The estuarine waters of Thomas Bay have been tentatively identified as a suitable in-water disposal location based on analysis of remote data. The Bay is semi-enclosed and subject to alluviation from Baird's Glacier, which forms a turbid freshwater lens over the marine water of the Bay. The upper parts of the Bay are quite deep (110-140 fathoms in places) with sandy and muddy substrate. Thomas Bay is approximately 12 miles northwest of the proposed dredging site in the South Harbor and the selection of this disposal option would require barge crossings of Frederick Sound. Frederick Sound is a known disposal location and EPA coordination is on-going as well as environmental sampling of both locations for a year to determine the most suitable in-water disposal location.

7.2.2 Construction Considerations

Prior to preparing plans and specifications, a survey of the dredge areas should be performed to verify project quantities. In addition to survey work, soil borings should be obtained to confirm that the material is suitable for its selected disposal method. The nature of the obstructions identified during the 2017 survey of the South Harbor should be identified to aid in planning for proper disposal of the obstructions.

The dredging is anticipated to take 1 year to complete. Dredging activities will need to be closely coordinated with the Petersburg harbormaster in order to efficiently dredge in an active harbor. It is assumed that the dredge window will be similar to the window for the North Harbor dredging which stipulated that no in-water work will be performed between 15 March and 15 June in order to avoid the peak herring spawn and juvenile salmon out-migration and rearing activities, and when Steller sea lion and humpback whale feeding and abundance is expected to be greatest in the project area.

In order to attract a number of bidders, it is recommended that 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 dredges are characterized by the use of some form of bucket to excavate and raise the bottom material. They are not normally assigned to transport the material to the ultimate disposal area. In some cases, the dredged material can be deposited directly in-water or on the bank immediately adjacent to the dredging area. Normally, however, the mechanical dredge deposits material onto a barge for transport to the disposal site. In this way, the dredge plant can continue to produce at a rate limited by the number of barges servicing it.

Mechanical dredges are important to the dredging fleet due to their ability to remove harder material than hydraulic dredges, minimal sediment volume increase through agitation, and their separation from the transport mechanism. Mechanical dredges are classified into three subgroups according to how their buckets are connected to the dredge:

- Wire rope connected: Examples include the dragline, clamshell, sauerman, and orange-peel dredges. These dredges are frequently called “grab” or “bucket” dredges and are distinguished from the bucket ladder dredges.
- Structurally connected: Examples include the power shovel, back hoe, and excavator dredges. These dredges are frequently called “dipper” dredges.
- Chain and structurally connected: Examples include the bucket line dredge and bucket ladder dredge. These dredges differ from other mechanical dredges by dredging continuously with multiple buckets mounted on an endless chain.

A dipper dredge would likely be required due to the consistency of the clay that would be dredged from the South Harbor. The dipper dredge is essentially a power shovel mounted on a barge. Traditionally, the bucket is on the end of the "stick," which in turn is connected about midway on the boom through a pivoting carriage, and by a wire at the boom head-sheave. Like the bucket dredge, its barge normally has three spuds. Figure 21 illustrates the basic components of a dipper dredge.

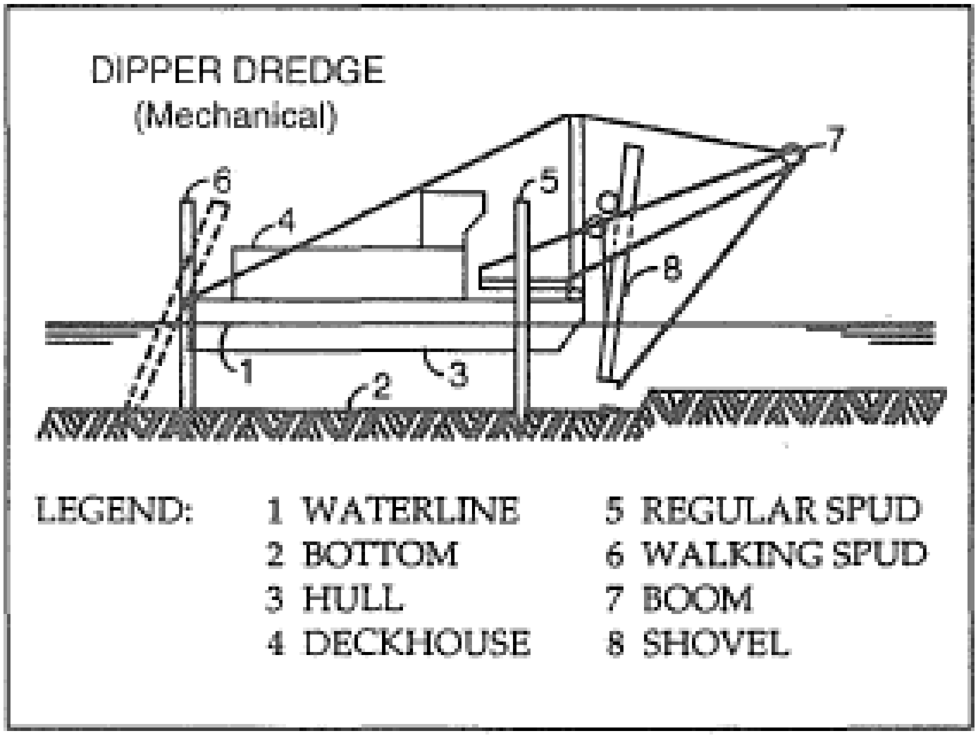

Figure 21. Basic Components of a Dipper Dredge

The dipper dredge can dig hard materials and has all the advantages of the bucket dredge, except for its deep-digging and sea-state capabilities. Because of its structural connection, it can be spotted more accurately than a wire mounted bucked.

The dipper dredge also shares the limitations of the bucket dredge. It has low to moderate capacity. It can lose capacity in light materials, but performs well in sand, gravel, rocks, and clay, including firm material. The shovel is structurally connected to the dredge, and in heavy seas would be subject to damage if and when the bucket is driven into the bottom by the dredge hull descending from a swell.

A typical sequence of dipper dredge operation is as follows:

1. The dipper dredge, barges, and attendant plant are moved to the work site by tug. (Mobilization)
2. The dredge is positioned to the point where work is to start; part of the weight is placed on the forward spuds to provide stability.
3. A barge is brought alongside and secured to the dipper dredge hull.
4. The dredge begins digging and placing the material into the barge.
5. When all the material within reach of the bucket is removed, the dredge is moved forward by lifting the forward spuds and maneuvering with the bucket and stern spud.
6. The loaded barges are towed to the disposal area and emptied by bottom if an open-water disposal area is used. They are unloaded by mechanical or hydraulic equipment if diked disposal is required.
7. This process is repeated until the dredging operation is completed.

The traditional dipper configuration has become relatively rare due to its specialized design and limited number of suitable projects.

The hydraulically actuated power shovel, or more frequently, the back hoe, has largely supplanted the traditional dipper. It performs the same functions and has the crowding action without the necessity of the heavy forward A-frame. It can change from a power shovel to a backhoe configuration or vice-versa as the job demands. They are now being produced by several manufacturers in a standard line of sizes for both landside and dredging operations.

7.2.4 Operations & Maintenance

The main source of sediment in the North, Middle, and South harbors appears to be sediment from Hammer Slough, estimated at 200 CY/year (USACE 1977). Bathymetric survey of the area indicates that the Slough flow is channelized and directed towards Middle and North Harbor. The frequency of infilling and need to dredge for this project is assumed to be similar or less than the infilling in the North Harbor. USACE dredged the North Harbor in 1971 and, 42 years later, in 2013 maintenance dredging removed approximately 27,000 cubic yards of material.

7.2.5 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 contribute to a more sustainable economy fostered by commercial fishing. The without-project condition sees continued vessel delays and loss of revenue negatively impacting Petersburg’s economy and commercial and subsistence lifestyles. By dredging South Harbor, these negative impacts on the fishing fleet can be reduced.

Proactively consider environmental consequences of all Corps 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. These actions include best practices during construction to avoid impacts to migration and spawning activities.

Create mutually supporting economic and environmentally sustainable solutions: The recommended plan is the National Economic Development plan and therefore provides the maximum amount of benefits to the nation. The project was formulated in a way that makes it lasting, requiring limited maintenance, and avoids long term environmental impacts wherever possible.

Continue to meet our corporate responsibility and accountability under the law for activities undertaken by the Corps which may impact human and natural environments: A full environmental assessment will be conducted as required by the National Environmental Policy Act. In addition, the principles of avoidance, minimization, and mitigation will be enacted to the extent possible.

Consider the environment in employing a risk management and systems approach throughout the life cycles of projects and programs: For this study, a systems approach was utilized to examine in-water disposal areas and categorize the species that could be impacted by the potential placement of dredge material in these areas. While the environmental sampling efforts will continue into D&I, the environment was considered throughout the formulation process.

Leverage scientific, economic and social knowledge to understand the environmental context and effects of Corps actions in a collaborative manner: The Corps worked closely with the Petersburg Borough throughout this study. The Borough is very knowledgeable about the environment surrounding South Harbor, Frederick Sound and Thomas Bay. In addition, the Corps reached out to the EPA in order to discuss the in-water disposal options and subsequent sampling efforts to determine that the correct measures were being taken to access these areas. Additional coordination took place with other federal and state agencies during the preparation of the draft Environmental Assessment.

Employ an open, transparent process that respects the views of individuals and groups interested in Corps activities: The Corps 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 the study started to gain feedback from commercial fishermen, the Borough, and stakeholders on what problems South Harbor faces and the impacts to commercial and subsistence activities. The group defined objectives, opportunities and constraints for the study and discussed alternative ideas that the team later screened and used to develop the final array of alternatives discussed in section 5.4.

7.2.6 Cultural Resource Consequences

Concurrence regarding the proposed activity’s effect on cultural resources will be obtained from the Alaska SHPO once a disposal area for the dredged materials is selected and prior to project construction, in keeping with the Alaska District’s standard operating procedure. It is unlikely that any cultural resources would be affected by any variations of the proposed project. Two known cultural resources are within the APE of the proposed dredging location (PET-200 and PET-529); however, both are historic watercraft which could be moved so as to not be affected by the dredging. Underwater investigation via waterproof camera and a remote operated underwater vehicle at locations throughout the South Harbor have documented no significant resources within the limits of the survey area, and it is unlikely that any unknown cultural resources exist within the limits of the dredge area.

7.2.7 Mitigation Measures

“Mitigation” is the process used to avoid, minimize, and compensate for environmental consequences of an action. Incorporating the following mitigation measures and conservation measures into the recommended corrective action will help to ensure that no significant adverse impacts would occur to EFH and EFH-managed species/species complexes and other fish and wildlife resources in the project area.

- The proposed action shall cease in-water construction between March 15 and June 15 during peak herring spawning activities, juvenile salmon outmigration and rearing activities, and when Steller sea lion and humpback whale feeding and abundance is expected to be greatest in the project area.
- To minimize the danger to marine mammals from project-related vessels, speed limits (e.g. less than 8 knots) shall be imposed on vessels moving in and around the project area.
- Project-related vessels and barges shall not be permitted to ground themselves on the bottom during low tide periods, unless there is a human safety issue requiring it.
- A construction oil spill prevention plan shall be prepared.
- Project-related vessels shall not travel within 3,000 feet of designated Steller sea lion critical habitat (haulouts or rookeries).
- USACE will conduct post-dredge bathymetry surveys to ensure that only the material identified to be dredged was removed to the authorized depth.
- A scow barge will be loaded so that enough of the freeboard remains to allow for safe movement of the barge and its material on the route to the offloading site to be identified.

7.3 Real Estate Considerations

There are no identified real estate issues that will prevent a project in this location at this time (Appendix G).

7.4 Summary of Accounts

Plan formulation was performed for this study with a focus on contributing to NED with consideration of all effects, beneficial or adverse, to each of the four evaluation accounts identified in the P&G. Plan selection was based on a weighting of the projected effects of each alternative on the four evaluation accounts. The PDT reviewed qualitative and quantitative information for major project effects and for major potential effect categories.

7.4.1 National Economic Development

Net benefits and the benefit cost ratio 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 benefit cost ratio is determined by dividing average annual benefits by average annual costs. Under all benefit scenarios considered, Alternative 3 is economically justified with a benefit cost ratio ranging from 1.2 to 4.5, and net annual benefits of $95,000 to $1.4M. The most likely BCR is 2.77 with net annual benefits of $698,000.

7.4.2 Regional Economic Development

Economic benefits that accrue to the region but not necessarily the nation include increased income and employment associated with the construction of a project. Regarding construction spending, further analysis of regional economic benefits is detailed in the RED analysis section this appendix. The RED analysis includes the use of regional economic impact models to provide estimates of regional job creation, retention, and other economic measures such as sales, or value added. Each alternative has a positive effect on RED commensurate with its construction expenditure.

7.4.3 Environmental Quality

Environmental Quality displays the non-monetary effects of the alternatives on natural resources and is described more fully in the environmental assessment sections of the draft feasibility report.

7.4.4 Other Social Effects

The categories of effects in the Other Social Effects (OSE) account include urban and community effects; life, health, and safety factors; displacement; long-term productivity; and energy requirements and energy conservation. OSE can be either beneficial or adverse (positive/negative) depending on the standard being measured.

Construction of this project in Petersburg supports the local economy and provides income to a small community. This injection of income to the Petersburg Borough allows for the provision of social services to the community, increasing community viability and quality of life. Enhanced revenue to local businesses provides incentive to hire additional personnel, providing income stability to more of the local citizenry.

7.4.5 Four Accounts Evaluation Summary

Based on this analysis of the four accounts, each alternative has positive effects for the RED and OSE accounts, and temporary negative effects for the EQ account. Based on its preference in the NED account, the TSP for this study is Alternative 3. Table 36 shows a summary of the four accounts for all alternatives, with the TSP highlighted in yellow.

Table 36. Four Accounts Evaluation Summary

Alternative	Net Annual NED Benefits (B/C Ratio)	EQ	RED	OSE
2	($993,000) 0.57	Negative (temporary)	Increased employment and income for the region and state	Beneficial
3	($698,000) 2.77	Negative (temporary)	Increased employment and income for the region and state	Beneficial
4	($858,000) 1.45	Negative (temporary)	Increased employment and income for the region and state	Beneficial
5	($546,000) 0.84	Negative (temporary)	Increased employment and income for the region and state	Beneficial

Notes:

1. This table shows net benefits and benefit–cost ratios for the “most likely” benefit scenario considered, which was estimated through Monte Carlo simulations. The BCR for Alternative 3 ranges from 1.2 to 4.5 based on the portion of vessels affected during low-tide cycles, with a most likely BCR of 2.77. See the Risk and Sensitivity section for details.

7.5 Risk & Uncertainty

In any planning decision, it is important to take into account 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. Figure 22 shows the risk items identified by category: high, medium and low.

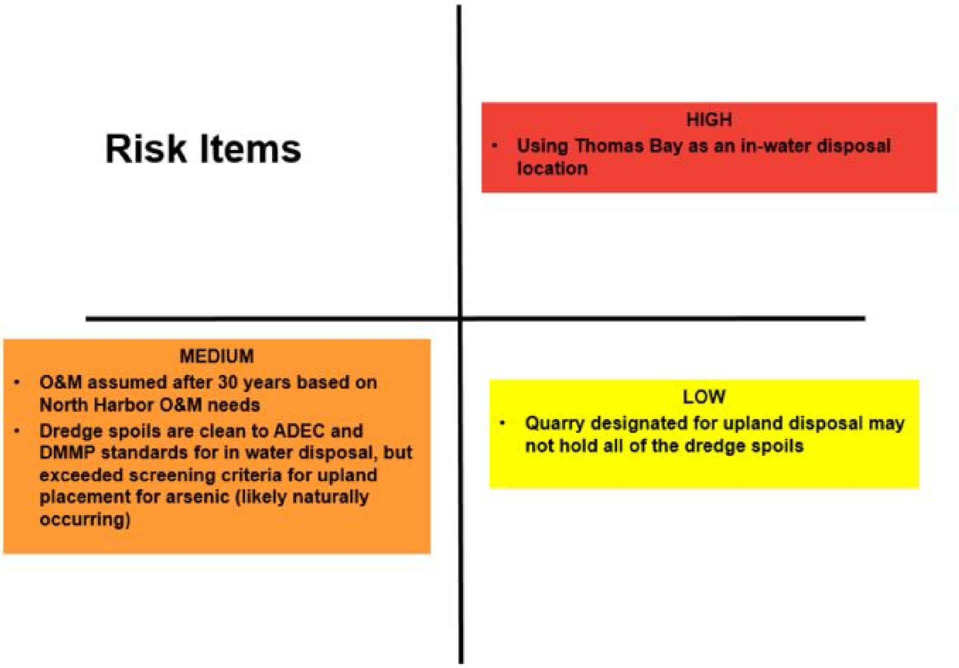

Figure 22. Risk Items

Environmental sampling took place in August of 2018 and will continue seasonally for one year with a completion date of May 2019. The high risk item will be reduced at that time once an in-water disposal location is determined. Frederick Sound is also being looked at as a possible disposal location and has been used historically as an active disposal area. Coordination with the EPA is on-going.

7.6 Cost Sharing

The recommended plan will be cost shared 90% Federal and 10% non-Federal. The initial construction cost of the general navigation features (GNF) is 90 percent for the initial Federal investment and 10 percent for the initial local share because the natural controlling depth of the project, defined in the case as "the shallowest portion of the channel that allows access to the mooring area" is shallower than -20 feet MLLW. The non-Federal sponsor must also contribute an additional 10 percent, plus interest, during a period not to exceed 30 years after completion of the GNF construction. The sponsor will be credited toward this 10-percent cost with the value of LERR necessary for construction, operation, and maintenance of the GNF. Table 37 shows the cost apportionment for the recommended plan.

Table 37. Federal/Non-Federal Initial Cost Apportionment for the Recommended Plan

Description	**Total Cost <20 Feet**	**Federal Share 90%**	**Non-Federal Share 10%**
Mobilization/Demobilization	$1,327,000	$1,194,000	$133,000
Dredging-In-water disposal			
Navigation Buoys	$20,000	$18,000	$2,000
Marker Buoys	$10,000	$9,000	$1,000
Dredge Entrance Channel to -19.25 ft MLLW (GNF)	$2,159,000	$1,943,000	$216,000
Dredge Maneuver Channel to -18 ft MLLW (LSF)	$1,349,000	$0	$1,349,000
Dredge Commercial slips to -18 ft MLLW (GNF)	$99,000	$89,000	$10,000
Dredge Subsistence slips to -10 ft MLLW (LSF)	$525,000	$0	$525,000
Dredge sump area to -9 ft MLLW (LSF)	$77,000	$0	$77,000
Surveys			
Hydrographic Surveys for Harbor	$186,000	$167,000	$19,000
Hydrographic Surveys for Disposal Area	$36,000	$32,000	$4,000
PED	$1,400,000	$1,260,000	$140,000
SIOH	$746,000	$671,000	$75,000
Subtotal Construction Costs:	$7,934,000	$5,383,000	$2,551,000
LERR Administrative Costs	$24,000	$0	$24,000
Total Project First Cost:	**$7,958,000**	**$5,383,000**	**$2,575,000**
10% over time adjustment (less LERR)	$772,000		$772,000
Final Allocation of Costs	**$7,958,000**	**$4,611,000**	**$3,347,000**

8. ENVIRONMENTAL CONSEQUENCES*

8.1 Physical Environment

8.1.1 Water Quality and Circulation Patterns

Future development, construction activities, and other foreseeable future projects, in combination with population growth within and adjacent to the project area, would produce changes in the amount of impervious surfaces and associated runoff in and around the harbor and adjacent watersheds. However, all projects are required to adhere to local, State, and Federal stormwater control regulations and best management practices, which are designed to limit surface water inputs. For all alternatives, the placement of dredged material from the South Harbor is expected to be a single event due to the limited sedimentation rate of the Harbor, so regardless of the eventual disposition of the dredged material from the proposed project a recurring need for disposal is not expected to occur. The proposed in-water disposal location would be certified for a single project and not be available for future dredging in the Petersburg area.

8.2 Biological Resources

Biological resources include fish and wildlife, vegetation, wetlands, Federal threatened and endangered species, other protected species. While historic development within and adjacent to the study area has caused some loss of aquatic habitat, these actions occurred in a regulatory landscape that is different from today. While future development will likely have localized impacts on these resources, under the current regulatory regime these resources are unlikely to suffer significant losses. Any future Federal actions would require additional evaluation under the National Environmental Policy Act at the time of their development. As explained under Baseline Conditions (Section 3.2), the project area can be viewed as 3 distinct areas for purposes of environmental analyses; proposed area for reorganizing the floats, proposed area where dredging may occur, and potential in-water disposal locations.

Environmental consequences for Alternatives 2 and 3 are listed below. These were the construction alternatives carried forward into detailed analysis. Alternative 2 is explained under Float Reorganization Footprint and Alternative 3 is explained under Dredge Footprint or combined, as appropriate. In-water disposal location refers to the areas in Frederick Sound or Thomas Bay where dredge material could potentially be placed. As stated in Section 3.2, Frederick Sound had been used before as a disposal option. As a result, Thomas Bay and Frederick Sound were carried forward as a potential open-water disposal sites for purposes of NEPA analyses. Alternatives 4 and 5 were removed from further consideration and, therefore impacts of alternatives which included Scow Bay were not analyzed. The No-Action Alternative would not result in any impacts to biological resources.

8.2.1 Marine Habitat

8.2.1.1 Birds

Dredge and Float Reorganization Footprint. Primary activities possibly affecting local avian populations within and in proximity to the study area are the to-and-from mobilization of construction equipment, vessels and personnel, and dredging. Vessels moving through the area to access the harbor could displace waterfowl and sea ducks within their intended course. Vessel lights could become an attractive nuisance causing bird collisions and subsequent injury or death; however, there is more potential for environmental impacts associated with vessels relating to the effects of petroleum compounds and other hazardous materials spills. The effects of fuel spills on avian populations are well documented, as direct contact and mortality is caused by ingestion during preening as well as hypothermia from matted feathers. The displacement of local avian populations from the study area during construction would be short-term. Overall, USACE believes that the recommended corrective action would not have a long-term effect on local avian populations. No significant adverse impacts are expected.

In-water Disposal Location. The depth of the water in the proposed disposal locations would likely preclude direct impacts to birds from the discharge. The sediment would release a plume of turbidity as it passes through the water column, but the ambient turbidity level is high due to the glacial alluvium at Thomas Bay and Frederick Sound and the discharge of dredge spoils would not measurably contribute to suspended sediment.

8.2.1.2 Marine Fish

Dredge and Float Reorganization Footprint. Transitional dredging or reorganizing floats would have little direct effect on mature fish inhabiting the project area, as their mobility allows them to avoid construction activities (e.g. mechanical dredging, generated turbidity, vessel movements, and underwater construction noise). No long-shore movements of juvenile fish would be disrupted by maintenance dredging.

Per the 1996 amendments to the MSFCMA, USACE has initiated consultation and coordination with the NMFS regarding the potential effects of the recommended corrective action on EFH. Impacts from implementation of project alternatives would result in short-term alterations of EFH for marine species and species such as rockfish, flatfish, gadids, salmonids. There would also be short-term impacts on forage fish such as capelin and sand lance as well as for species such as Pacific herring that are important prey for species with designated EFH. USACE concludes that its' Federal action may affect, but is not likely to adversely affect, EFH and EFH-managed species/species complexes for Gulf of Alaska groundfish and Alaska stocks of Pacific salmon. See Appendix D for the USACE EFH assessment.

8.2.1.3 Marine Mammals

Dredge Footprint. Construction noise, construction vessel traffic, and construction-generated turbidity related to maintenance dredging would temporarily and indirectly disturb marine mammals near the site. Airborne noise would be generated by the operation of heavy equipment, and waterborne noise would be generated by work boats and the clamshell dredge. At levels of sound resulting from the work activities, expected to be less than 150 dB re 1 uPa, the primary reaction of marine mammals is likely to be to move away from the work area during the construction period. Similarly, the noise generated by barges and tugs in transit to or from the work area from other locations in Southeast Alaska would be similar to that generated by routine small vessel traffic in the shipping lanes. Low levels of turbidity would be generated by dredging and placing the material on the barge in the marine environment, causing marine mammals to temporarily avoid the area until such time that the construction-generated plume dissipates to background levels. Overall, the USACE project would likely cause marine mammals that would otherwise be present in the vicinity to move away from the area temporarily during construction, but would not likely produce significant long-term harm to any species.

Float Reorganization Footprint. Airborne noise would be generated by the operation of equipment, and waterborne noise would be generated by work boats. At levels of sound resulting from the work activities, expected to be less than 150 dB re 1 uPa, the primary reaction of marine mammals is likely to be to move away from the work area during the construction period. The noise generated by barges and tugs in transit to or from the work area from other locations in Southeast Alaska would be similar to that generated by routine small vessel traffic in the shipping lanes. Overall, the USACE project would likely cause marine mammals that would otherwise be present in the vicinity to move away from the area temporarily during periods of higher vessel activity and movement within the harbor, but would not likely produce significant long-term harm to any species.

In-water Disposal Location. The discharge of dredged materials in Thomas Bay or Frederick Sound would not likely directly impact marine mammals present in that area due to the depth of the water and dominant feeding patterns of the marine mammals found in the area; none of the mammals listed in Table 6 are deep-diving benthic feeders. Second order impacts to marine mammals could be manifested through trophic levels if the placement of dredged materials in Thomas Bay has a significant impact on the benthic productivity. For example, if low trophic level organisms such as polychaetes are significantly impacted, the nutrient availability in the system could be reduced and impact animals higher in the food chain such as marine mammals. Mammals could be impacted by the transportation of dredged materials to the disposal location through vessel strikes, but this is unlikely given the low speed of the barges that would service the project.

8.2.1.4 Marine Invertebrates

Dredge Footprint. Sessile invertebrates such as the urchins and anemones within the dredge prism would likely be killed or injured by the proposed project due to their inability to move out of the project area during dredging. The consistency of the substrate would also be significantly altered by the removal of the upper section of the seafloor. The underlying clay would be exposed and alter the physical characteristics of the area. The newly exposed clay would be difficult to colonize by benthic invertebrates due to the lack of interstitial areas or voids. Epifauna may also find the area lacking in suitable attachment structure. Post construction invertebrate habitat would be poor quality.

Motile invertebrates such as crabs would likely vacate the area during construction, but some animals could be killed by construction or turbidity. The harbor area did not appear to be heavily used by motile invertebrates during the November 2017 USACE site visit.

Float Reorganization Footprint. This non-structural alternative does not aim to disturb the substrate nor create any turbidity in excess of increased vessel traffic. Overall, it is not anticipated that any marine invertebrates would be disturbed during the reorganization of the float system.

In-water Disposal Location. Benthic invertebrates inhabiting the seafloor in the proposed in-water disposal areas are those species adapted for life in deep water (greater than 600 feet) and high rates of inorganic deposition. The physical characteristics of the seafloor are unknown beyond the rough indications given on the nautical chart, which indicates mud and sand with “hard” and “soft” modifiers applied in areas.

Based on the uses of the outer portion of Thomas Bay, an understanding of the depths of the proposed disposal areas, and inferences regarding the physical nature of the substrate, it is likely red king crabs, tanner crabs, and shrimp would be impacted by the in-water disposal of dredged material. The primary impact would be direct physical injury caused by the impact of the dredged material on benthic epifauna. Infaunal impacts would also occur; the placement of thousands of cubic yards of sand, silt, and clay would entomb organisms living in the seafloor. The physical nature of the substrate would be temporarily altered by the placement of the dredged material; the existing hard or soft mud and sand would be replaced by a fairly well-sorted epipedon composed of clay masses, sands, and silts from the dredge prism. Due to the rapid rate of glacial alluvium accretion at Thomas Bay, this alteration would be temporary. The silt from Baird Glacier would likely return the seafloor to its pre-project consistency within a couple of year.

8.2.2 Federal & State Threatened & Endangered Species

8.2.2.1 Environmental Consequences of the Proposed Action

Section 7 of the ESA requires that any action by a Federal agency shall ensure that its actions are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of habitat of such species.

The following NMFS-managed ESA species may occur in the project area: humpback whale (threatened); Steller sea lion (endangered western population overlap). The two DPSs of humpback whale likely to be encountered in Southeast Alaska and Northern British Columbia are the unlisted Hawaii DPS and threatened Mexico DPS. Humpback whales in the project area are expected to be represented by the unlisted Hawaii DPS 93.9% of the time and the threatened Mexico DPS 6.1% of the time.

Project construction activities would result in temporary alterations to habitat used by Steller sea lions in the project area. Vessel noise and transit associated with construction activities have the potential to cause avoidance, disturbance, or displacement of Steller sea lions and humpback whales from the Petersburg area during peak Pacific herring spawning activities when Steller sea lions and humpback whales feed on staging and spawning adult herring. Therefore, USACE has proposed to cease in-water construction during peak Pacific herring spawning activities (between March 15 and June 1). Construction activities outside this period coincide with periods when a minimum quantity of marine mammals is present. Additionally, speed limits would be imposed on construction vessels moving between the project area and material suppliers to mitigate the danger of vessel-marine mammal collisions.

USACE believes that the proposed action: (1) would not modify or adversely affect designated critical habitat; and (2) may affect, but is not likely to adversely affect, humpback whales or Steller sea lions.

8.2.2.2 Environmental Consequences of the No Action Alternative

The selection of the No-Action Alternative would incur no new impacts to protected resources.

8.2.3 Essential Fish Habitat

The USACE assessment of its project on EFH is similar to (FAA, 2009), as the FAA project is adjacent to the USACE project area in Sitka and includes similar features, such as fill placed in the marine near- shore environment and construction activities.

The types of impacts that would possibly affect EFH species/species complexes (five Pacific salmon species, the sculpin complex, and several species of flatfish, rockfish, and forage fish) known or highly likely to occur within the project area are separated into short-term and long-term impacts.

Short-term impacts include: water quality impacts in the form of increased levels of turbidity resulting from fill and rock placement and oil/grease releases from work vessels and equipment; noise disturbance from operation of heavy equipment, cranes, or barges; and disturbance from increased construction-related work boat traffic in the project area and along supply routes.

No long-term impacts are expected.

8.3 Subsistence

There is no indication that any reasonably foreseeable future action in the vicinity of the proposed deepening project would contribute to cumulative impacts on subsistence resources.

8.3.1 Environmental Consequences of the Recommended Plan

The Alaska Native Interest Lands Conservation Act identifies three factors related to subsistence uses as items affected by changes in management activities or land uses: resource distribution and abundance; access to resources; and competition for the use of resources. Subsistence resources, such as marine plants and animals affected primarily by the various alternatives are predominantly food resources collected for primary diet, customary and traditional practices, or to supplement other existing food resources.

Transition dredging on the sea floor within the harbor would temporarily affect local fishing within the harbor. Short-term impacts to fish occurring within the harbor would be minimal, as dredging temporarily increased turbidity within the harbor. However, due to tidal currents, water conditions would likely return to normal within a couple of hours following dredging activity. USACE is unaware of any herring-spawn harvesting within the harbor at Petersburg; however, should it occur, the impacts on that activity would be short term. In conclusion, USACE believes that there would be no anticipated significant impacts to marine-related subsistence resources or access to and competition for subsistence resources from the corrective action.

The proposed deepening project could increase the commercial fishing activity in Petersburg and in doing so, increase the pressure on subsistence fishing in the region. The Alaska District does not have an expectation that this increase in commercial fishing would have a significant impact on subsistence fishing.

8.3.2 Environmental Consequences of the No-Action Alternative

The No-Action Alternative would not incur any new impacts to subsistence resources.

8.4 Cultural and Historic Resources

The harbor has been dredged in the past. No cultural and historic resources are expected to be impacted by the proposed dredging action. The Thomas Bay disposal area has been screened for cultural resources. An alternative upland disposal location has not been identified, so an impacts determination would be premature as of this writing. No cultural and historic resources are expected to be impacted by the proposed dredged material placement action. Reasonably foreseeable future actions within and adjacent to the developed project area are subject to review and approval by the State Historic Preservation Officer, and would be anticipated to have minor impacts, if any, on cultural resources.

8.5 Socio-economic

The proposed action and future USACE maintenance dredging activities would alleviate shoaling impacts to navigation and would not change the type or quantity of goods shipped or the type or size of commercial vessels transiting the harbor. Waterborne commerce would remain an important component of the local and regional economy. Some short-term interference to recreational and commercial traffic could occur during proposed and future dredging and material placement activities, including USACE maintenance dredging of the harbor and any future dredging that may be recommended. However, these conflicts are expected to be an inconvenience rather than a direct impact to commercial and recreational activity.

8.6 Environmental Justice and Protection of Children

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," requires Federal agencies to identify and address any disproportionately high and adverse human health effects of its programs and activities on minority and low-income populations. The footprint of the project, route to the disposal area, and the disposal area itself are located in marine waters and not low income areas or zones utilized by children. The impacts of the proposed projects are not disproportionately impactful to resources utilized by low-income individuals or children.

8.7 Unavoidable Adverse Impacts

There are no unavoidable adverse impacts associated with this project. All impacts associated with this project are expected to be less than significant and temporary in nature.

8.8 Cumulative & Long-term Impacts

Federal law (40 CFR 651.16) requires that NEPA documents assess cumulative effects, which are the impact on the environment resulting from the incremental impacts of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time. The past and present actions that have occurred within and adjacent to the harbor project area are identified below. Together, these actions have resulted in the existing conditions of the project area (see Section 1.1).

- 1984-The original harbor project was constructed
- 2002-Expansion of the South Harbor was completed by the City of Petersburg, including the construction of a sheetpile bulkhead drive-down dock to contain sediment exceeding in-water disposal standards

The reasonably foreseeable future actions under consideration in this analysis are identified below. The list includes relevant foreseeable actions within and adjacent to the harbor, including those by USACE, other Federal agencies, State and local agencies, and private and commercial entities.

- Continued operation and maintenance of the harbor to the various design depths plus 1 foot of overdepth.
- Continued use and development of the project area, including areas adjacent to the harbor for commercial, industrial, and residential uses in proportion to any future increases in population within the Petersburg area.
- Continued operation and maintenance of private berths and terminals associated with the harbor.

The cumulative impacts analysis evaluated the effects of implementing the proposed action in association with past, present, and reasonably foreseeable future USACE and other parties' actions within and adjacent to the project area. Past and present actions have resulted in the present conditions in the harbor. Reasonably foreseeable future actions that have been considered included relevant foreseeable actions within and adjacent to the project area, including those of USACE, other Federal agencies, State and local agencies, and private and commercial entities. The cumulative impacts associated with implementation of the proposed action were evaluated with respect to each of the resource evaluation categories, and no cumulatively significant adverse impacts were identified.

9. PUBLIC AND AGENCY INVOLVEMENT*

The following list of agencies were contacted during the May 15, 2018 through June 15, 2018 scoping period in order to solicit input on the scope of the impacts and resources affected by the proposed project. No responses were received regarding the proposed South Harbor deepening and disposal project at the time of this writing.

- Alaska Department of Environmental Conservation, Water Quality Division
- Alaska Department of Fish and Game, Habitat Division
- Alaska Department of Fish and Game, Commercial Fishing Division
- Alaska Department of Natural Resources, Division of Land, Mining and Water
- Alaska State Historic Preservation Office

- Alaska Department of Environmental Conservation, Solid Waste Program
- 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
- City of Petersburg, Harbormaster's Office

9.1 Status of Environmental Compliance

9.1.1 Evaluation of Availability of Practicable Alternatives

USACE must evaluate alternatives that are practicable and reasonable. Practicable is defined as meaning the alternative is available, and capable of being done after taking into consideration cost, existing technology, and/or logistics in light of the overall project purpose. Reasonable is based on consideration of the project purpose as well as technology, economics and common sense. Disposal location of dredged material and dredge type were evaluated below to determine whether they are practicable and reasonable.

The dredged material from the South Harbor meets in-water disposal standards, so in-water placement is a practicable alternative from a technological and logistic perspective. Contemporary estimates regarding the cost of upland disposal increase the total project cost from an in-water disposal estimate of $7.96 million to approximately $9.6 million (not including construction of a containment facility), so upland disposal is not a practicable alternative from a cost perspective.

The remaining options are mechanical bucket dredging versus suction dredging. The relatively small area to be dredged, consolidated nature of the clay material, and the restricted confines of the harbor basin, would probably necessitate the use of a bucket dredge. A suction dredge may loft less sediment during sediment removal, but would generate a slurry of much higher water content that would then need to be managed and dewatered at the scow. It is not likely that the use of suction dredging would result in lesser impacts to water quality. The use of a closed-top bucket during dredging may result in less fallback and out-wash of sediment, and therefore, limit the impact on water quality.

9.1.2 Compliance with Applicable State Water Quality Standards

The Alaska District has been in coordination with the ADEC Water Quality Division regarding the proposed project. Final determination regarding compliance with State water quality standards cannot be completed until the disposal location is identified, but the Alaska District expects the State to certify the discharge as compliant with water quality standards under Section 401 of the Clean Water Act. The USFWS will provide a Planning Aid Letter (PAL). No Coordination Act Report (CAR) is anticipated. Reference Appendix D for the EFH analysis. Appendix F states the evaluation under Section 404(b)(1) Clean Water Act 40 CFR Part 230 and additional correspondence.

9.1.3 Compliance with Endangered Species Act of 1973

The proposed action is not expected to harm any threatened or endangered species or their critical habitat. There would be no direct impacts to critical habitat and the proposed mitigation measures would prevent impacts to endangered Steller sea lions or threatened humpback whales. USACE will obtain concurrence from the NMFS Protected Resource Division regarding the determination the proposed project may affect, but is not likely to adversely affect, ESA listed species or their critical habitat after the project design reaches the level of detail and specificity required for concurrence to be granted. This detail includes the timing and duration of the project, type of equipment, and disposal location.

9.1.4 Compliance with Specified Protection Measures for Marine Sanctuaries Designed by the Marine Protection Research and Sanctuaries Act of 1972

No action associated with the proposed project would violate the above Act. USACE is evaluating a disposal location in ocean waters and would prepare a site selection study under Section 103 to submit to the US EPA if the potential ocean waters locations is selected.

9.1.5 Evaluation of Extent of Degradation of the Waters of the United States

There would be no significant adverse impacts to municipal and private water supplies, recreation and commercial fisheries, plankton, fish, shellfish, wildlife and/or aquatic sites caused by the proposed action. There would be no significant adverse effects on regional aquatic ecosystem diversity, productivity, and/or stability caused by the placement of the fill material nor would there be significant adverse effects on recreation, aesthetic, and/or economic values caused by this project.

9.1.6 Appropriate and Practicable Steps Taken to Minimize Potential Adverse Impacts of the Discharge on Aquatic Ecosystems

All appropriate and practicable steps would be taken to minimize potential adverse impacts of the discharge on the aquatic ecosystem. Those steps include timing of dredging and disposal activities to avoid species of concern, selecting the dredging method that results in the smallest amount of re-suspension, and incorporating best management practices and mitigation measures into the project design and construction contract.

The proposed discharge will be reviewed for compliance with the Guidelines for Specification of Disposal Sites for Dredged or Fill Material (40 CFR part 230) upon identification and characterization of a dredged material disposal location and is expected to be found in compliance due to the chemical and physical properties of the sediments. The ADEC Water Quality Division has been engaged regarding the proposed dredging project and has no objection at this stage of project development. A Section 401 Water Quality Certificate of Reasonable Assurance will be obtained prior to dredging and disposal.

9.2 Views of the Sponsor

The Petersburg Borough supports the findings of this study and understands the cost share for design and construction of the proposed project.

10. PREPARERS OF THE ENVIRONMENTAL ASSESSMENT

This consideration of environmental impacts report was prepared by Matt Ferguson of the Environmental Resources Section, Alaska District, U.S Army Corps of Engineers. The Corps Planner and Project Manager is Amber Metallo.

11. CONCLUSIONS & RECOMMENDATIONS

11.1 Conclusions

The proposed deepening of the South Harbor would not constitute a significant impact to the quality of the human environment because the harbor area is already developed and the proposed activity would be merely deepening. The dredged material has been tested and found to contain concentrations of environmental contaminants below the screening levels provided in the DMMP and so determined suitable for unconfined in-water disposal. The newly exposed surface of the seafloor predates anthropogenic influences, so the dredging would not expose any contamination. The disposal of dredged material in-water in either Thomas Bay in accordance with 40 CFR 230-Section 404(b)(1) guidelines for the placement of dredged or fill material in waters of the United States or in Frederick Sound Disposal Area in accordance with the site selection study and Ocean Dumping Permit issued by the US EPA under Section 103 of the MPRSA will be determined in PED.

11.2 Recommendations

In view of the conclusions just presented, it is recommended that Alternative 3 be approved as the recommended plan.

I recommend that the navigation improvements at Petersburg, Alaska be constructed generally in accordance with the plan herein, and with such modifications thereof as at the discretion of the Chief of Engineers may be advisable at an estimated total Federal cost of $7.96M and $95,000 annually for Federal maintenance provided that prior to construction the non-Federal partner agrees to the following:

a. Provide, during the period of design, 10 percent up-front for design costs allocated by the Government to navigation features in accordance with the terms of a design agreement entered into prior to commencement of design work for the project; and provide, during the first year of construction, any additional funds necessary to pay the full non-Federal share of design costs allocated to the Government for general navigation features (GNF) navigation features in accordance with the cost sharing as set out in paragraph b., below;

b. Provide, during construction, 10 percent of the total cost of construction of the navigation features. The Non-Federal Sponsor is also responsible for providing an additional 10 percent of total construction costs of the general navigation feature up to 30 years upon completion of construction.

c. Provide all lands, easements, and rights-of-way, and perform or ensure the performance of all relocations determined by the Federal Government to be necessary for the construction or operation and maintenance of the general navigation features:

d. Accomplish all removals determined necessary by the Federal Government other than those removals specifically assigned to the Federal Government;

e. Shall not use funds from other Federal programs, including any non-Federal contribution required as a matching share thereof, 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 expenditure of such funds for such purpose is authorized;

f. Comply with all applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended (42 United States Code 4601-4655), and the Uniform Regulations contained in 49 Code of Federal Regulations Part 24, in acquiring lands, easements, and rights-of-way required for construction of the navigation features, including those necessary for relocations, the borrowing of materials, or the disposal of dredged or excavated material and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

g. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal partner owns or controls for access to the project for the purpose of inspecting the navigation features;

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

i. Keep and maintain books, records, documents, or other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, or other evidence are required, to the extent and in such detail as will properly reflect total costs of construction of the navigation features, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations Section 33.20;

j. Comply with all applicable Federal and State laws and regulations, including, but not limit to: Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 United States Code 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7 entitled “Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army”; and all applicable Federal labor standards requirements including, but not limited to, 40 United States Code 3141-3148 and 40 United States Code 3701-3708 (revising, codifying and enacting without substantial change the provisions of the Davis-Bacon Act (formerly 40 United States Code 276a *et seq.*) the Contract Work Hours and Safety Standards Act (formerly 40 United States Code 327 *et seq.*) and the Copeland Anti- Kickback Act (formerly 40 United States Code 276c *et seq.*);

k. Perform, or ensure performance of, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act, Public Law 96-520, as amended (42 United States Code 9601-9675), that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction of the navigation features;

l. Assume, as between the Federal Government and the non-Federal partner, complete financial responsibility for necessary cleanup and response costs of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act that are located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction of the navigation features;

m. To the maximum extent practicable, perform its obligations in a manner that will not cause liability to arise under the Comprehensive Environmental Response, Compensation, and Liability Act; and

n. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 United States Code 1962d-5b), and Section 101(e) of the Water Resources Development Act of 1986, Public Law 99-662, as amended (33 United States Code 2211), which provides that the Secretary of the Army shall not commence the construction of any water resources project, or separable element thereof, until each non-Federal partner has entered into a written agreement to furnish its required cooperation for the project or separable element.

The recommendations for implementation of navigation improvements at Petersburg, Alaska reflect the policies governing formulation of individual projects and the information available at this time. They do not necessarily reflect the program and budgeting priorities inherent in the local and State programs or the formulation of a national civil works water resources program. Consequently, the recommendations may be changed at higher review levels of the executive branch outside Alaska before they are used to support funding.

NOTE ON THE INFORMATION PRESENTED IN THIS DOCUMENT
The information contained herein reflects the policies governing formulation of individual projects and the information available at this time. It does not necessarily reflect program and budgeting priorities inherent in the local and state program or the formulation of a National Civil Works Construction Program. Consequently, the recommendations may be modified before they are implemented.

________________________________ ______________________

Phillip J. Borders Date
Colonel, U.S. Army
Commanding

12. REFERENCES

Alaska Department of Commerce, Community, and Economic Development (Community Database). 2018. Community Database Online, Petersburg. Online document, accessed February 15, 2018.

Alaska Department of Transportation and Public Facilities, Bridge Section (ADOT&PF). 2017. 2017 Bridge Inventory Report, State of Alaska, Department of Transpiration Bridge Section, Juneau, AK.

Alaska Heritage Resources Survey (AHRS). 2018. AHRS Database. Alaska Office of History and Archaeology.

American Society of Civil Engineers Task Committee on Maninas. 2012. Planning and Design Guidelines for Small Craft Harbors, Revised Edition. New York: American Society of Civil Engineers.

ASCE Task Committee on Marinas 2020. 2012. Planning and Design for Small Craft Harbors: Third Edition. ASCE.

Black, Lydia. 2004. Russians in Alaska: 1732-1867. University of Alaska Press, Fairbanks, Alaska.

Bureau of Ocean Energy Management (BOEM). 2011. Alaskan Shipwrecks Table. Online document, https://www.boem.gov/Alaska-Coast-Shipwrecks/, accessed January 17, 2018.

Crowell, Aron L. and Wayne K. Howell. 2013. Time, Oral Tradition, and Archaeology at Xakwnoowu, A Little Ice Age Fort in Southeastern Alaska. Cambridge University Press 78(1): 3-23.

Davis, Stanley D. 1990. Prehistory of Southeastern Alaska. In Handbook of North American Indians, Volume 7, Northwest Coast, Pp 197-202, Wayne Suttles and William C. Sturtevant eds. Smithsonian Institution, Washington.

De Laguna, Frederica. 1960. The Story of a Tlingit Community: A Problem in the Relationship between Archaeological, Ethnological, and Historical Methods. Smithsonian Institution, Bureau of American Ethnology Bulletin 172. United States Government Printing Office, Washington.

De Laguna, Frederica. 1990. Tlingit. In Handbook of North American Indians, Volume 7, Northwest Coast, Pp 203-228, Wayne Suttles and William C. Sturtevant eds. Smithsonian Institution, Washington, D.C.

Dredged Material Management Office (DMMO), US Army Corps of Engineers, Seattle District. 2016. Dredged Material Management Program. August 2016.

Esposito, Gina S. 2003. A Cultural Resource Investigation of the Mitkof Highway Coastal Path Project Area, Mitkof Island, Alaska. USDA Forest Service, Tongass National Forest, Petersburg Ranger District, Project R20041005210002.

Federal Aviation Administration. 2009. Final Environmental Impact Statement. Sitka Rocky Gutierrez Airport, Sitka, Alaska. Anchorage, AK. May. http://www.sitkaeis.com/feis.htm.

Guimary, Donald L. 1983. Salmon Canneries in Southeast Alaska: A Documentation of Selected Historic Salmon Canneries and Cannery Sites. AHRS Document Repository Record ID 16058767.

Kamenskii, Anatolii. 1906 [1999]. Fr. Anatolii Kamenskii Tlingit Indians of Alaska. The Rasmuson Library Historical Translation Series Volume II. Translated by Sergei Kan. University of Alaska Press, Fairbanks, Alaska.

Moss, Madonna L. 1998. Northern Northwest Coast Regional Overview. Arctic Anthropology 35(1):88-111.

Moulten, W. 2005. National Register of Historic Places Registration Form, F/V Charles W. PET-00529. AHRS Document Repository Report ID: MSH2160.

National Marine Fisheries Service (NMFS). 2005a. Essential Fish Habitat Assessment Report for the Groundfish Resources of the Gulf of Alaska Region, Appendix F.1, NMFS Alaska Region, Juneau, Alaska.

- 2005b. Essential Fish Habitat Assessment Report for the Salmon Fisheries in the EEZ off the Coast of Alaska, Appendix F.5, NMFS Alaska Region, Juneau, Alaska.

NOAA Technical Memorandum NMFS-AFSC-160. 2005. Community Profiles for North Pacific Fisheries – Alaska, December 2005. http://alaskafisheries.noaa.gov/habitat/efh.htm, February 10, 2011.

National Oceanic Atmospheric Administration (NOAA). 2018a. Wrecks and Obstructions Database. Online document, https://wrecks.nauticalcharts.noaa.gov/viewer/, accessed January 30, 2018.

National Oceanic Atmospheric Administration (NOAA). 2018b. Raster Navigational Charts (RNC) Viewer. Online document https://nauticalcharts.noaa.gov/rnconline/rnconline.html, accessed May 30, 2018.

Renaud, P.E., Wlodarska-Kowalczuk, M., Trannum, H., Holte, B., Weslawski, J.M., Cochrane, S., Dahle, S., Gulliksen, B. 2006. Multidecadal stability of benthic community structure in a high-Arctic glacial fjord (van Mijenfjord, Spitsbergen) Polar Biology. (2007) 30:295-305.

Sorensen, Conner. 1990. The M/V *Chugach*, Summary and Progress Report of her Nomination to the National Register. U.S. Forest Service, Petersburg, AK, April 6, 1990.

Sorensen, Conner, and T. Schley. National Register of Historic Places Registration Form, M/V Chugach, PET-0200. AHRS Document Repository Report ID: MSH2186.

Tides& Currents Pro, Version 3.7.0.117: Software utilized to estimate current velocities in Wrangell Narrows.

USACE, A Study of Dredging Means and Disposal Methods in Eighteen Alaskan Small Boat Harbors, September 30, 1977.

U.S Army Corps of Engineers. 1984. "EM 1110-2-1615 Hydraulic Design of Small Boat Harbors."

USACE, Technical Memorandum, Chemical and Physical Data Pertaining to Placement of Dredged Harbor Sediment at Petersburg Landfill, September 2011.

USACE, May 2001, report titled “Final Chemical Data Report, Petersburg North Harbor Maintenance Dredging, Petersburg, Alaska, USACE, May 2001.

USACE, Chemical Data Report, Petersburg Small Boat Harbor Sediment Study, Petersburg Small Boat Harbor, Petersburg, Alaska, P#2 138810 NPDL# 11-051. June 2011.

USACE, ERDC TN-DOER-E21. 2005. Silt Curtains as a Dredging Project Management Tool, current velocity limits for silt curtains, September 2005.

U.S. Army Corps of Engineers. 2008. "Coastal Engineering Manual."

U.S. Army Corps of Engineers. 1984. "Shore Protection Manual."

United Stated Department of Agriculture Forest Service (USDAFS). 2005. USDA Forest Service Alaska Region Heritage Program FY 2004 Annual Report. Prepared by the Alaska Region Heritage Team. AHRS Document Repository Record ID 16029597.

USGS. 1995. Overview of Environmental and Hydrogeologic Conditions near Petersburg, Alaska.

Worl, Rosita. 1990. History of Southeastern Alaska Since 1867. In *Handbook of North American Indians, Volume 7, Northwest Coast*, Pp 149-158, Wayne Suttles and William C. Sturtevant eds. Smithsonian Institution, Washington, D.C.

Petersburg Navigation Improvements

Appendix A: Geotechnical

Petersburg, Alaska

September 2018

US Army Corps of Engineers
Alaska District

DEPARTMENT OF THE ARMY
ALASKA DISTRICT, U.S. ARMY CORPS OF ENGINEERS
P.O. BOX 6898
JBER, AK 99506-0898

CEPOA-EN-G-GM 29 August 2018

MEMORANDUM FOR

Civil Works Project Management (CEPOA-PM-C-PL), Amber Metallo

SUBJECT: Geotechnical Data Report for Petersburg Navigation Improvements, Petersburg, Alaska.

1. Enclosed is the Geotechnical Data Report for the Petersburg Navigation Improvement project, Petersburg, Alaska. Included with the report are the Project Location and Vicinity Map, a Test Boring Location Map, geotechnical exploration logs, and a discussion of the findings of the geotechnical investigation for the project.

2. Questions should be addressed to Inocencio Roman at 907-753-2685 or John Rajek at 907-753-5695.

Inocencio J. Roman
Civil Engineer
CEPOA-EC-G-GM

SIGNED
John Rajek, P.E.
Chief, Geotechnical and Materials Section
CEPOA-EC-G-GM

SIGNED
Douglas A. Bliss, P.E., P.G.
Chief, Geotechnical and Engineering Services
CEPOA-EC-G

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Appendix C – Laboratory Test Results

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1.0 Introduction

This report documents the results of the geotechnical investigation performed for the planned dredging at the Petersburg South Harbor located in Petersburg, Alaska. The scope of the investigation was to identify surface and subsurface conditions and address geotechnical concerns of the site. This report presents a summary of the findings based on site observations and results of the field exploration and laboratory testing program.

2.0 Project Location and Description

Petersburg South Harbor is located on Mitkof Island west of the City of Petersburg and adjacent to the Wrangell Narrows Channel. The Petersburg Harbor System is divided into three parts respectively, the North Harbor, Middle Harbor, and South Harbor. This report documents geotechnical site conditions within the Petersburg South Harbor for proposed new work and maintenance dredging within the harbor basin and navigation channels to depths ranging from -9.0 to -20.0 feet mean lower low water (MLLW) respectively. A Project Location and Vicinity Map and Petersburg Harbor map are enclosed as Figure A-1 and A-2.

3.0 Existing Geotechnical Information

Peratrovich, Nottingham & Drage, Inc. (PND) performed a geotechnical site investigation which included drilling test borings within the Petersburg South Harbor in 1997 for the City of Petersburg. This field exploration effort was documented in the Geotechnical Report Petersburg South Harbor Improvements, Petersburg, Alaska, dated September 1997. The approximate locations of test borings drilled by PND in 1997 are shown on the Test Boring Location Map provided in Appendix A. For reference the 1997 PND Geotechnical Report has been included in Appendix D.

4.0 Regional Geology

The Petersburg Borough is located on Mitkof Island in southeastern Alaska which is bound by Frederick Sound to the north, Sumner Strait to the south, Scow Bay to the east and Wrangell Narrows and Petersburg Harbor to the west. Mitkof Island is one of thousands of forest-covered islands located in offshore, southeastern Alaska that make up the Alexander Archipelago.

According to the United States Geological Survey (USGS), Geologic Map of Southeastern Alaska, 1992, the surface geology of the Boriough of Petersburg is comprised of sedimentary rocks from the Cretaceous and Jurassic Geologic Eras (KJs). Beneath this surface sedimentary layer, the geology is comprised of volcanic rocks (KJv) from the same eras. These volcanic rocks outcrop in the Midwestern and Southern portions of Mitkof Island. Also predominant of the island are the igneous intrusive rocks granodiorite and tonalite from the Cretaceous Era (Kgt) that are found on either near vertical mountain slopes above the tree line or along the coast.

Past (and present) glaciations also occurred in this region, carving present day landscapes and depositing glacial sediment. Tidewater glaciers dumped glacial sediment from floating icebergs and sea ice. The glacial sediments were deposited in the sea then carried to the shore area of Mitkof Island by ocean tide. Most of the shore area is presently underlain by these glacial-marine deposits.

5.0 Field Exploration

The geotechnical subsurface investigation for this project was conducted from 7 through 10 April 2018. A total of 18 locations where sampled to ten feet below the ground surface or to refusal using a Gravity Environmental Vibracore equipped with either a five foot or ten foot long by 3-1/4 inch inside diameter split barrel sampler or by manually pushing a 2.0 inch inside diameter PVC sampling tube to refusal. Sampling locations were assigned permanent numbers and are designated AP-20 through AP-37. Sampling operations were performed aboard the landing craft RB (Reid Brothers), owned and operated by Glen Reid under contract with the Petersburg Borough. The landing craft was utilized as a conveyance and a work platform, it was equipped with a crane to lift the vibracore from the deck to selected locations within the harbor. A photograph of the Gravity Environmental Vibracore equipment is shown as Figure 1 and Figure 2, providing a view of the Vibracore being lowered into the water to collect a sample.

Figure 1: Environmental Gravity Vibracore

Figure 2. Preparing to lower the Environmental Gravity Vibracore sampling equipment below water for sampling.

An engineer from U.S. Army Corps of Engineers, Alaska District (USACE-AD) supervised the sampling effort and logged the sediment samples. Field identification and classification of the soils were conducted in accordance with ASTM D 2488, Description and Identification of Soils (Visual-Manual Procedure). Exploration logs which documented the sampling effort are presented in Appendix B.

Chemists from USACE-AD also collected soil from the samples for further environmental contamination testing. All environmental contamination test results were reported below the Dredged Material Management Project screening criteria. Those results are presented separately in the report titled “Chemical Data Report, Petersburg South Harbor Sediment Sampling (18-041), Petersburg South Boat Harbor, Alaska”, dated June 2018.

Horizontal coordinates of sampling locations were determined by a handheld Magellan global positioning system (GPS) and should be considered approximate. Sample location coordinates reported on the exploration logs are based on NAD83 (CORS), Alaska State Plane Zone 1, in feet. The elevations at each sampling location were determined by importing the horizontal coordinates of the sample locations into the Petersburg South Harbor Project Condition Survey CAD drawing dated 19 January 2018 by eTrac, Inc. Sampling surface elevations were selected from the digital surface within the bathymetry survey drawing. Vertical control from the hydrographic survey is referenced to mean lower low water (MLLW) datum, in feet. Test boring locations can be found as Sheet A-3 and a summary table of sample coordinates and elevations are presented in Appendix B.

6.0 Laboratory Testing Program

A laboratory testing program was established to classify and determine physical properties of the soils encountered. The testing program consisted of sieve analyses and classification testing for the soil’s Liquid Limit, Plastic Limit, and Plasticity Index. These tests were performed in accordance with the latest edition of the following methods shown in Table 1. Laboratory soil test results, and grain-size distribution curves are provided in Appendix C.

Table 1: Soils Laboratory Test Methods

Test Designation	Test Description
ASTM C 136	Sieve Analysis of Fine and Coarse Aggregates
ASTM D 2487	Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 4318	Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

7.0 Site Conditions

The Petersburg Harbor System was first dredged in 1937 under the Rivers and Harbors Act dated 30 August 1935. New work and maintenance dredging and harbor expansions have been performed since then with the most recent dredging effort conducted in 2013 at the Petersburg North Harbor.

7.1.Surface Conditions

The harbor basin and navigation channel surfaces within the proposed dredge areas are comprised of coarse and fine-grained soils. Recent marine sediment deposits have been transported from tidal currents, waves, and from the nearby Hammer Slough which drains into the South Harbor basin. During low tides the seafloor surface could vaguely be seen while standing on the harbor floats or sampling barge. Marine organisms consisting of star fish, sea anemones, clams, sea shells, and other organisms were present throughout the dredge areas. In addition to the organic marine life, debris consisting of metal and plastic pipes, ropes, metal cables, logs, miscellaneous metal, and other debris could be seen within the dredge area. Hydrographic survey results also indicate the presence of dredging obstructions and debris within the dredging limits. Several large wooden or steel pipe piles were identified during the hydrographic survey lying on the surface within the harbor basin.

A sunken vessel measuring approximately ten feet by four feet by three feet near AP-32 was also reported. During this site investigation braided steel cable commonly used in the marine industry was caught in the anchor of the landing craft RB. A portion of the steel cable that had to be cut to release the anchor is shown in Figure 3.

Figure 3. Part of the cable that was caught in the anchor of the landing craft RB.

7.2.Subsurface Conditions

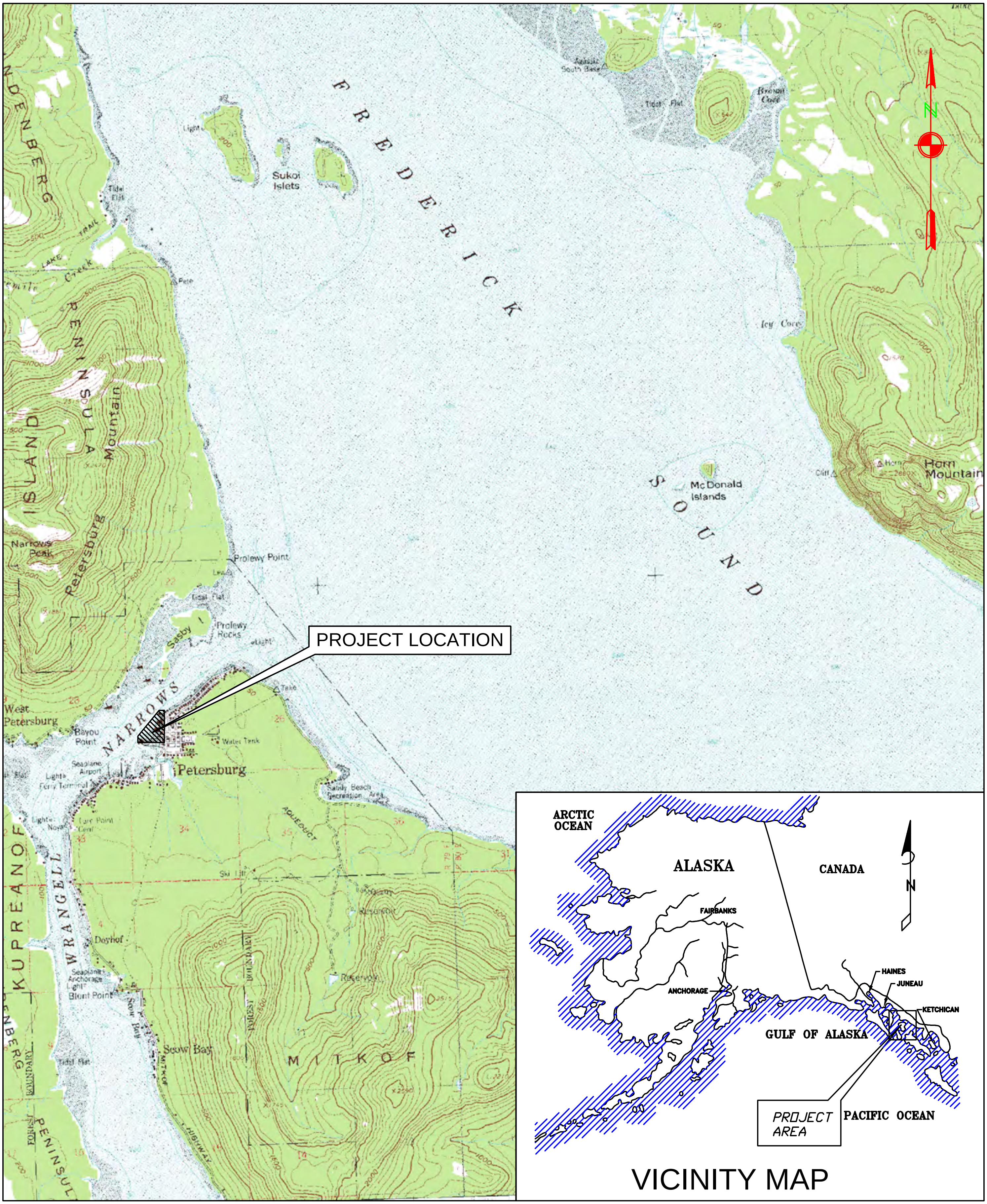
The subsurface conditions in the South Harbor dredge area generally consist of recent marine deposits overlying glacial marine deposits. Soils within the dredge limits were generally classified as sandy silty clay, sandy silt, silty sand, poorly graded sand with silt, and poorly graded sand with gravel (CL-ML, ML, SM, SP-SM, SP). Field and laboratory testing indicated the soils plasticity ranged from non-plastic to medium plasticity. Laboratory test results reported the soil's Liquid Limit (LL) ranged from 19 to 30 percent, Plastic Limit (PL) ranged from 13 to 17 percent and the Plasticity Index (PI) ranged from three to seven percent. Figure 4 shows a typical sample of sandy silty clay (CL-ML) encountered during the site investigation.

Figure 4: Sandy silty clay (CL-ML) encountered in AP-24.

Environmental Gravity Vibracore sampler refusal was encountered in most locations sampled. Sampler refusal was attributed to the dense to very dense glacial marine deposits underlying the softer marine sediments and the presence of cobbles and boulders. During previous dredging efforts in the Petersburg North Harbor, larger boulders were removed from the harbor basin. Figure 5 shows an example boulder that was dredged from the Petersburg North Harbor. Similar sized boulders will be encountered while dredging the South Harbor. The average dimension of boulders within the South Harbor dredge area is anticipated to be 15 feet or less.

Figure 5. Example 8.5 foot boulder that was dredged from the Petersburg North Harbor basin during the Fall of 2013.

APPENDIX A
Maps and Drawings



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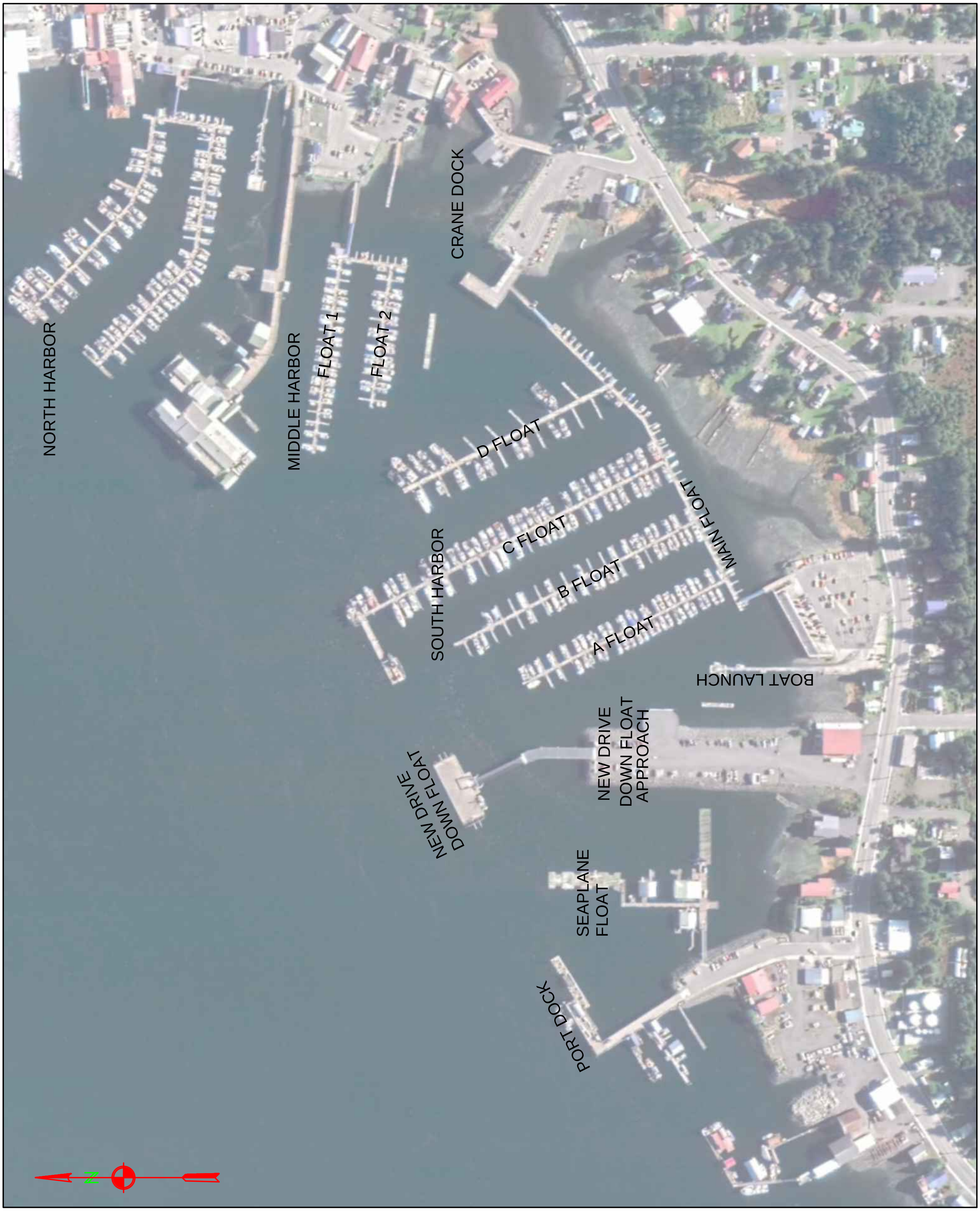
PROJECT LOCATION AND VICINITY MAP
PETERSBURG NAVIGATION IMPROVEMENTS
PETERSBURG, ALASKA

SCALE: NTS
DATE: JUN 2018
DRAWN/RVW: IJR/JJR
FIGURE A–1



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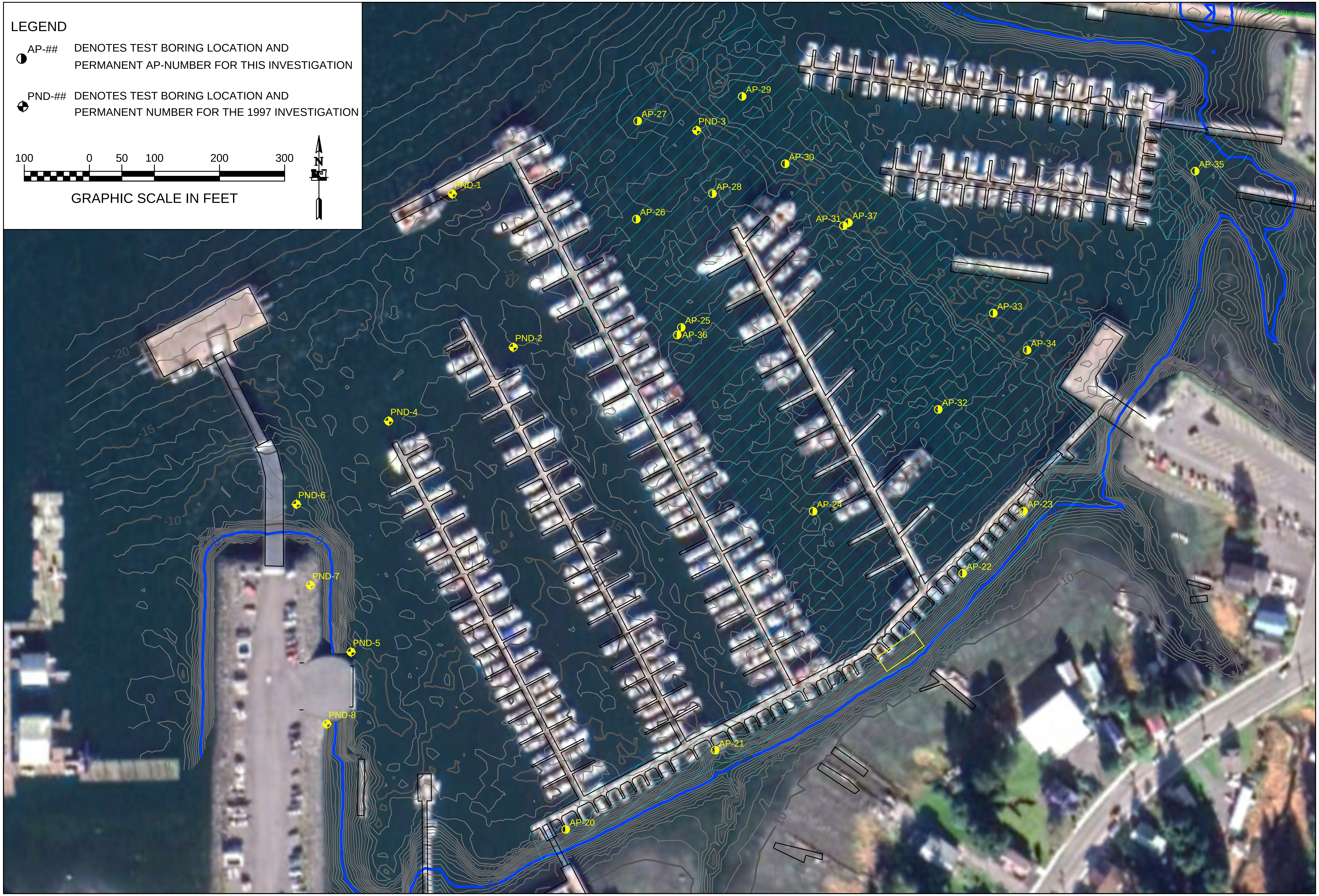
FLOAT NAMES AND HARBOR NAMES
PETERSBURG NAVIGATION
IMPROVEMENTS
PETERSBURG, ALASKA

SCALE: NTS
DATE: AUGUST 2018
DRAWN/RVW: IJR/JJR

FIGURE A-2



US ARMY CORPS
OF ENGINEERS
ALASKA DISTRICT

SCALE: GRAPHICAL
DRAWN: IJR
REVIEWED: JJR
DATE: AUGUST 2018

TEST BORING LOCATION MAP
PETERSBURG NAVIGATION IMPROVEMENTS
PETERSBURG, ALASKA

ALASKA DISTRICT
CORPS OF ENGINEERS
Geotechnical and Materials

REFERENCE NUMBER
A-3
SHEET A-3

Appendix B

Exploration Logs

Petersburg Borehole Location Coordinates

Permanent Number	Field Number	Northing	Easting	Elevation	Description
AP-20	TB-01	1,817,642.97	2,826,372.56	-11.47	Soil Boring
AP-21	TB-02	1,817,765.92	2,826,601.81	-7.48	Soil Boring
AP-22	TB-03	1,818,037.87	2,826,982.26	-11.61	Soil Boring
AP-23	TB-04	1,818,133.56	2,827,076.04	-8.78	Soil Boring
AP-24	TB-05	1,818,127.47	2,826,752.87	-16.54	Soil Boring
AP-25	TB-06	1,818,416.00	2,826,549.72	-16.26	Soil Boring
AP-26	TB-07	1,818,582.83	2,826,480.58	-16.49	Soil Boring
AP-27	TB-08	1,818,733.54	2,826,482.73	-15.69	Soil Boring
AP-28	TB-09	1,818,621.90	2,826,597.73	-16.70	Soil Boring
AP-29	TB-10	1,818,771.36	2,826,643.27	-12.36	Soil Boring
AP-30	TB-11	1,818,667.77	2,826,709.42	-13.52	Soil Boring
AP-31	TB-12	1,818,572.53	2,826,799.04	-16.08	Soil Boring
AP-32	TB-13	1,818,289.92	2,826,944.85	-18.07	Soil Boring
AP-33	TB-14	1,818,438.07	2,827,029.39	-14.82	Soil Boring
AP-34	TB-15	1,818,381.12	2,827,081.44	-16.23	Soil Boring
AP-35	TB-16	1,818,656.37	2,827,339.60	-3.48	Soil Boring
AP-36	TB-6A	1,818,404.61	2,826,543.46	-16.94	Soil Boring
AP-37	TB-12A	1,818,577.16	2,826,806.75	-15.30	Soil Boring

1. PRIMARY PROJECT HORIZONTAL CONTROL IS ALASKA STATE PLANE, ZONE 1, NAD83, (2011)(2010.00), IN US SURVEY FEET BASED ON A FULLY CONSTRAINED STATIC GPS NETWORK HOLDING THE PUBLISHED NAD83 2010.00 EPOCH VALUES OF NGS CORS STATIONS: "ANNETTE ISLAND 5 CORS ARP" (PID DK6482); "KLAWOCK AIR AK 2006 CORS ARP" (PID DM7451); "LEVEL ISLAND 6 CORS ARP" (PID DJ 3035); "PORT ALEXAN AK 2005 CORS ARP" (PID DL6695) AND "JUNEAU WAAS 1 CORS ARP (PID DF4367).

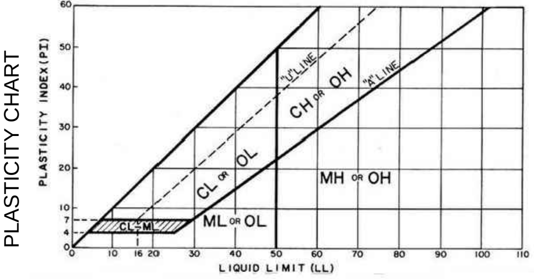
LOCAL PROJECT HORIZONTAL CONTROL IS ALASKA STATE PLANE, ZONE 1, NAD83 2010, IN US SURVEY FEET HOLDING "NH-4 2000" AS N 1,818,325.34' E 2,827,135.71' AND "945 1434 C" AS N 1,814,470.18' E 2,823,146.11'.

2. VERTICAL CONTROL IS MEAN LOWER LOW WATER (MLLW=0.0 FT), BASED ON THE NOAA/NOS TIDAL BENCH MARK LIST "945 1434 TURN POINT, ALASKA", PUBLISHED 06/08/2009. THIS TIDAL DATUM IS BASED ON THE 1983-2001 TIDAL EPOCH AND IS REFERENCED BY HOLDING NOAA/NOS TIDAL BENCH MARK "945 1434 A 2006" (VM#18109/PID BBBC62) AS 27.14 FT.

3. VERTICAL TIES TO THE NATIONAL SPATIAL REFERENCE SYSTEM ARE BASED ON PUBLISHED NAVD88 (GEOID12B) ELEVATIONS HOLDING NOS 3.5" DOMED BRASS CAP "945 1434 C" (PID BBBFV47) AS 14.216 FT.

4. SOUNDINGS ARE IN US SURVEY FEET AND ARE MINUS UNLESS OTHERWISE INDICATED.

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART (modified from ASTM D2487)

MAJOR DIVISIONS				SYMBOLS	DESCRIPTIONS	
COARSE GRAINED SOILS MORE THAN 50% RETAINED ON NO. 200 SIEVE	GRAVEL AND GRAVELLY SOILS > 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS <5% FINES	$C_u \geq 4$ AND $1 \leq C_c \leq 3$	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	If soil contains ≥15% sand, add "with sand"
			$C_u < 4$ AND/OR $[C_c < 1$ OR $C_c > 3]$	GP	Poorly graded gravels, gravel-sand mixtures, little or no fines	
		GRAVELS WITH FINES >12% FINES	FINES CLASSIFY AS ML OR MH	GM	Silty gravels, gravel-sand-silt mixtures	
			FINES CLASSIFY AS CL OR CH	GC	Clayey gravels, gravel-sand-clay mixtures	
	SAND AND SANDY SOILS > 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	CLEAN SANDS <5% FINES	$C_u \geq 6$ AND $1 \leq C_c \leq 3$	SW	Well-graded sands, gravelly sands, little or no fines	If soil contains ≥15% gravel, add "with gravel"
			$C_u < 6$ AND/OR $[C_c < 1$ OR $C_c > 3]$	SP	Poorly graded sands, gravelly sands, little or no fines	
		SANDS WITH FINES >12% FINES	FINES CLASSIFY AS ML OR MH	SM	Silty sands, sand-silt mixtures	
			FINES CLASSIFY AS CL OR CH	SC	Clayey sands, sand-clay mixtures	
FINE GRAINED SOILS 50% OR MORE PASSES THE NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT <50	PLASTICITY CHART 		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	If soil contains coarse-grained soil from 15% to 29%, add "with sand" or "with gravel" for whichever type is prominent, or for ≥30%, add "sandy" or "gravelly"
				ML	Inorganic silts, very fine sands, rock flour, silty/clayey fine sands or clayey silts of slight plasticity	
				OL	Organic silts and organic silty clays of low plasticity	
	SILTS AND CLAYS LIQUID LIMIT ≥50			CH	Inorganic clays of high plasticity, fat clays	
				MH	Inorganic silts, macaceous or dimaceous fine sandy or silty soils, elastic silt	
				OH	Organic clays of high plasticity, fat clays	
HIGHLY ORGANIC SOILS		PRIMARILY ORGANIC MATTER, DARK IN COLOR, AND ORGANIC ODOR		PT	Peat humus, swamp soils with high organic content	

COMPONENT DEFINITIONS BY GRADATION

COMPONENT	SIZE RANGE
BOULDERS	**> 12 IN. (300 MM)**
COBBLES	**12 IN. (300 MM) to 3 IN. (75 MM)**
GRAVEL	**3 IN. (75 MM) to #4 SIEVE (4.76 MM)**
COARSE GRAVEL	**3 IN. (75 MM) to 3/4 IN. (18.75 MM)**
FINES GRAVEL	**3/4 IN. to #4 SIEVE (4.76 MM)**
SAND	**#4 (4.76 MM) to #200 (0.074 MM)**
COARSE SAND	**#4 (4.76 MM) to #10 (2.0 MM)**
MEDIUM SAND	**#10 (2.0 MM) to #40 (0.42 MM)**
FINE SAND	**#40 (0.42 MM) to #200 (0.074 MM)**
SILT & CLAY (FINES)	**< #200 (0.074 MM)**

FROST DESIGN SOIL CLASSIFICATION (UFC 3-250-01FA, TABLE 18-2)

GROUP	TYPICAL SOILS
F1	**Gravelly Soils**
F2	**Gravelly Soils, Sands**
F3	**Gravelly Soils, Sands, Except Very Fine Silt Sands**
F4	**All Silts, Very Fine Silty Sands, Clays, PI >12, Varved Clays and Other Fine-Grained Banded Sediments**
NFS	**Non-Frost-Susceptible**
PFS	**Possibly Frost Susceptible**
S1	**Gravelly Soils**
S2	**Sandy Soils**

DESCRIPTION OF FROZEN SOILS (ASTM D4083)

GROUP	DESCRIPTION
ICE NOT VISIBLE	
Nf	**Poorly Bonded or Friable**
Nbn	**Well Bonded, No Excess Ice**
Nbe	**Well Bonded, Excess Ice**
VISIBLE ICE, < 1 IN. THICK	
Vx	**Crystals**
Vc	**Ice Coatings or Particles**
Vr	**Ice Formations**
Vs	**Stratified or Distinctly Oriented Ice Formations**
VISIBLE ICE, > 1 IN. THICK	
Ice	**Ice without Soil Inclusions**
Ice + Soil	**Ice with Soil Inclusions**

NOTES TO UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

NOTES:

1. **Coefficient of uniformity : $C_u = D_{60}/D_{10}$**
2. **Coefficient of curvature: $C_c = [(D_{30})^2] / (D_{10} \times D_{60})$**
3. **$D_{(x\%)}$ is soil particle diameter where x% is % finer.**
4. **Gravels or sands with 5% to 12% fines require dual symbols (GW-GM, GW-GC, GP-GM, GP-GC, SW-SM, SW-SC, SP-SM, SP-SC) and add "with clay" or "with silt" to group name. If fines classify as CL-ML for GM or SM, use dual symbol GC-GM or SC-SM.**

TEST BORING NOTES

TEST BORING NOTES:

1. **The number of blows required to drive each six-inch increment is recorded on the exploration logs. The reported blow count is an indication of the relative density or consistency of the soil. It should be noted that blow counts obtained in frozen soils do not represent the penetration of those same soils in a thawed state.**
2. **Soil classifications and descriptions reported on the exploration logs are in accordance with ASTM D 2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) and ASTM D 2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).**
3. **The soil classifications and descriptions contained on the exploration logs are the project engineer's interpretation of the field logs and results of the laboratory testing program. The stratification lines shown on the exploration logs represent approximate boundaries between soil types. The actual transitions are often gradual or not discernable by drill action.**

CRITERIA FOR DESCRIBING MOISTURE CONDITION (ASTM D2488)

Dry	**Absence of moisture, dusty, dry to the touch**
Moist	**Damp, but no visible water**
Wet	**Visible free water, usually soil is below water table**

OTHER MATERIAL SYMBOLS

ASPHALT PAVEMENT	■
BASALT	⬡
BEDROCK	▨
PORTLAND CEMENT CONCRETE	▨
COBBLES/BOULDERS	○

SAMPLER ABBREVIATIONS/SYMBOLS

AUGER	**Auger Cuttings**	▨
CORE	**Rock Core**	▨
GRAB	**Grab Sample**	▨
LPT	**Large Penetration Test**	⧗
NR	**No Recovery**	○
SH	**Tube Sample**	■
SPT	**Standard Penetration Test (ASTM D 1586)**	⊠
UNDIST	**Undisturbed Sample**	■
VANE	**Vane Shear**	▨

ALASKA DISTRICT
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Geotechnical and Materials

LEGEND TO EXPLORATION LOGS
PETERSBURG NAVIGATION IMPROVEMENTS
PETERSBURG, ALASKA

SCALE: NTS
DATE: JUN 2018
DRAWN/RVW: GF/CJC
LOG LEGEND

ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Geotechnical and Materials Section

EXPLORATION LOG

Project: **Petersburg Navigation Improvements, Petersburg, Alaska**

Page 1 of 1

Date: **10 Apr 2018**

Drilling Agency: ☐ Alaska District ☒ Other **ERDC**

Datum: Vertical **MLLW** Horizontal **ASP1 NAD83**

Location: Northing: **1,817,643 ft. ±** Easting: **2,826,373 ft. ±**

Top of Hole Elevation: **-11.5 ft. ±**

Hole Number, Field: **TB-01** Permanent: **AP-20**

Operator: **Tommy Kirklin**

Inspector: **Inocencio Roman**

Type of Hole: ☒ other **Tube sampler**
☐ Test Pit ☐ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater: **Sampled Below Water**

Depth Drilled: **3.0 ft.**

Total Depth: **3.0 ft.**

Hammer Weight:

Split Spoon I.D.:

Size and Type of Bit: **NA**

Type of Equipment: **2 in. inside diameter clear plastic pipe**

Type of Samples: **Tube**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	N-Value	Sample Type	Symbol	Classification ASTM: D 2487 or D 2488	PID (ppm)	% Water	Description and Remarks **south end of floats parallel to the shore**
	▨	▨		**F4***			■	**SM**	**Silty SAND**	-/ 0.0		**Black, wet, 2% gravel, 58% fine to coarse sand, 40% nonplastic fines, organic odor, refusal at three feet**
1	▨	1					■					
2	▨	▨					■					
3												**Bottom of Hole 3.0 ft.** **Elevation -14.5 ft. ±** **Sampled Below Water** **PID = (Cold/Hot) Photo Ionization Detector** **Surficial sample was taken by manually pushing a 2 in. inside diameter clear plastic pipe**
4												
5												
6												
7												
8												
9												

* Indicates Estimated Frost Classification

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EXPLORATION LOG

Project: **Petersburg Navigation Improvements, Petersburg, Alaska**

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Date: **10 Apr 2018**

Drilling Agency: ☐ Alaska District ☒ Other **ERDC**

Datum: Vertical **MLLW** Horizontal **ASP1 NAD83**

Location: Northing: **1,817,766 ft. ±** Easting: **2,826,602 ft. ±**

Top of Hole Elevation: **-7.5 ft. ±**

Hole Number, Field: **TB-02**

Permanent: **AP-21**

Operator: **Tommy Kirklin**

Inspector: **Inocencio Roman**

Type of Hole: ☒ other **Tube sampler**
☐ Test Pit ☐ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater: **Sampled Below Water**

Depth Drilled: **1.0 ft.**

Total Depth: **1.0 ft.**

Hammer Weight:

Split Spoon I.D.:

Size and Type of Bit: **NA**

Type of Equipment: **2 in. inside diameter PVC pipe**

Type of Samples: **Tube**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	N-Value	Sample Type	Symbol	Classification ASTM: D 2487 or D 2488	PID (ppm)	% Water	Description and Remarks **south end of floats parallel to the shore**
	▨	1		**NFS***			■	**SP**	**Poorly graded SAND**			**Gray, wet, 6% gravel, 90% fine to coarse sand, 4% nonplastic fines, seashells, organic odor, refusal at one foot**
1												**Bottom of Hole 1.0 ft.** **Elevation -8.5 ft. ±** **Sampled Below Water** **PID = (Cold/Hot) Photo Ionization Detector** **Surficial sample was taken by manually pushing a 2 in. inside diameter PVC pipe**
2												
3												
4												
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6												
7												
8												
9												

* Indicates Estimated Frost Classification

Project: **Petersburg Navigation Improvements,**

Hole Number: **AP-21**

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Project: **Petersburg Navigation Improvements, Petersburg, Alaska**

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Date: **10 Apr 2018**

Drilling Agency: ☐ Alaska District ☒ Other **ERDC**

Datum: Vertical **MLLW** Horizontal **ASP1 NAD83**

Location: Northing: **1,818,038 ft. ±** Easting: **2,826,982 ft. ±**

Top of Hole Elevation: **-11.6 ft. ±**

Hole Number, Field: **TB-03** Permanent: **AP-22**

Operator: **Tommy Kirklin**

Inspector: **Inocencio Roman**

Type of Hole: ☒ other **Tube sampler** ☐ Test Pit ☐ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater: **Sampled Below Water**

Depth Drilled: **1.0 ft.**

Total Depth: **1.0 ft.**

Hammer Weight:

Split Spoon I.D.:

Size and Type of Bit: **NA**

Type of Equipment: **2 in. inside diameter PVC pipe**

Type of Samples: **Tube**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	N-Value	Sample Type	Symbol	Classification ASTM: D 2487 or D 2488	PID (ppm)	% Water	Description and Remarks **south end of floats parallel to the shore**
	▨	1		**F4***			■	**SM**	**Silty SAND**			**Gray to black, wet, 5% angular to subrounded gravel, 58% fine to coarse sand, 37% nonplastic to low plasticity plasticity fines, max size = 0.25 in., seashells, organic odor, refusal at one foot**
1												**Bottom of Hole 1.0 ft.** **Elevation -12.6 ft. ±** **Sampled Below Water** **PID = (Cold/Hot) Photo Ionization Detector** **Surficial sample was taken by manually pushing a 2 in. inside diameter PVC pipe**
2												
3												
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* Indicates Estimated Frost Classification

Project: **Petersburg Navigation Improvements,**

Hole Number: **AP-22**

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Date: **10 Apr 2018**

Drilling Agency: ☐ Alaska District ☒ Other **ERDC**

Datum: Vertical **MLLW** Horizontal **ASP1 NAD83**

Location: Northing: **1,818,134 ft. ±** Easting: **2,827,076 ft. ±**

Top of Hole Elevation: **-8.8 ft. ±**

Hole Number, Field: **TB-04** Permanent: **AP-23**

Operator: **Tommy Kirklin**

Inspector: **Inocencio Roman**

Type of Hole: ☒ other **Tube sampler**
☐ Test Pit ☐ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater: **Sampled Below Water**

Depth Drilled: **2.0 ft.**

Total Depth: **2.0 ft.**

Hammer Weight:

Split Spoon I.D.:

Size and Type of Bit: **NA**

Type of Equipment: **2 in. inside diameter PVC pipe**

Type of Samples: **Tube**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	N-Value	Sample Type	Symbol	Classification ASTM: D 2487 or D 2488	PID (ppm)	% Water	Description and Remarks **south end of floats parallel to the shore**
0–2	▨	1		**F4***			■	**SM**	**Silty SAND**			**Gray to black, wet, 82% fine to coarse sand, 18% nonplastic fines, organic odor, shells, Liquid Limit =30, Plasticity Index = Nonplastic, refusal at two feet**
2												**Bottom of Hole 2.0 ft.** **Elevation -10.8 ft. ±** **Sampled Below Water** **PID = (Cold/Hot) Photo Ionization Detector** **Surficial sample was taken by manually pushing a 2 in. inside diameter PVC pipe**
3												
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8												
9												

* Indicates Estimated Frost Classification

Project: **Petersburg Navigation Improvements,**

Hole Number: **AP-23**

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Date: **8 Apr 2018**

Drilling Agency: ☐ Alaska District ☒ Other **ERDC**

Datum: Vertical **MLLW** Horizontal **ASP1 NAD83**

Location: Northing: **1,818,127 ft. ±** Easting: **2,826,753 ft. ±**

Top of Hole Elevation: **-16.5 ft. ±**

Hole Number, Field: **TB-05**

Permanent: **AP-24**

Operator: **Tommy Kirklin**

Inspector: **Inocencio Roman**

Type of Hole: ☒ other **Gravity Environmental Vibracore**

☐ Test Pit ☐ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater: **Sampled Below Water**

Depth Drilled: **3.0 ft.**

Total Depth: **3.0 ft.**

Hammer Weight:

Split Spoon I.D.: **3.25 in.**

Size and Type of Bit: **NA**

Type of Equipment: **Gravity Environmental Vibracore**

Type of Samples: **Core**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	N-Value	Sample Type	Symbol	Classification ASTM: D 2487 or D 2488	PID (ppm)	% Water	Description and Remarks
0–1		1		F4*				CL-ML	**Sandy Silty CLAY with Gravel**			**Gray, wet, 21% subangular to subrounded gravel, 28% fine to coarse sand, 51% low to medium plasticity fines, max size = 1.5 in.**
1–3		2		F4*				CL-ML	**Sandy Silty Clay**			**Gray, wet, 8% subangular to subrounded gravel, 25% fine to coarse sand, 67% low to medium plasticity fines, max size = 2.5 in., Liquid Limit =24, Plastic Limit = 17, Plasticity Index = 7, refusal at 3 feet**
3												**Bottom of Hole 3.0 ft.** **Elevation -19.5 ft. ±** **Sampled Below Water** **PID = (Cold/Hot) Photo Ionization Detector** **Samples were taken with a 3-1/4 in. inside diameter split barrel sampler driven by the Vibracore**

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9

* Indicates Estimated Frost Classification

Project: **Petersburg Navigation Improvements,**

Hole Number: **AP-24**

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Date: **8 Apr 2018**

Drilling Agency: ☐ Alaska District ☒ Other **ERDC**

Datum: Vertical **MLLW** Horizontal **ASP1 NAD83**

Location: Northing: **1,818,416 ft. ±** Easting: **2,826,550 ft. ±**

Top of Hole Elevation: **-16.3 ft. ±**

Hole Number, Field: **TB-06** Permanent: **AP-25**

Operator: **Tommy Kirklin**

Inspector: **Inocencio Roman**

Type of Hole: ☒ other **Gravity Environmental Vibracore**
☐ Test Pit ☐ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater: **Sampled Below Water**

Depth Drilled: **1.0 ft.**

Total Depth: **1.0 ft.**

Hammer Weight:

Split Spoon I.D.: **3.25 in.**

Size and Type of Bit: **NA**

Type of Equipment: **Gravity Environmental Vibracore**

Type of Samples: **Core**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	N-Value	Sample Type	Symbol	Classification ASTM: D 2487 or D 2488	PID (ppm)	% Water	Description and Remarks
	▨	1		**F4***			■	**CL-ML**	**Sandy Silty Clay**			**Gray, wet, 9% subangular to subrounded gravel, 41% fine to coarse sand, 50% low plasticity plasticity fines, max size = 1 in., refusal at one foot**
1												**Bottom of Hole 1.0 ft.** **Elevation -17.3 ft. ±** **Sampled Below Water** **PID = (Cold/Hot) Photo Ionization Detector** **Samples were taken with a 3-1/4 in. inside diameter split barrel sampler driven by the Vibracore**
2												
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* Indicates Estimated Frost Classification

Project: **Petersburg Navigation Improvements,**

Hole Number: **AP-25**

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Date: **8 Apr 2018**

Drilling Agency: ☐ Alaska District ☒ Other **ERDC**

Datum: Vertical **MLLW** Horizontal **ASP1 NAD83**

Location: Northing: **1,818,583 ft. ±** Easting: **2,826,481 ft. ±**

Top of Hole Elevation: **-16.5 ft. ±**

Hole Number, Field: **TB-07** Permanent: **AP-26**

Operator: **Tommy Kirklin**

Inspector: **Inocencio Roman**

Type of Hole: ☒ other **Gravity Environmental Vibracore**
☐ Test Pit ☐ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater: **Sampled Below Water**

Depth Drilled: **1.0 ft.**

Total Depth: **1.0 ft.**

Hammer Weight:

Split Spoon I.D.: **3.25 in.**

Size and Type of Bit: **NA**

Type of Equipment: **Gravity Environmental Vibracore**

Type of Samples: **Core**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	N-Value	Sample Type	Symbol	Classification ASTM: D 2487 or D 2488	PID (ppm)	% Water	Description and Remarks
		1		**S2***				**SP-SM**	**Poorly graded SAND with Silt and Gravel**			**Gray, wet, 21% subangular to subrounded gravel, 68% fine to coarse sand, 11% nonplastic fines, max size = 1 in., seashells, piece of wood, refusal at one foot**
1												**Bottom of Hole 1.0 ft.** **Elevation -17.5 ft. ±** **Sampled Below Water** **PID = (Cold/Hot) Photo Ionization Detector** **Samples were taken with a 3-1/4 in. inside diameter split barrel sampler driven by the Vibracore**
2												
3												
4												
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9												

* Indicates Estimated Frost Classification

Project: **Petersburg Navigation Improvements,**

Hole Number: **AP-26**

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Date: **8 Apr 2018**

Drilling Agency: ☐ Alaska District ☒ Other **ERDC**

Datum: Vertical **MLLW** Horizontal **ASP1 NAD83**

Location: Northing: **1,818,734 ft. ±** Easting: **2,826,483 ft. ±**

Top of Hole Elevation: **-15.7 ft. ±**

Hole Number, Field: **TB-08**

Permanent: **AP-27**

Operator: **Tommy Kirklin**

Inspector: **Inocencio Roman**

Type of Hole: ☒ other **Gravity Environmental Vibracore**
☐ Test Pit ☐ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater: **Sampled Below Water**

Depth Drilled: **3.5 ft.**

Total Depth: **3.5 ft.**

Hammer Weight:

Split Spoon I.D.: **3.25 in.**

Size and Type of Bit: **NA**

Type of Equipment: **Gravity Environmental Vibracore**

Type of Samples: **Core**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	N-Value	Sample Type	Symbol	Classification ASTM: D 2487 or D 2488	PID (ppm)	% Water	Description and Remarks
1		1		**NFS***				**SP**	**Poorly graded SAND**			**Gray, wet, 13% subangular to subrounded gravel, 83% fine to coarse sand, 4% nonplastic fines, seashells**
2 3		2		**S2***				**SP-SM**	**Poorly graded SAND with Silt and Gravel**			**Gray, wet, 19% subangular to subrounded gravel, 75% fine to coarse sand, 6% nonplastic fines, max size = 1.25 in., seashells, refusal at three feet**
4 5 6 7 8 9												**Bottom of Hole 3.5 ft.** **Elevation -19.2 ft. ±** **Sampled Below Water** **PID = (Cold/Hot) Photo Ionization Detector** **Samples were taken with a 3-1/4 in. inside diameter split barrel sampler driven by the Vibracore**

* Indicates Estimated Frost Classification

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Date: **8 Apr 2018**

Drilling Agency: ☐ Alaska District ☒ Other **ERDC**

Datum: Vertical **MLLW**
Horizontal **ASP1 NAD83**

Location: Northing: **1,818,622 ft. ±**
Easting: **2,826,598 ft. ±**

Top of Hole Elevation: **-16.7 ft. ±**

Hole Number, Field: **TB-09**

Permanent: **AP-28**

Operator: **Tommy Kirklin**

Inspector: **Inocencio Roman**

Type of Hole: ☒ other **Gravity Environmental Vibracore**
☐ Test Pit ☐ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater: **Sampled Below Water**

Depth Drilled: **0.5 ft.**

Total Depth: **0.5 ft.**

Hammer Weight:

Split Spoon I.D.: **3.25 in.**

Size and Type of Bit: **NA**

Type of Equipment: **Gravity Environmental Vibracore**

Type of Samples: **Core**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	N-Value	Sample Type	Symbol	Classification ASTM: D 2487 or D 2488	PID (ppm)	% Water	Description and Remarks
0–0.5		1		**F2***				**SM**	**Silty SAND with Gravel**			**Gray, wet, 24% subangular to subrounded gravel, 56% fine to coarse sand, 20% nonplastic fines, max size = 2.5 in., seashells, refusal**
												Bottom of Hole 0.5 ft. **Elevation -17.2 ft. ±** **Sampled Below Water** **PID = (Cold/Hot) Photo Ionization Detector** **Samples were taken with a 3-1/4 in. inside diameter split barrel sampler driven by the Vibracore**
1												
2												
3												
4												
5												
6												
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8												
9												

* Indicates Estimated Frost Classification

Project: **Petersburg Navigation Improvements,**

Hole Number: **AP-28**

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Date: **9 Apr 2018**

Drilling Agency: ☐ Alaska District ☒ Other **ERDC**

Datum: Vertical **MLLW**
Horizontal **ASP1 NAD83**

Location: Northing: **1,818,771 ft. ±** Easting: **2,826,643 ft. ±**

Top of Hole Elevation: **-12.4 ft. ±**

Hole Number, Field: **TB-10** Permanent: **AP-29**

Operator: **Tommy Kirklin**

Inspector: **Inocencio Roman**

Type of Hole: ☒ other **Gravity Environmental Vibracore**
☐ Test Pit ☐ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater: **Sampled Below Water**

Depth Drilled: **1.0 ft.**

Total Depth: **1.0 ft.**

Hammer Weight:

Split Spoon I.D.: **3.25 in.**

Size and Type of Bit: **NA**

Type of Equipment: **Gravity Environmental Vibracore**

Type of Samples: **Core**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	N-Value	Sample Type	Symbol	Classification ASTM: D 2487 or D 2488	PID (ppm)	% Water	Description and Remarks **Near two large boulders identified in the survey**
0–1		1		**S2***				**SP-SM**	**Poorly graded SAND with Silt**			**Gray, wet, 8% subangular to subrounded gravel, 86% fine to coarse sand, 6% nonplastic fines, max size = 1 in., seashells, refusal at one foot**
1												**Bottom of Hole 1.0 ft.** **Elevation -13.4 ft. ±** **Sampled Below Water** **PID = (Cold/Hot) Photo Ionization Detector** **Samples were taken with a 3-1/4 in. inside diameter split barrel sampler driven by the Vibracore**
2												
3												
4												
5												
6												
7												
8												
9												

* Indicates Estimated Frost Classification

Project: **Petersburg Navigation Improvements,**

Hole Number: **AP-29**

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Date: **7 Apr 2018**

Drilling Agency: ☐ Alaska District ☒ Other **ERDC**

Datum: Vertical **MLLW**
Horizontal **ASP1 NAD83**

Location: Northing: **1,818,668 ft. ±**
Easting: **2,826,709 ft. ±**

Top of Hole Elevation: **-13.5 ft. ±**

Hole Number, Field: **TB-11**

Permanent: **AP-30**

Operator: **Tommy Kirklin**

Inspector: **Inocencio Roman**

Type of Hole: ☒ other **Gravity Environmental Vibracore**
☐ Test Pit ☐ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater: **Sampled Below Water**

Depth Drilled: **1.0 ft.**

Total Depth: **1.0 ft.**

Hammer Weight:

Split Spoon I.D.: **3.25 in.**

Size and Type of Bit: **NA**

Type of Equipment: **Gravity Environmental Vibracore**

Type of Samples: **Core**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	N-Value	Sample Type	Symbol	Classification ASTM: D 2487 or D 2488	PID (ppm)	% Water	Description and Remarks **Near two large boulders identified in the survey**
		1		**F4***				**SM**	**Silty SAND with Gravel**			**Gray, wet, 19% subangular to subrounded gravel, 37% fine to coarse sand, 44% nonplastic fines, max size = 2.5 in., seashells, refusal at one foot**
1												**Bottom of Hole 1.0 ft.** **Elevation -14.5 ft. ±** **Sampled Below Water** **PID = (Cold/Hot) Photo Ionization Detector** **Samples were taken with a 3-1/4 in. inside diameter split barrel sampler driven by the Vibracore**
2												
3												
4												
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* Indicates Estimated Frost Classification

Project: **Petersburg Navigation Improvements,**

Hole Number: **AP-30**

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Date: **7 Apr 2018**

Drilling Agency: ☐ Alaska District ☒ Other **ERDC**

Datum: Vertical **MLLW** Horizontal **ASP1 NAD83**

Location: Northing: **1,818,573 ft. ±** Easting: **2,826,799 ft. ±**

Top of Hole Elevation: **-16.1 ft. ±**

Hole Number, Field: **TB-12**

Permanent: **AP-31**

Operator: **Tommy Kirklin**

Inspector: **Inocencio Roman**

Type of Hole: ☒ other **Gravity Environmental Vibracore**
☐ Test Pit ☐ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater: **Sampled Below Water**

Depth Drilled: **2.5 ft.**

Total Depth: **2.5 ft.**

Hammer Weight:

Split Spoon I.D.: **3.25 in.**

Size and Type of Bit: **NA**

Type of Equipment: **Gravity Environmental Vibracore**

Type of Samples: **Core**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	N-Value	Sample Type	Symbol	Classification ASTM: D 2487 or D 2488	PID (ppm)	% Water	Description and Remarks
0 – 2.5		1		F4*				SM	**Silty SAND with Gravel**			**Gray, wet, 14% subangular to subrounded gravel, 37% fine to coarse sand, 49% low to medium plasticity fines, max size = 1.5 in., seashells, refusal at 2.5 feet**
2.5												**Bottom of Hole 2.5 ft.** **Elevation -18.6 ft. ±** **Sampled Below Water** **PID = (Cold/Hot) Photo Ionization Detector** **Samples were taken with a 3-1/4 in. inside diameter split barrel sampler driven by the Vibracore**

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9

* Indicates Estimated Frost Classification

Project: **Petersburg Navigation Improvements,**

Hole Number: **AP-31**

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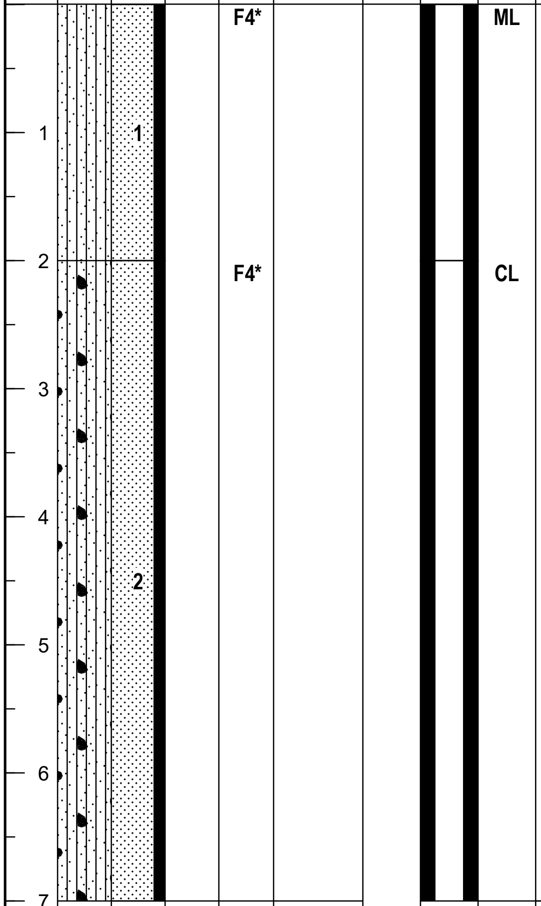
Drilling Agency: ☐ Alaska District ☒ Other **ERDC**		Datum: Vertical **MLLW** Horizontal **ASP1 NAD83**	
Location: Northing: **1,818,290 ft. ±** Easting: **2,826,945 ft. ±**		Top of Hole Elevation: **-18.1 ft. ±**	
Hole Number, Field: **TB-13**	Permanent: **AP-32**	Operator: **Tommy Kirklin**	Inspector: **Inocencio Roman**
Type of Hole: ☒ other **Gravity Environmental Vibracore** ☐ Test Pit ☐ Auger Hole ☐ Monitoring Well ☐ Piezometer	Depth to Groundwater: **Sampled Below Water**	Depth Drilled: **7.0 ft.**	Total Depth: **7.0 ft.**
Hammer Weight:	Split Spoon I.D.: **3.25 in.**	Size and Type of Bit: **NA**	Type of Equipment: **Gravity Environmental Vibracore**
Type of Samples: **Core**			



Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class: ufc3-250-01fa	Blow Count	N-Value	Sample Type	Symbol	Classification ASTM: D 2487 or D 2488	PID (ppm)	% Water	Description and Remarks
0		1		F4*				ML	**Sandy SILT**			**Gray, wet, 11% subangular to subrounded gravel, 35% fine to coarse sand, 54% low to medium plasticity fines, max size = 0.5 in., organics, seashells, refusal at seven feet**
2		2		F4*				CL	**Sandy lean CLAY with Gravel**			**Gray, wet, 15% subangular to subrounded gravel, 27% fine to coarse sand, 58% low plasticity fines, max size = 2 in., Liquid Limit = 19, Plastic Limit = 16, Plasticity Index=3, refusal at seven feet**
7												**Bottom of Hole 7.0 ft.** **Elevation -25.1 ft. ±** **Sampled Below Water** **PID = (Cold/Hot) Photo Ionization Detector** **Samples were taken with a 3-1/4 in. inside diameter split barrel sampler driven by the Vibracore**

* Indicates Estimated Frost Classification

Project: **Petersburg Navigation Improvements,**	Hole Number: **AP-32**

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Date: **7 Apr 2018**

Drilling Agency: ☐ Alaska District ☒ Other **ERDC**

Datum: Vertical **MLLW** Horizontal **ASP1 NAD83**

Location: Northing: **1,818,438 ft. ±** Easting: **2,827,029 ft. ±**

Top of Hole Elevation: **-14.8 ft. ±**

Hole Number, Field: **TB-14**

Permanent: **AP-33**

Operator: **Tommy Kirklin**

Inspector: **Inocencio Roman**

Type of Hole: ☒ other **Gravity Environmental Vibracore**
☐ Test Pit ☐ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater: **Sampled Below Water**

Depth Drilled: **6.0 ft.**

Total Depth: **6.0 ft.**

Hammer Weight:

Split Spoon I.D.: **3.25 in.**

Size and Type of Bit: **NA**

Type of Equipment: **Gravity Environmental Vibracore**

Type of Samples: **Core**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	N-Value	Sample Type	Symbol	Classification ASTM: D 2487 or D 2488	PID (ppm)	% Water	Description and Remarks
0		1		F4*				SM	**Silty SAND with Gravel**			**Gray, wet, 16% subangular to subrounded gravel, 38% fine to coarse sand, 46% low to medium plasticity fines, max size = 2 in.**
4		2		F4*				ML	**Sandy SILT**			**Gray, wet, 4% gravel, 31% fine to coarse sand, 65% low to medium plasticity fines, max size = 0.5 in., refusal at six feet**
6												**Bottom of Hole 6.0 ft.** **Elevation -20.8 ft. ±** **Sampled Below Water** **PID = (Cold/Hot) Photo Ionization Detector** **Samples were taken with a 3-1/4 in. inside diameter split barrel sampler driven by the Vibracore**
7												
8												
9												

* Indicates Estimated Frost Classification

Project: **Petersburg Navigation Improvements,**

Hole Number: **AP-33**

ALASKA DISTRICT
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Geotechnical and Materials Section

EXPLORATION LOG

Project: **Petersburg Navigation Improvements, Petersburg, Alaska**

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Date: **7 Apr 2018**

Drilling Agency: ☐ Alaska District ☒ Other **ERDC**

Datum: Vertical **MLLW** Horizontal **ASP1 NAD83**

Location: Northing: **1,818,381 ft. ±** Easting: **2,827,081 ft. ±**

Top of Hole Elevation: **-16.2 ft. ±**

Hole Number, Field: **TB-15**

Permanent: **AP-34**

Operator: **Tommy Kirklin**

Inspector: **Inocencio Roman**

Type of Hole: ☒ other **Gravity Environmental Vibracore**
☐ Test Pit ☐ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater: **Sampled Below Water**

Depth Drilled: **10.0 ft.**

Total Depth: **10.0 ft.**

Hammer Weight:

Split Spoon I.D.: **3.25 in.**

Size and Type of Bit: **NA**

Type of Equipment: **Gravity Environmental Vibracore**

Type of Samples: **Core**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	N-Value	Sample Type	Symbol	Classification ASTM: D 2487 or D 2488	PID (ppm)	% Water	Description and Remarks
0		1		**F4***				**SM**	**Silty SAND with Gravel**			**Gray, wet, 24% subangular to subrounded gravel, 30% fine to coarse sand, 46% low to medium plasticity fines, max size = 2 in.**
1		2		**F4***				**CL-ML**	**Sandy Silty Clay**			**Gray, wet, 6% subangular to subrounded gravel, 29% fine to coarse sand, 65% low to medium plasticity fines, Liquid Limit = 20, Plastic Limit = 15, Plasticity Index = 5**
10												**Bottom of Hole 10.0 ft.** **Elevation -26.2 ft. ±** **Sampled Below Water** **PID = (Cold/Hot) Photo Ionization Detector** **Samples were taken with a 3-1/4 in. inside diameter split barrel sampler driven by the Vibracore**

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13

* Indicates Estimated Frost Classification

Project: **Petersburg Navigation Improvements,**

Hole Number: **AP-34**

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EXPLORATION LOG

Project: **Petersburg Navigation Improvements, Petersburg, Alaska**

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Date: **7 Apr 2018**

Drilling Agency: ☐ Alaska District ☒ Other **ERDC**

Datum: Vertical **MLLW** Horizontal **ASP1 NAD83**

Location: Northing: **1,818,656 ft. ±** Easting: **2,827,340 ft. ±**

Top of Hole Elevation: **-3.5 ft. ±**

Hole Number, Field: **TB-16**

Permanent: **AP-35**

Operator: **Tommy Kirklin**

Inspector: **Inocencio Roman**

Type of Hole: ☒ other **Gravity Environmental Vibracore**
☐ Test Pit ☐ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater: **Sampled Below Water**

Depth Drilled: **1.7 ft.**

Total Depth: **1.7 ft.**

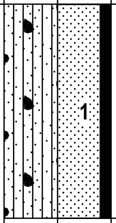
Hammer Weight:

Split Spoon I.D.: **3.25 in.**

Size and Type of Bit: **NA**

Type of Equipment: **Gravity Environmental Vibracore**

Type of Samples: **Core**



Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	N-Value	Sample Type	Symbol	Classification ASTM: D 2487 or D 2488	PID (ppm)	% Water	Description and Remarks
1		1		**F2***				**SM**	**Silty SAND with Gravel**			**Gray, wet, 29% subangular to subrounded gravel, 41% fine to coarse sand, 30% low to medium plasticity fines, max size = 1.5 in., seashells, refusal at 1.67 feet**
2 3 4 5 6 7 8 9												**Bottom of Hole 1.7 ft.** **Elevation -5.2 ft. ±** **Sampled Below Water** **PID = (Cold/Hot) Photo Ionization Detector** **Samples were taken with a 3-1/4 in. inside diameter split barrel sampler driven by the Vibracore**

* Indicates Estimated Frost Classification

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EXPLORATION LOG

Project: **Petersburg Navigation Improvements, Petersburg, Alaska**

Page 1 of 1

Date: **9 Apr 2018**

Drilling Agency: ☐ Alaska District ☒ Other **ERDC**

Datum: Vertical **MLLW** Horizontal **ASP1 NAD83**

Location: Northing: **1,818,405 ft. ±** Easting: **2,826,543 ft. ±**

Top of Hole Elevation: **-16.9 ft. ±**

Hole Number, Field: **TB-06A** Permanent: **AP-36**

Operator: **Tommy Kirklin**

Inspector: **Inocencio Roman**

Type of Hole: ☒ other **Gravity Environmental Vibracore**
☐ Test Pit ☐ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater: **Sampled Below Water**

Depth Drilled: **2.5 ft.**

Total Depth: **2.5 ft.**

Hammer Weight:

Split Spoon I.D.: **3.25 in.**

Size and Type of Bit: **NA**

Type of Equipment: **Gravity Environmental Vibracore**

Type of Samples: **Core**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	N-Value	Sample Type	Symbol	Classification ASTM: D 2487 or D 2488	PID (ppm)	% Water	Description and Remarks
1 2	▨	1		**F4***			■	**CL-ML**	**Sandy Silty Clay**			**Gray, wet, 11% subangular to subrounded gravel, 28% fine to coarse sand, 61% low to medium plasticity fines, seashells, seaweed, Liquid Limit = 20, Plastic Limit = 13, Plasticity Index = 7, refusal at 2.5 feet**
3 4 5 6 7 8 9												**Bottom of Hole 2.5 ft.** **Elevation -19.4 ft. ±** **Sampled Below Water** **PID = (Cold/Hot) Photo Ionization Detector** **Samples were taken with a 3-1/4 in. inside diameter split barrel sampler driven by the Vibracore**

* Indicates Estimated Frost Classification

Project: **Petersburg Navigation Improvements,**

Hole Number: **AP-36**

EXPLORATION LOG 2018 SOUTH HARBOR - REV.GPJ BUCKLAND.GPJ 8/29/18

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Geotechnical and Materials Section

EXPLORATION LOG

Project: **Petersburg Navigation Improvements, Petersburg, Alaska**

Page 1 of 1

Date: **9 Apr 2018**

Drilling Agency: ☐ Alaska District ☒ Other **ERDC**

Datum: Vertical **MLLW** Horizontal **ASP1 NAD83**

Location: Northing: **1,818,577 ft. ±** Easting: **2,826,807 ft. ±**

Top of Hole Elevation: **-15.3 ft. ±**

Hole Number, Field: **TB-12A** Permanent: **AP-37**

Operator: **Tommy Kirklin**

Inspector: **Inocencio Roman**

Type of Hole: ☒ other **Gravity Environmental Vibracore**
☐ Test Pit ☐ Auger Hole ☐ Monitoring Well ☐ Piezometer

Depth to Groundwater: **Sampled Below Water**

Depth Drilled: **2.5 ft.**

Total Depth: **2.5 ft.**

Hammer Weight:

Split Spoon I.D.: **3.25 in.**

Size and Type of Bit: **NA**

Type of Equipment: **Gravity Environmental Vibracore**

Type of Samples: **Core**

Depth (ft.)	Lithology	Sample Recovery	ASTM D 4083 Frozen	Frost Class. ufc3-250-01fa	Blow Count	N-Value	Sample Type	Symbol	Classification ASTM: D 2487 or D 2488	PID (ppm)	% Water	Description and Remarks
		1		F4*				ML	Sandy SILT			Gray, wet, 13% subangular to subrounded gravel, 31% fine to coarse sand, 56% low to medium plasticity fines, max size = 1.5 in., seashells
1		2		F4*				ML	Sandy SILT			Gray, wet, 12% subangular to subrounded gravel, 31% fine to coarse sand, 57% low to medium plasticity fines, max size = 1.5 in., Liquid Limit = 19, Plastic Limit = 16, Plasticity Index = 3, refusal at 2.5 feet
2												
3												Bottom of Hole 2.5 ft. Elevation -17.8 ft. ± Sampled Below Water PID = (Cold/Hot) Photo Ionization Detector Samples were taken with a 3-1/4 in. inside diameter split barrel sampler driven by the Vibracore
4												
5												
6												
7												
8												
9												

* Indicates Estimated Frost Classification

Project: **Petersburg Navigation Improvements,**

Hole Number: **AP-37**

Appendix C

Laboratory Test Results

Summary of Laboratory Test Results

Petersburg South Harbor Navigation Improvements

Petersburg, Alaska

NGE-TFT Project #:4977-18

Exploration ID	Sample Number	Depth Interval		Atterberg Limit ASTM D4318	Particle Size Analysis ASTM C136/D422/D6913 (% By Mass)			Passing 0.02mm ASTM D7928 (% By Mass)	Frost Class.	Unified Soil Classification ASTM D2487
		(ft) Top	(ft) Bottom		Gravel	Sand	Silt/Clay			
TB-01	S-1	0.0	3.0		2.0	58.0	40.0			(SM) Silty sand
TB-02	S-1	0.0	1.0		6.6	89.8	3.6			(SP) Poorly-graded sand
TB-03	S-1	0.0	1.0		4.6	58.5	36.9			(SM) Silty sand
TB-04	S-1	0.0	2.0	LL=30	0.2	82.0	17.8			(SM) Silty sand
TB-05	S-1	0.0	1.0		21.3	27.9	50.8			(ML) Sandy silt w/ gravel
TB-05	S-2	1.0	3.0	LL=24 / PL=17 / PI=7	8.2	25.0	66.8			(CL-ML) Sandy silty clay
TB-06	S-1	0.0	1.0		8.7	41.0	50.3			(ML) Sandy silt
TB-06A	S-1	0.0	2.5	LL=20 / PL=13 / PI=7	10.9	28.3	60.8			(CL-ML) Sandy silty clay
TB-07	S-1	0.0	1.0		20.8	68.4	10.8			(SP-SM) Poorly-graded sand w/ silt and gravel
TB-08	S-1	0.0	1.8		13.4	82.8	3.8			(SP) Poorly-graded sand
TB-08	S-2	1.8	3.5		19.1	75.0	5.9			(SP-SM) Poorly-graded sand w/ silt and gravel
TB-09	S-1	0.0	0.6		24.1	56.4	19.5			(SM) Silty sand w/ gravel
TB-10	S-1	0.0	1.0		7.8	86.6	5.6			(SP-SM) Poorly-graded sand w/ silt
TB-11	S-1	0.0	1.0		18.6	36.9	44.5			(SM) Silty sand w/ gravel
TB-12	S-1	0.0	2.5		13.6	36.7	49.7			(SM) Silty sand
TB-12A	S-1	0.0	1.0		12.6	31.1	56.3			(ML) Sandy silt
TB-12A	S-2	1.0	2.5	LL=19 / PL=16 / PI=3	12.4	30.7	56.9			(ML) Sandy silt
TB-13	S-1	0.0	2.0		11.2	34.8	54.0			(ML) Sandy silt
TB-13	S-2	2.0	7.0	LL=19 / PL=16 / PI=3	15.3	26.4	58.3			(ML) Sandy silt w/ gravel
TB-14	S-1	0.0	1.0		16.2	37.5	46.3			(SM) Silty sand w/ gravel
TB-14	S-2	1.0	6.0		3.6	31.2	65.2			(ML) Sandy silt
TB-15	S-1	0.0	1.0		23.7	30.2	46.1			(SM) Silty sand w/ gravel
TB-15	S-2	1.0	10.0	LL=20 / PL=15 / PI=5	6.1	28.9	65.0			(CL-ML) Sandy silty clay
TB-16	S-1	0.0	1.6		28.9	41.2	29.9			(SM) Silty sand w/ gravel

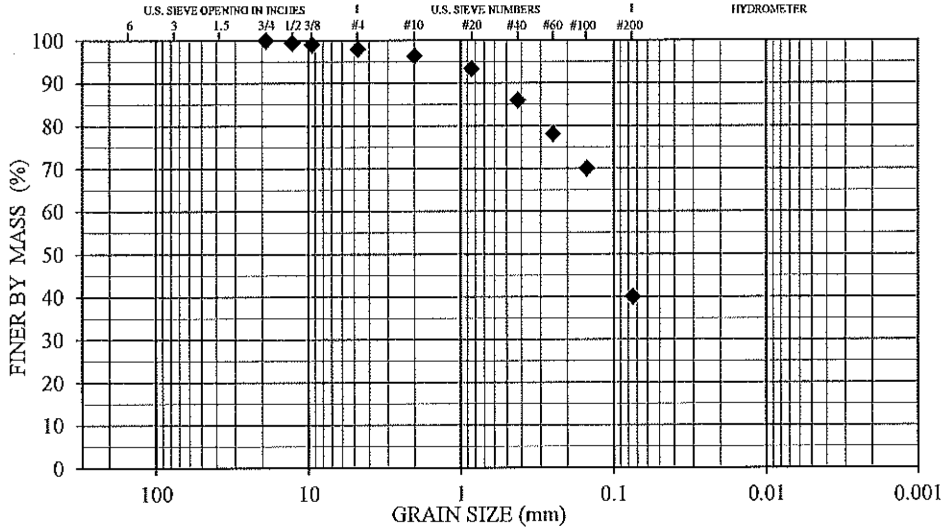
NORTHERN GEOTECHNICAL ENGINEERING, INC. / TERRA FIRMA TESTING

Laboratory Testing Geotechnical Engineering Instrumentation Construction Monitoring Services Thermal Analysis

PROJECT CLIENT:	**U.S. Army Corps of Engineers**
PROJECT NAME:	**Petersburg S. Harbor Navigation Improvements**
PROJECT NO.:	**4977-18**
SAMPLE LOC.:	**TB-01**
NUMBER/ DEPTH:	**S-1 / 0' - 3'**
DESCRIPTION:	**Silty sand**
DATE RECEIVED:	**4/13/2018**
TESTED BY:	**JA**
REVIEWED BY:	**RJPC**

% GRAVEL	**2.0**	USCS	**SM**
% SAND	**58.0**	USACOE FC	**N/A**
% SILT/CLAY	**40.0**	% PASS. 0.02 mm	**N/A**
% MOIST. CONTENT		% PASS. 0.002 mm	**N/A**
UNIFORMITY COEFFICIENT (C_u)			**UNKNOWN**
COEFFICIENT OF GRADATION (C_c)			**UNKNOWN**
ASTM D1557 (uncorrected)			**N/A**
ASTM D4718 (corrected)			**N/A**
OPTIMUM MOIST. CONTENT. (corrected)			**N/A**

PARTICLE SIZE ANALYSIS ASTM D7928 / C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

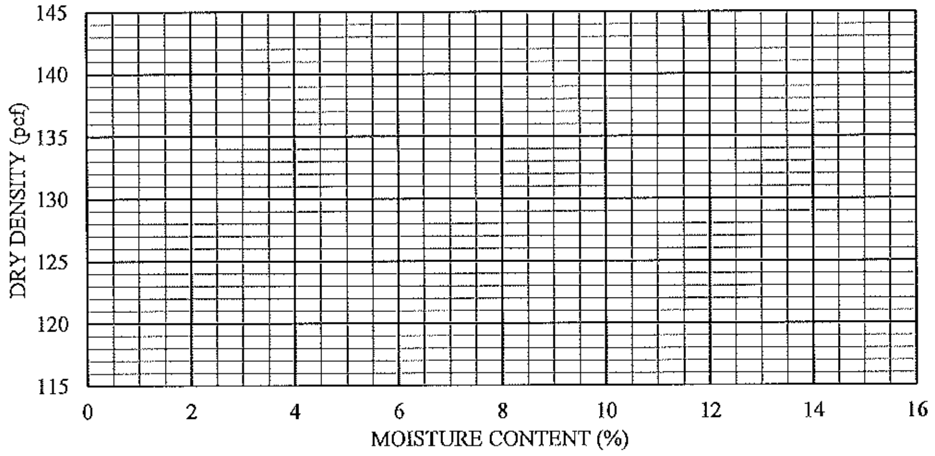
SIEVE ANALYSIS RESULT

SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"		
38.10	1.5"		
19.00	3/4"	**100**	
12.70	1/2"	**99**	
9.50	3/8"	**99**	
4.75	#4	**98**	
2.00	#10	**96**	
0.85	#20	**93**	
0.43	#40	**86**	
0.25	#60	**78**	
0.15	#100	**70**	
0.075	#200	**40.0**	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



HYDRAULIC COND. (ASTM D2434)	
DEGRADATION (ATM T-313)	
ATTERBERG LIMITS ASTM 4318	

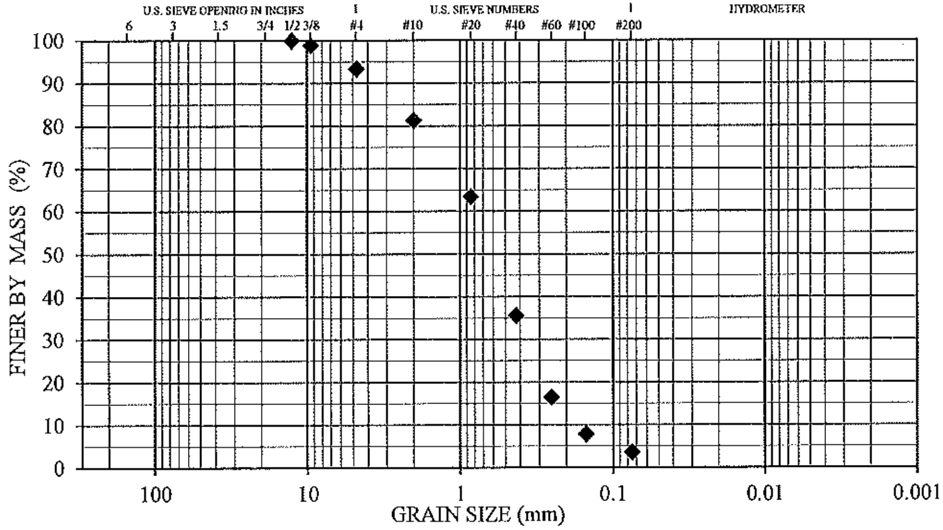
NORTHERN GEOTECHNICAL ENGINEERING, INC. / TERRA FIRMA TESTING

Laboratory Testing · Geotechnical Engineering · Instrumentation · Construction Monitoring Services · Thermal Analysis

PROJECT CLIENT:	**U.S. Army Corps of Engineers**
PROJECT NAME:	**Petersburg S. Harbor Navigation Improvements**
PROJECT NO.:	**4977-18**
SAMPLE LOC.:	**TB-02**
NUMBER/ DEPTH:	**S-1 / 0' - 1'**
DESCRIPTION:	**Poorly-graded sand**
DATE RECEIVED:	**4/13/2018**
TESTED BY:	**JA**
REVIEWED BY:	**RJPC**

% GRAVEL	**6.6**	USCS	**SP**
% SAND	**89.8**	USACOE FC	**N/A**
% SILT/CLAY	**3.6**	% PASS. 0.02 mm	**N/A**
% MOIST. CONTENT		% PASS. 0.002 mm	**N/A**
UNIFORMITY COEFFICIENT (C_u)	**4.6**		
COEFFICIENT OF GRADATION (C_c)	**1.0**		
ASTM D1557 (uncorrected)	**N/A**		
ASTM D4718 (corrected)	**N/A**		
OPTIMUM MOIST. CONTENT. (corrected)	**N/A**		

PARTICLE SIZE ANALYSIS ASTM D7928 / C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

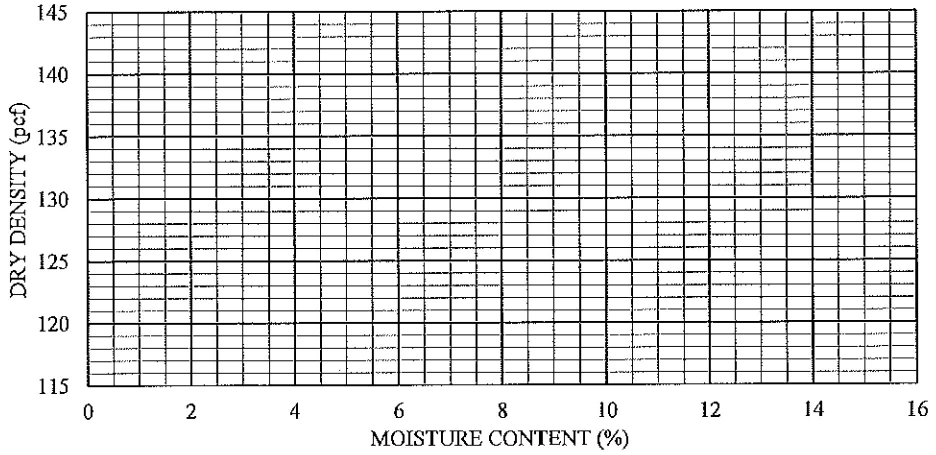
SIEVE ANALYSIS RESULT

SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"		
38.10	1.5"		
19.00	3/4"		
12.70	1/2"	**100**	
9.50	3/8"	**99**	
4.75	#4	**93**	
2.00	#10	**81**	
0.85	#20	**63**	
0.43	#40	**36**	
0.25	#60	**16**	
0.15	#100	**8**	
0.075	#200	**3.6**	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



HYDRAULIC COND. (ASTM D2434)	
DEGRADATION (ATM T-313)	
ATTERBERG LIMITS ASTM 4318	

NORTHERN GEOTECHNICAL ENGINEERING, INC. / TERRA FIRMA TESTING

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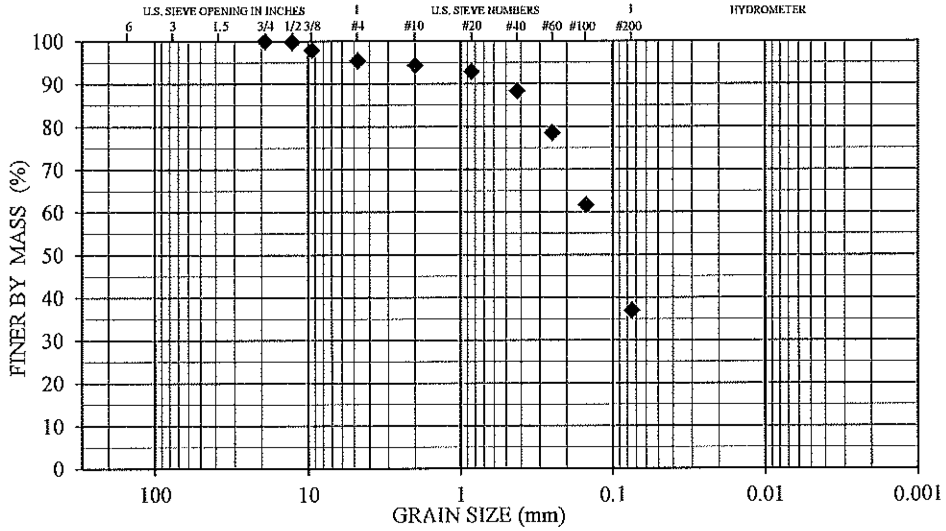
PROJECT CLIENT:	**U.S. Army Corps of Engineers**
PROJECT NAME:	**Petersburg S. Harbor Navigation Improvements**
PROJECT NO.:	**4977-18**
SAMPLE LOC.:	**TB-03**
NUMBER/ DEPTH:	**S-1 / 0' - 1'**
DESCRIPTION:	**Silty sand**
DATE RECEIVED:	**4/13/2018**
TESTED BY:	**JA**
REVIEWED BY:	**RJPC**

% GRAVEL	**4.6**	USCS	**SM**
% SAND	**58.5**	USACOE FC	**N/A**
% SILT/CLAY	**36.9**	% PASS. 0.02 mm	**N/A**
% MOIST. CONTENT		% PASS. 0.002 mm	**N/A**
UNIFORMITY COEFFICIENT (C_u)			**UNKNOWN**
COEFFICIENT OF GRADATION (C_c)			**UNKNOWN**
ASTM D1557 (uncorrected)			**N/A**
ASTM D4718 (corrected)			**N/A**
OPTIMUM MOIST. CONTENT. (corrected)			**N/A**

PARTICLE SIZE ANALYSIS ASTM D7928 / C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

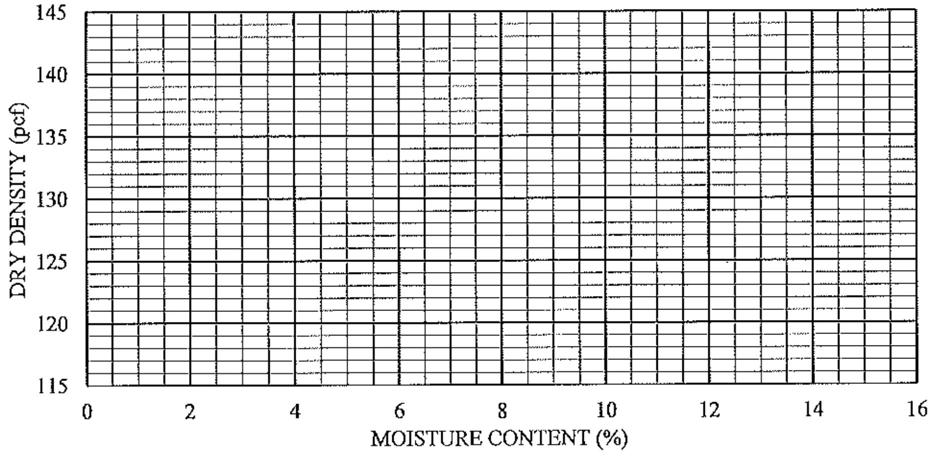
SIEVE ANALYSIS RESULT

SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"		
38.10	1.5"		
19.00	3/4"	**100**	
12.70	1/2"	**100**	
9.50	3/8"	**98**	
4.75	#4	**95**	
2.00	#10	**94**	
0.85	#20	**93**	
0.43	#40	**88**	
0.25	#60	**79**	
0.15	#100	**62**	
0.075	#200	**36.9**	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



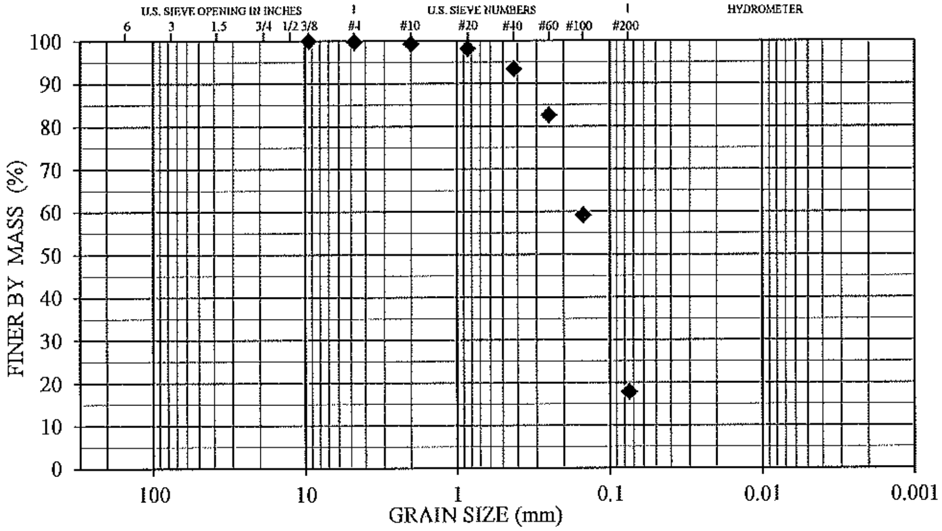
HYDRAULIC COND. (ASTM D2434)	
DEGRADATION (ATM T-313)	
ATTERBERG LIMITS ASTM 4318	

PROJECT CLIENT:	**U.S. Army Corps of Engineers**
PROJECT NAME:	**Petersburg S. Harbor Navigation Improvements**
PROJECT NO.:	**4977-18**
SAMPLE LOC.:	**TB-04**
NUMBER/ DEPTH:	**S-1 / 0' - 2'**
DESCRIPTION:	**Silty sand**
DATE RECEIVED:	**4/13/2018**
TESTED BY:	**JA**
REVIEWED BY:	**RJPC**

% GRAVEL	**0.2**	USCS	**SM**
% SAND	**82.0**	USACOE FC	**N/A**
% SILT/CLAY	**17.8**	% PASS. 0.02 mm	**N/A**
% MOIST. CONTENT		% PASS. 0.002 mm	**N/A**

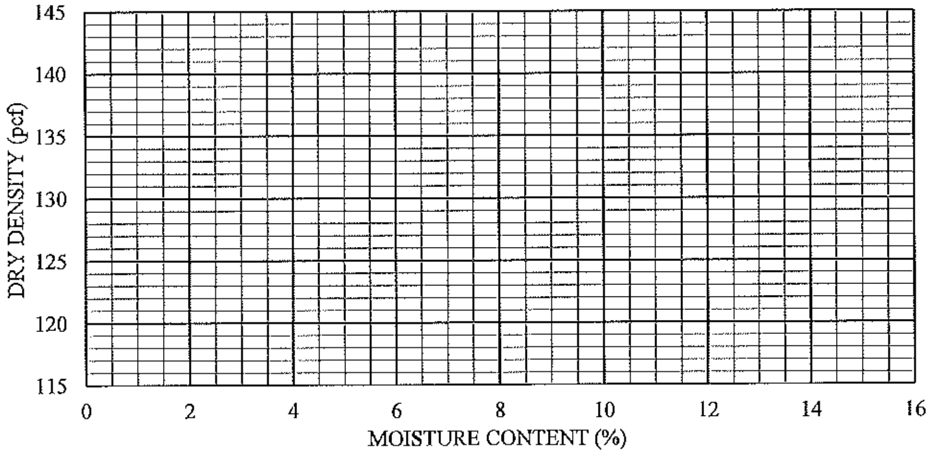
UNIFORMITY COEFFICIENT (C_u)	**UNKNOWN**
COEFFICIENT OF GRADATION (C_c)	**UNKNOWN**
ASTM D1557 (uncorrected)	**N/A**
ASTM D4718 (corrected)	**N/A**
OPTIMUM MOIST. CONTENT. (corrected)	**N/A**

PARTICLE SIZE ANALYSIS ASTM D7928 / C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



SIEVE ANALYSIS RESULT

SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"		
38.10	1.5"		
19.00	3/4"		
12.70	1/2"		
9.50	3/8"	**100**	
4.75	#4	**100**	
2.00	#10	**99**	
0.85	#20	**98**	
0.43	#40	**93**	
0.25	#60	**83**	
0.15	#100	**59**	
0.075	#200	**17.8**	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

HYDRAULIC COND. (ASTM D2434)	
DEGRADATION (ATM T-313)	
ATTERBERG LIMITS ASTM 4318	**LL = 30**

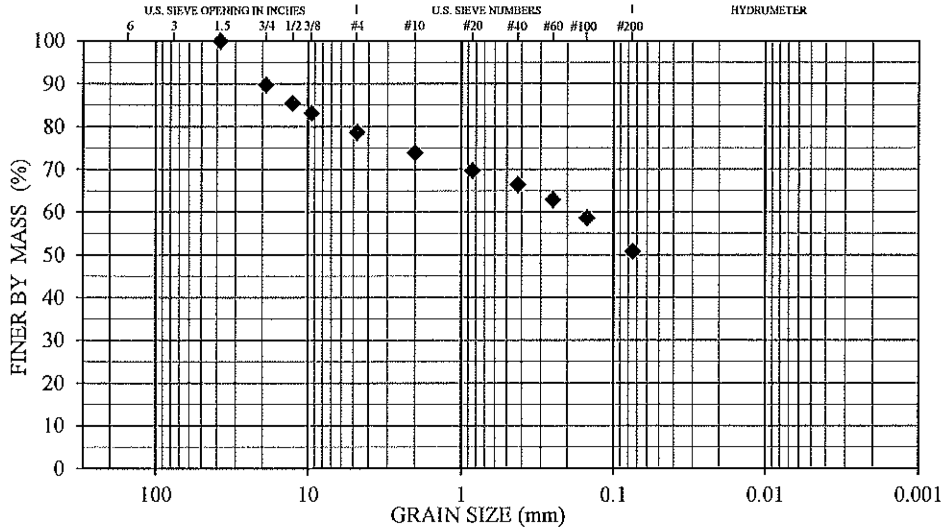
NORTHERN GEOTECHNICAL ENGINEERING, INC. / TERRA FIRMA TESTING

Laboratory Testing · Geotechnical Engineering · Instrumentation · Construction Monitoring Services · Thermal Analysis

PROJECT CLIENT:	**U.S. Army Corps of Engineers**
PROJECT NAME:	**Petersburg S. Harbor Navigation Improvements**
PROJECT NO.:	**4977-18**
SAMPLE LOC.:	**TB-05**
NUMBER/ DEPTH:	**S-1 / 0' - 1'**
DESCRIPTION:	**Sandy silt w/ gravel**
DATE RECEIVED:	**4/13/2018**
TESTED BY:	**JA**
REVIEWED BY:	**RJPC**

% GRAVEL	**21.3**	USCS	**ML**
% SAND	**27.9**	USACOE FC	**N/A**
% SILT/CLAY	**50.8**	% PASS. 0.02 mm	**N/A**
% MOIST. CONTENT		% PASS. 0.002 mm	**N/A**
UNIFORMITY COEFFICIENT (C_u)	**UNKNOWN**		
COEFFICIENT OF GRADATION (C_c)	**UNKNOWN**		
ASTM D1557 (uncorrected)	**N/A**		
ASTM D4718 (corrected)	**N/A**		
OPTIMUM MOIST. CONTENT. (corrected)	**N/A**		

PARTICLE SIZE ANALYSIS ASTM D7928 / C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

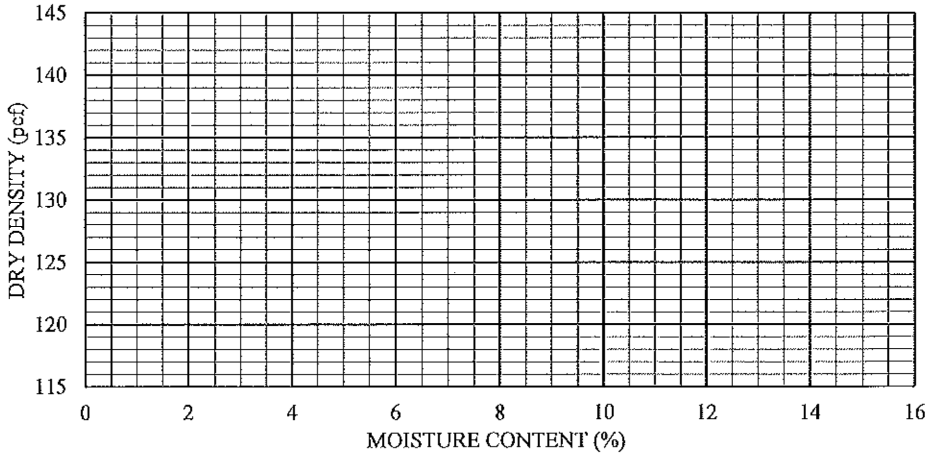
SIEVE ANALYSIS RESULT

SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"		
38.10	1.5"	**100**	
19.00	3/4"	**90**	
12.70	1/2"	**85**	
9.50	3/8"	**83**	
4.75	#4	**79**	
2.00	#10	**74**	
0.85	#20	**70**	
0.43	#40	**66**	
0.25	#60	**63**	
0.15	#100	**59**	
0.075	#200	**50.8**	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



HYDRAULIC COND. (ASTM D2434)	
DEGRADATION (ATM T-313)	
ATTERBERG LIMITS ASTM 4318	

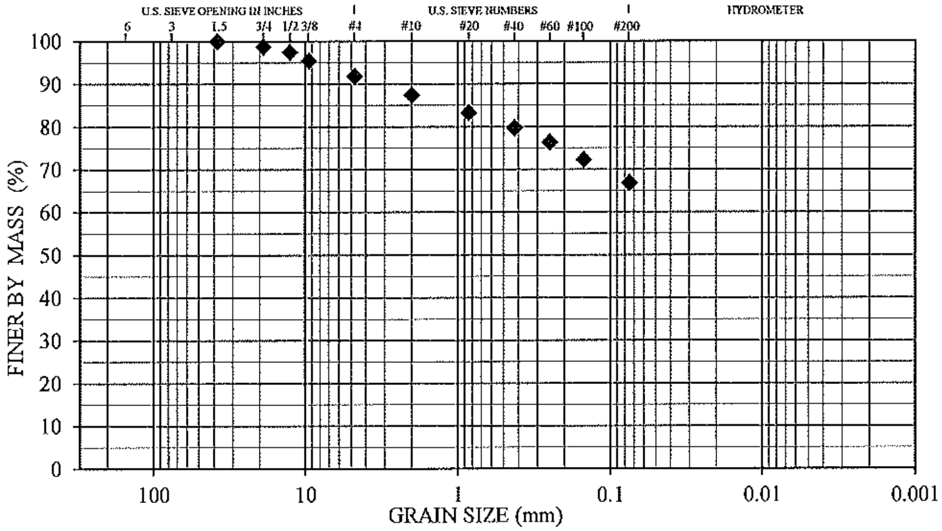
NORTHERN GEOTECHNICAL ENGINEERING, INC. / TERRA FIRMA TESTING

Laboratory Testing · Geotechnical Engineering · Instrumentation · Construction Monitoring Services · Thermal Analysis

PROJECT CLIENT:	**U.S. Army Corps of Engineers**
PROJECT NAME:	**Petersburg S. Harbor Navigation Improvements**
PROJECT NO.:	**4977-18**
SAMPLE LOC.:	**TB-05**
NUMBER/ DEPTH:	**S-2 / 1' - 3'**
DESCRIPTION:	**Sandy silty clay**
DATE RECEIVED:	**4/13/2018**
TESTED BY:	**JA**
REVIEWED BY:	**RJPC**

% GRAVEL	**8.2**	USCS	**CL-ML**
% SAND	**25.0**	USACOE FC	**N/A**
% SILT/CLAY	**66.8**	% PASS. 0.02 mm	**N/A**
% MOIST. CONTENT		% PASS. 0.002 mm	**N/A**
UNIFORMITY COEFFICIENT (C_u)			**UNKNOWN**
COEFFICIENT OF GRADATION (C_c)			**UNKNOWN**
ASTM D1557 (uncorrected)			**N/A**
ASTM D4718 (corrected)			**N/A**
OPTIMUM MOIST. CONTENT. (corrected)			**N/A**

PARTICLE SIZE ANALYSIS ASTM D7928 / C136

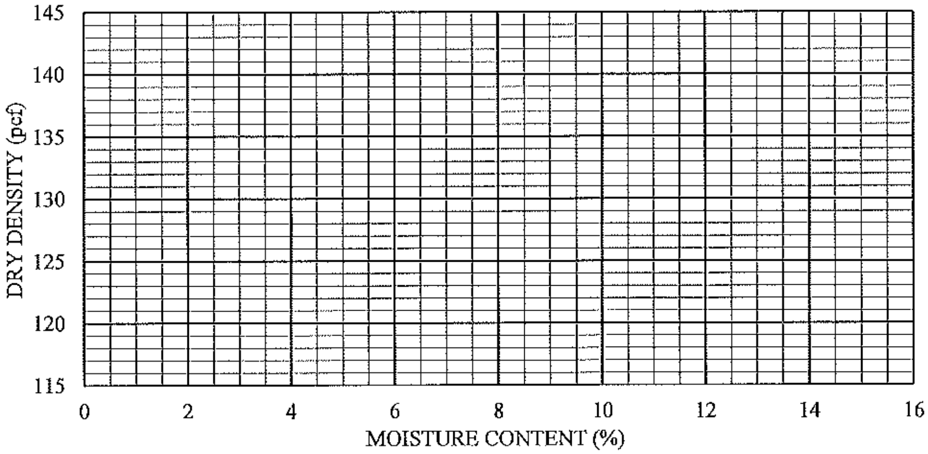


COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SIEVE ANALYSIS RESULT

SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"		
38.10	1.5"	**100**	
19.00	3/4"	**99**	
12.70	1/2"	**97**	
9.50	3/8"	**95**	
4.75	#4	**92**	
2.00	#10	**87**	
0.85	#20	**83**	
0.43	#40	**80**	
0.25	#60	**76**	
0.15	#100	**72**	
0.075	#200	**66.8**	

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

HYDRAULIC COND. (ASTM D2434)	
DEGRADATION (ATM T-313)	
ATTERBERG LIMITS ASTM 4318	**LL = 24** **PI = 7**

NORTHERN GEOTECHNICAL ENGINEERING, INC. / TERRA FIRMA TESTING

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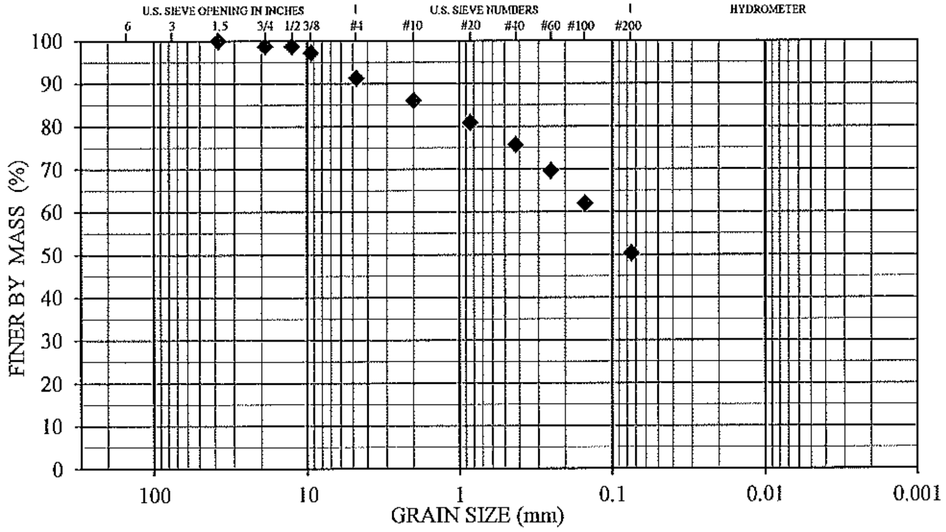
PROJECT CLIENT:	**U.S. Army Corps of Engineers**
PROJECT NAME:	**Petersburg S. Harbor Navigation Improvements**
PROJECT NO.:	**4977-18**
SAMPLE LOC.:	**TB-06**
NUMBER/ DEPTH:	**S-1 / 0' - 1'**
DESCRIPTION:	**Sandy silt**
DATE RECEIVED:	**4/13/2018**
TESTED BY:	**JA**
REVIEWED BY:	**RJPC**

% GRAVEL	**8.7**	USCS	**ML**
% SAND	**41.0**	USACOE FC	**N/A**
% SILT/CLAY	**50.3**	% PASS. 0.02 mm	**N/A**
% MOIST. CONTENT		% PASS. 0.002 mm	**N/A**
UNIFORMITY COEFFICIENT (C_u)			**UNKNOWN**
COEFFICIENT OF GRADATION (C_c)			**UNKNOWN**
ASTM D1557 (uncorrected)			**N/A**
ASTM D4718 (corrected)			**N/A**
OPTIMUM MOIST. CONTENT. (corrected)			**N/A**

PARTICLE SIZE ANALYSIS ASTM D7928 / C136

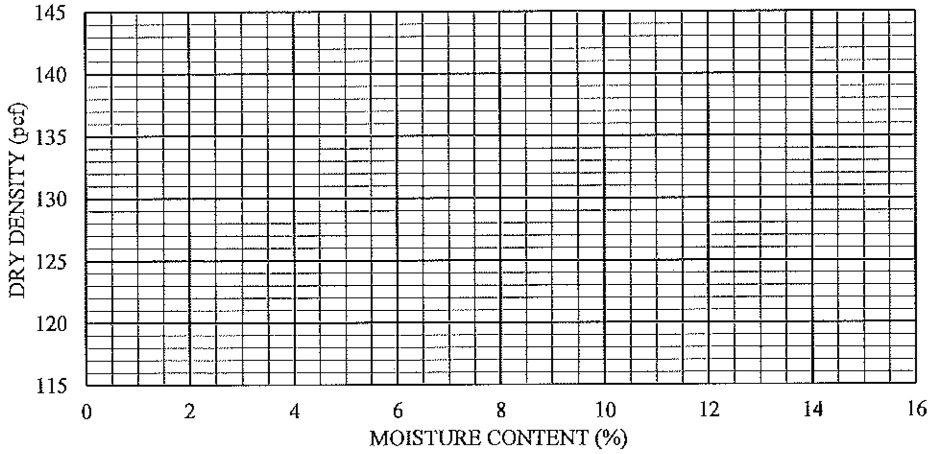


COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SIEVE ANALYSIS RESULT

SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"		
38.10	1.5"	**100**	
19.00	3/4"	**99**	
12.70	1/2"	**99**	
9.50	3/8"	**97**	
4.75	#4	**91**	
2.00	#10	**86**	
0.85	#20	**81**	
0.43	#40	**76**	
0.25	#60	**70**	
0.15	#100	**62**	
0.075	#200	**50.4**	

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



HYDROMETER RESULT

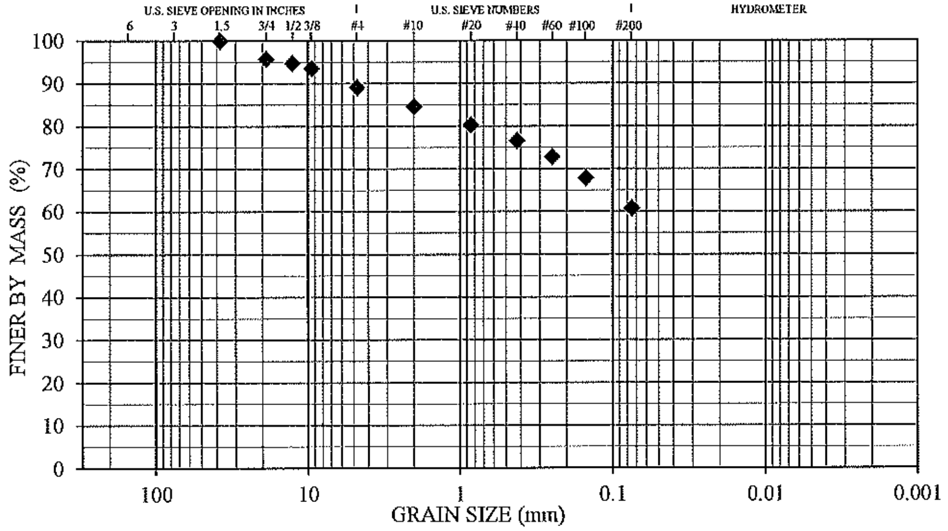
ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

HYDRAULIC COND. (ASTM D2434)	
DEGRADATION (ATM T-313)	
ATTERBERG LIMITS ASTM 4318	

PROJECT CLIENT:	**U.S. Army Corps of Engineers**
PROJECT NAME:	**Petersburg S. Harbor Navigation Improvements**
PROJECT NO.:	**4977-18**
SAMPLE LOC.:	**TB-06A**
NUMBER/ DEPTH:	**S-1 / 0' - 2.5'**
DESCRIPTION:	**Sandy silty clay**
DATE RECEIVED:	**4/13/2018**
TESTED BY:	**JA**
REVIEWED BY:	**RJPC**

% GRAVEL	**10.9**	USCS	**CL-ML**
% SAND	**28.3**	USACOE FC	**N/A**
% SILT/CLAY	**60.8**	% PASS. 0.02 mm	**N/A**
% MOIST. CONTENT		% PASS. 0.002 mm	**N/A**
UNIFORMITY COEFFICIENT (C_u)			**UNKNOWN**
COEFFICIENT OF GRADATION (C_c)			**UNKNOWN**
ASTM D1557 (uncorrected)			**N/A**
ASTM D4718 (corrected)			**N/A**
OPTIMUM MOIST. CONTENT. (corrected)			**N/A**

PARTICLE SIZE ANALYSIS ASTM D7928 / C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SIEVE ANALYSIS RESULT

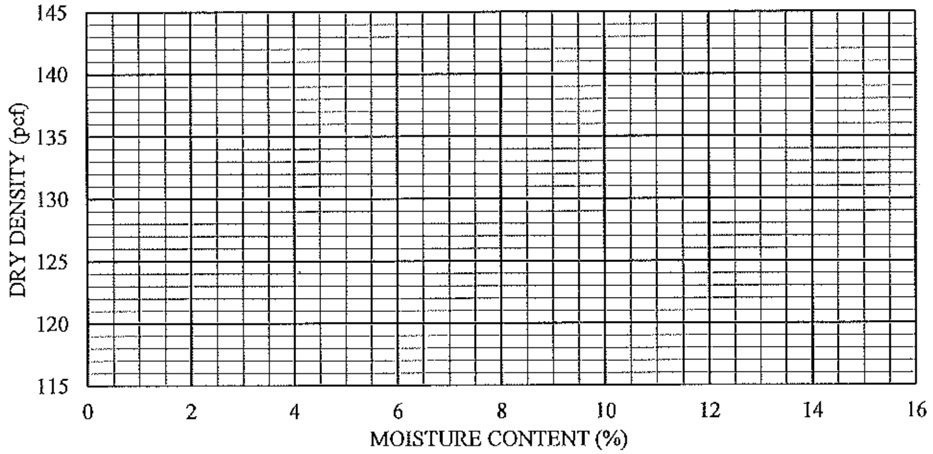
SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"		
38.10	1.5"	**100**	
19.00	3/4"	**96**	
12.70	1/2"	**95**	
9.50	3/8"	**94**	
4.75	#4	**89**	
2.00	#10	**85**	
0.85	#20	**80**	
0.43	#40	**77**	
0.25	#60	**73**	
0.15	#100	**68**	
0.075	#200	**60.8**	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

HYDRAULIC COND. (ASTM D2434)	
DEGRADATION (ATM T-313)	
ATTERBERG LIMITS ASTM 4318	**LL =20** **PI = 7**

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



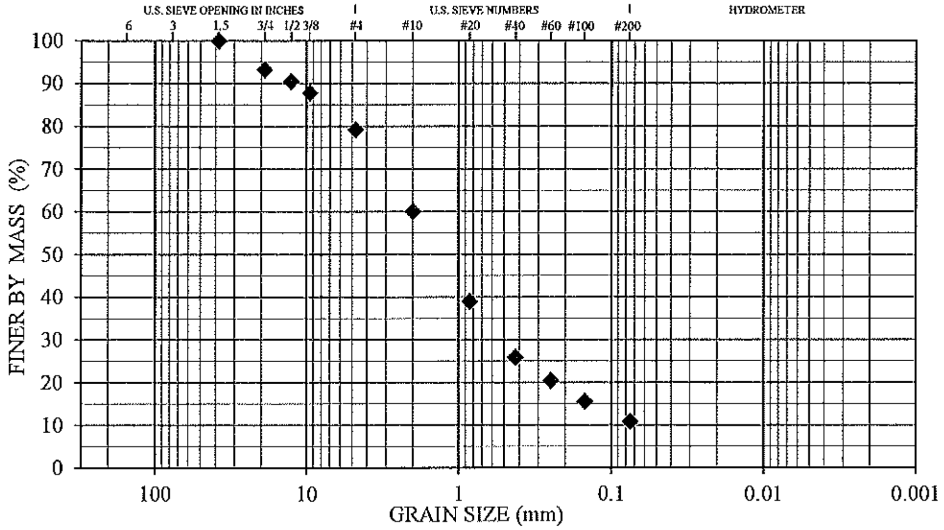
NORTHERN GEOTECHNICAL ENGINEERING, INC. ⁄ TERRA FIRMA TESTING

Laboratory Testing · Geotechnical Engineering · Instrumentation · Construction Monitoring Services · Thermal Analysis

PROJECT CLIENT:	**U.S. Army Corps of Engineers**
PROJECT NAME:	**Petersburg S. Harbor Navigation Improvements**
PROJECT NO.:	**4977-18**
SAMPLE LOC.:	**TB-07**
NUMBER/ DEPTH:	**S-1 / 0' - 1'**
DESCRIPTION:	**Poorly-graded sand w/ silt and gravel**
DATE RECEIVED:	**4/13/2018**
TESTED BY:	**JA**
REVIEWED BY:	**RJPC**

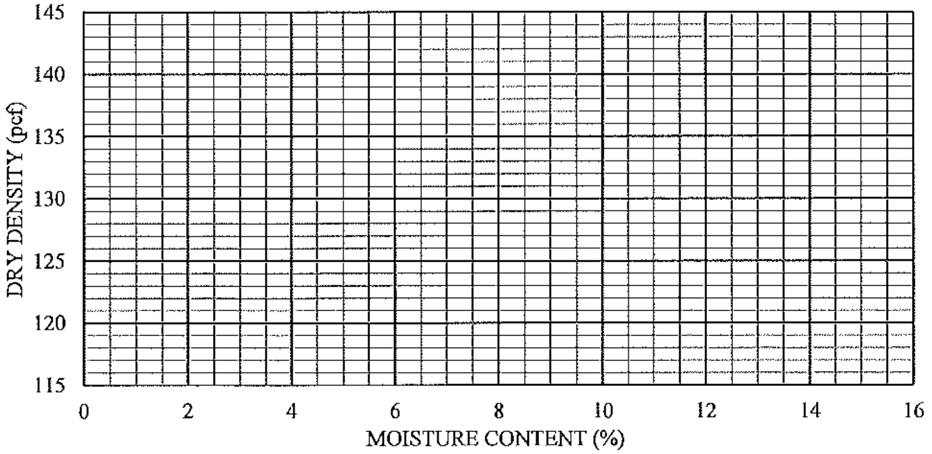
% GRAVEL	**20.8**	USCS	**SP-SM**
% SAND	**68.4**	USACOE FC	**N/A**
% SILT/CLAY	**10.8**	% PASS. 0.02 mm	**N/A**
% MOIST. CONTENT		% PASS. 0.002 mm	**N/A**
UNIFORMITY COEFFICIENT (C_u)			**UNKNOWN**
COEFFICIENT OF GRADATION (C_c)			**UNKNOWN**
ASTM D1557 (uncorrected)			**N/A**
ASTM D4718 (corrected)			**N/A**
OPTIMUM MOIST. CONTENT. (corrccted)			**N/A**

PARTICLE SIZE ANALYSIS ASTM D7928 / C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



SIEVE ANALYSIS RESULT

SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"		
38.10	1.5"	**100**	
19.00	3/4"	**93**	
12.70	1/2"	**91**	
9.50	3/8"	**88**	
4.75	#4	**79**	
2.00	#10	**60**	
0.85	#20	**39**	
0.43	#40	**26**	
0.25	#60	**20**	
0.15	#100	**16**	
0.075	#200	**10.8**	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

HYDRAULIC COND. (ASTM D2434)	
DEGRADATION (ATM T-313)	
ATTERBERG LIMITS ASTM 4318	

NORTHERN GEOTECHNICAL ENGINEERING, INC. / TERRA FIRMA TESTING

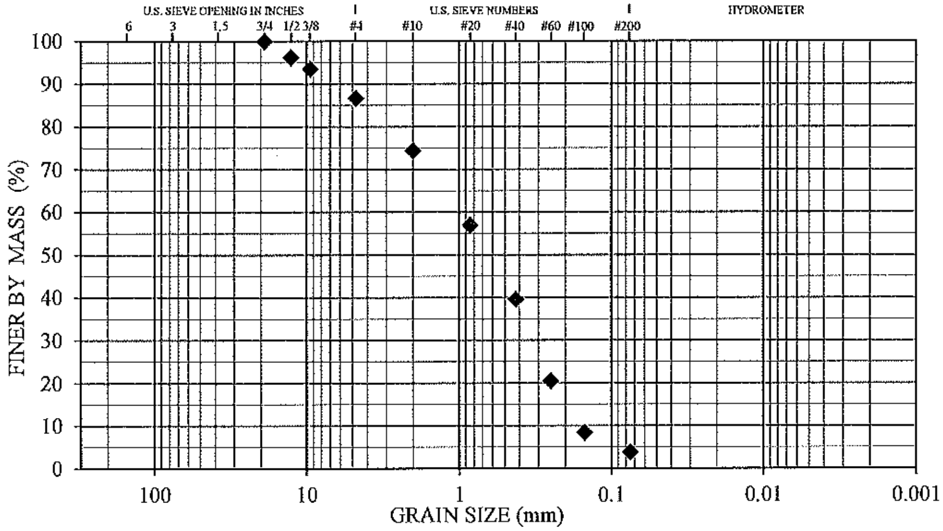
Laboratory Testing   Geotechnical Engineering   Instrumentation   Construction Monitoring Services   Thermal Analysis

PROJECT CLIENT:	**U.S. Army Corps of Engineers**
PROJECT NAME:	**Petersburg S. Harbor Navigation Improvements**
PROJECT NO.:	**4977-18**
SAMPLE LOC.:	**TB-08**
NUMBER/ DEPTH:	**S-1 / 0' - 1.8'**
DESCRIPTION:	**Poorly-graded sand**
DATE RECEIVED:	**4/13/2018**
TESTED BY:	**JA**
REVIEWED BY:	**RJPC**

% GRAVEL	**13.4**	USCS	**SP**
% SAND	**82.8**	USACOE FC	**N/A**
% SILT/CLAY	**3.8**	% PASS. 0.02 mm	**N/A**
% MOIST. CONTENT		% PASS. 0.002 mm	**N/A**

UNIFORMITY COEFFICIENT (C_u)	**6.4**
COEFFICIENT OF GRADATION (C_c)	**0.7**
ASTM D1557 (uncorrected)	**N/A**
ASTM D4718 (corrected)	**N/A**
OPTIMUM MOIST. CONTENT. (corrected)	**N/A**

PARTICLE SIZE ANALYSIS ASTM D7928 / C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

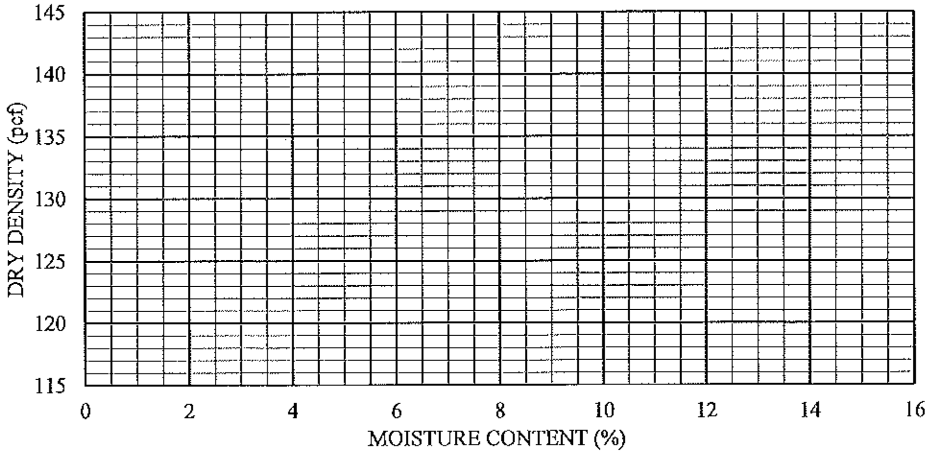
SIEVE ANALYSIS RESULT

SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"		
38.10	1.5"		
19.00	3/4"	**100**	
12.70	1/2"	**96**	
9.50	3/8"	**93**	
4.75	#4	**87**	
2.00	#10	**74**	
0.85	#20	**57**	
0.43	#40	**40**	
0.25	#60	**20**	
0.15	#100	**8**	
0.075	#200	**3.8**	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



HYDRAULIC COND. (ASTM D2434)	
DEGRADATION (ATM T-313)	
ATTERBERG LIMITS ASTM 4318	

NORTHERN GEOTECHNICAL ENGINEERING, INC. / TERRA FIRMA TESTING

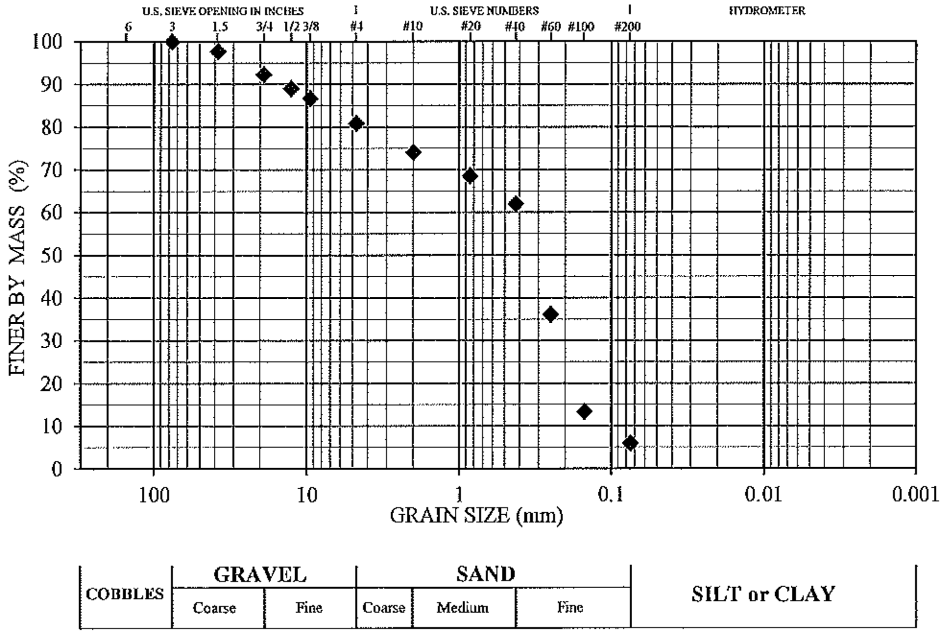
Laboratory Testing   Geotechnical Engineering   Instrumentation   Construction Monitoring Services   Thermal Analysis

PROJECT CLIENT:	**U.S. Army Corps of Engineers**
PROJECT NAME:	**Petersburg S. Harbor Navigation Improvements**
PROJECT NO.:	**4977-18**
SAMPLE LOC.:	**TB-08**
NUMBER/ DEPTH:	**S-2 / 1.8' - 3.5'**
DESCRIPTION:	**Poorly-graded sand w/ silt and gravel**
DATE RECEIVED:	**4/13/2018**
TESTED BY:	**JA**
REVIEWED BY:	**RJPC**

% GRAVEL	**19.1**	USCS	**SP-SM**
% SAND	**75.0**	USACOE FC	**N/A**
% SILT/CLAY	**5.9**	% PASS. 0.02 mm	**N/A**
% MOIST. CONTENT		% PASS. 0.002 mm	**N/A**

UNIFORMITY COEFFICIENT (C_u)	**3.5**
COEFFICIENT OF GRADATION (C_c)	**1.0**
ASTM D1557 (uncorrected)	**N/A**
ASTM D4718 (corrected)	**N/A**
OPTIMUM MOIST. CONTENT. (corrected)	**N/A**

PARTICLE SIZE ANALYSIS ASTM D7928 / C136



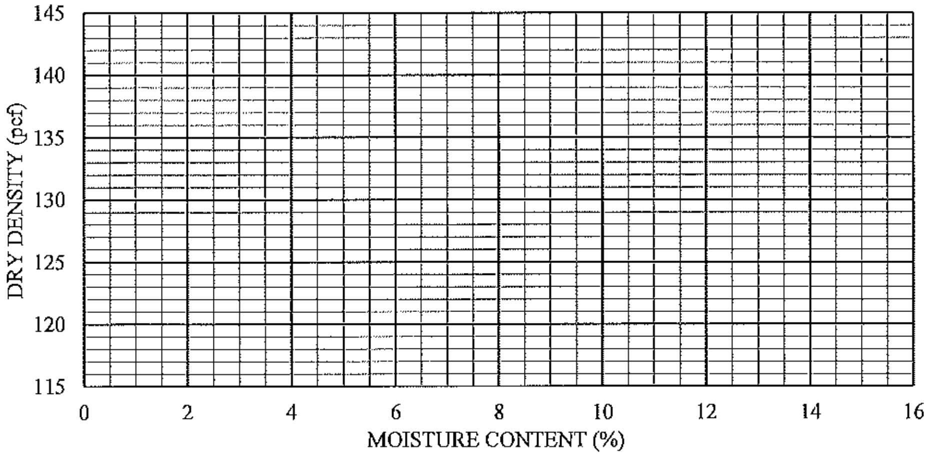
SIEVE ANALYSIS RESULT

SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"	**100**	
38.10	1.5"	**98**	
19.00	3/4"	**92**	
12.70	1/2"	**89**	
9.50	3/8"	**87**	
4.75	#4	**81**	
2.00	#10	**74**	
0.85	#20	**69**	
0.43	#40	**62**	
0.25	#60	**36**	
0.15	#100	**13**	
0.075	#200	**5.9**	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



HYDRAULIC COND. (ASTM D2434)	
DEGRADATION (ATM T-313)	
ATTERBERG LIMITS ASTM 4318	

The testing services reported herein have been performed to recognized industry standards, unless otherwise noted. No other warranty is made. Should engineering interpretation or opinion be required, NGE-TFT will provide upon written request.

11301 Olive Lane · Anchorage, Alaska 99515 · Phone: 907-344-5934 · Fax: 907-344-5993 · www.nge-tft.com

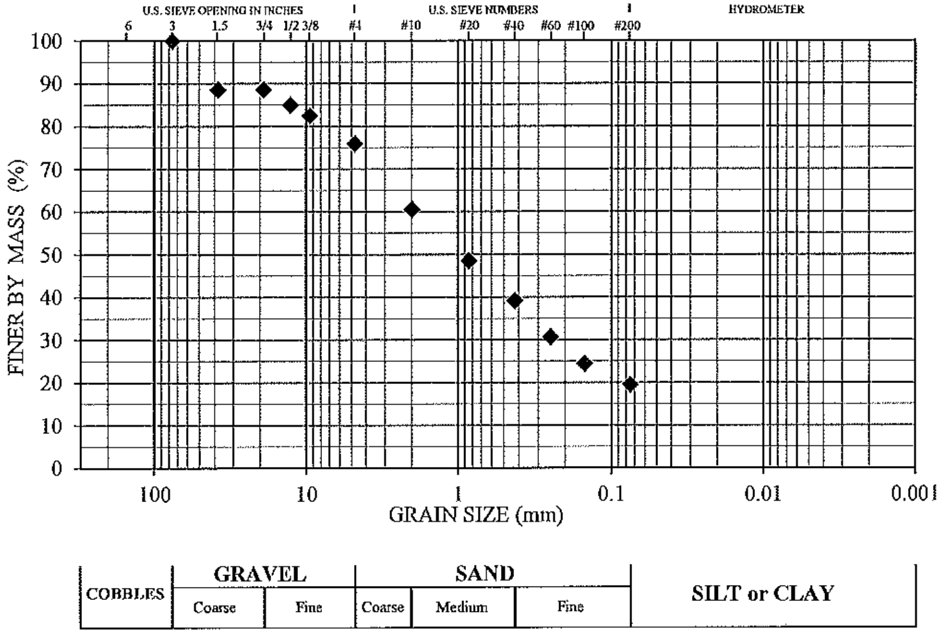
NORTHERN GEOTECHNICAL ENGINEERING, INC. / TERRA FIRMA TESTING

Laboratory Testing Geotechnical Engineering Instrumentation Construction Monitoring Services Thermal Analysis

PROJECT CLIENT:	**U.S. Army Corps of Engineers**
PROJECT NAME:	**Petersburg S. Harbor Navigation Improvements**
PROJECT NO.:	**4977-18**
SAMPLE LOC.:	**TB-09**
NUMBER/ DEPTH:	**S-1 / 0' - 0.6'**
DESCRIPTION:	**Silty sand w/ gravel**
DATE RECEIVED:	**4/13/2018**
TESTED BY:	**JA**
REVIEWED BY:	**RJPC**

% GRAVEL	**24.1**	USCS	**SM**
% SAND	**56.4**	USACOE FC	**N/A**
% SILT/CLAY	**19.5**	% PASS. 0.02 mm	**N/A**
% MOIST. CONTENT		% PASS. 0.002 mm	**N/A**
UNIFORMITY COEFFICIENT (C_u)			**UNKNOWN**
COEFFICIENT OF GRADATION (C_c)			**UNKNOWN**
ASTM D1557 (uncorrected)			**N/A**
ASTM D4718 (corrected)			**N/A**
OPTIMUM MOIST. CONTENT. (corrected)			**N/A**

PARTICLE SIZE ANALYSIS ASTM D7928 / C136



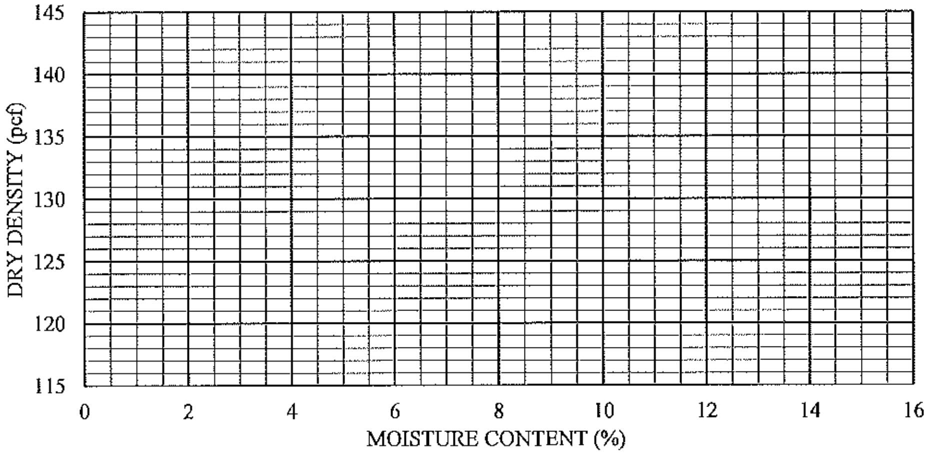
SIEVE ANALYSIS RESULT

SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"	**100**	
38.10	1.5"	**89**	
19.00	3/4"	**89**	
12.70	1/2"	**85**	
9.50	3/8"	**82**	
4.75	#4	**76**	
2.00	#10	**61**	
0.85	#20	**49**	
0.43	#40	**39**	
0.25	#60	**31**	
0.15	#100	**24**	
0.075	#200	**19.5**	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



HYDRAULIC COND. (ASTM D2434)	
DEGRADATION (ATM T-313)	
ATTERBERG LIMITS ASTM 4318	

The testing services reported herein have been performed to recognized industry standards, unless otherwise noted. No other warranty is made. Should engineering interpretation or opinion be required, NGE-TFT will provide upon written request.

11301 Olive Lane · Anchorage, Alaska 99515 · Phone: 907-344-5934 · Fax: 907-344-5993 · www.nge-tft.com

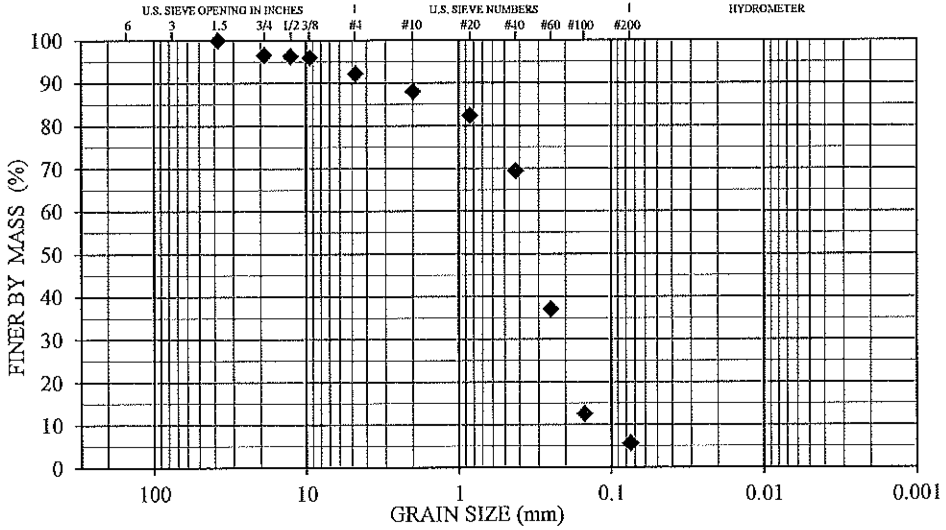
NORTHERN GEOTECHNICAL ENGINEERING, INC. / TERRA FIRMA TESTING

Laboratory Testing · Geotechnical Engineering · Instrumentation · Construction Monitoring Services · Thermal Analysis

PROJECT CLIENT:	**U.S. Army Corps of Engineers**
PROJECT NAME:	**Petersburg S. Harbor Navigation Improvements**
PROJECT NO.:	**4977-18**
SAMPLE LOC.:	**TB-10**
NUMBER/ DEPTH:	**S-1 / 0' - 1'**
DESCRIPTION:	**Poorly-graded sand w/ silt**
DATE RECEIVED:	**4/13/2018**
TESTED BY:	**JA**
REVIEWED BY:	**RJPC**

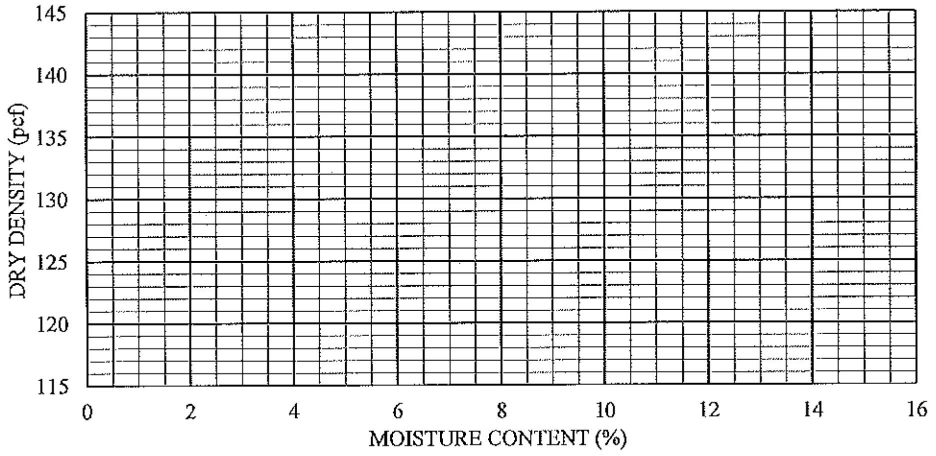
% GRAVEL	**7.8**	USCS	**SP-SM**
% SAND	**86.6**	USACOE FC	**N/A**
% SILT/CLAY	**5.6**	% PASS. 0.02 mm	**N/A**
% MOIST. CONTENT		% PASS. 0.002 mm	**N/A**
UNIFORMITY COEFFICIENT (C_u)			**3.1**
COEFFICIENT OF GRADATION (C_c)			**1.1**
ASTM D1557 (uncorrected)			**N/A**
ASTM D4718 (corrected)			**N/A**
OPTIMUM MOIST. CONTENT. (corrected)			**N/A**

PARTICLE SIZE ANALYSIS ASTM D7928 / C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



SIEVE ANALYSIS RESULT

SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"		
38.10	1.5"	**100**	
19.00	3/4"	**97**	
12.70	1/2"	**96**	
9.50	3/8"	**96**	
4.75	#4	**92**	
2.00	#10	**88**	
0.85	#20	**82**	
0.43	#40	**69**	
0.25	#60	**37**	
0.15	#100	**13**	
0.075	#200	**5.6**	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

HYDRAULIC COND. (ASTM D2434)	
DEGRADATION (ATM T-313)	
ATTERBERG LIMITS ASTM 4318	

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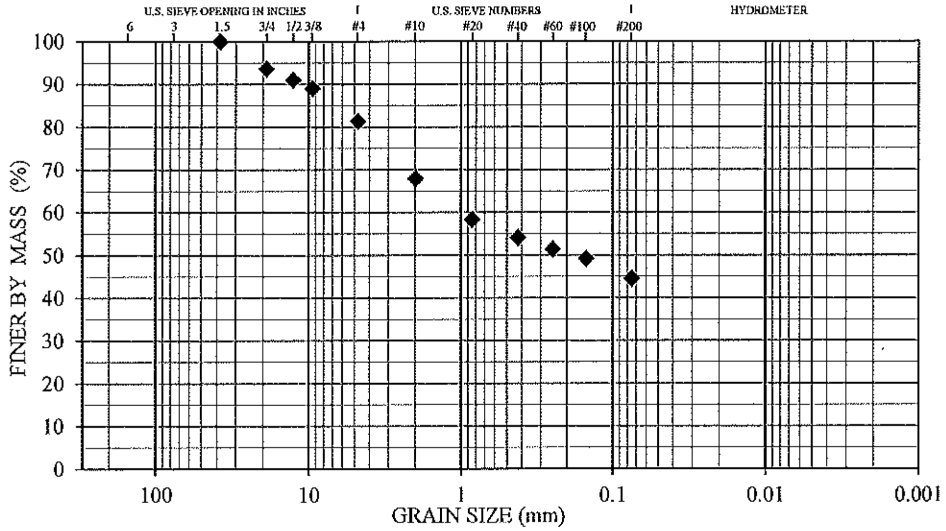
PROJECT CLIENT:	**U.S. Army Corps of Engineers**
PROJECT NAME:	**Petersburg S. Harbor Navigation Improvements**
PROJECT NO.:	**4977-18**
SAMPLE LOC.:	**TB-11**
NUMBER/ DEPTH:	**S-1 / 0' - 1'**
DESCRIPTION:	**Silty sand w/ gravel**
DATE RECEIVED:	**4/13/2018**
TESTED BY:	**JA**
REVIEWED BY:	**RJPC**

% GRAVEL	**18.6**	USCS	**SM**
% SAND	**36.9**	USACOE FC	**N/A**
% SILT/CLAY	**44.5**	% PASS. 0.02 mm	**N/A**
% MOIST. CONTENT		% PASS. 0.002 mm	**N/A**
UNIFORMITY COEFFICIENT (C_u)			**UNKNOWN**
COEFFICIENT OF GRADATION (C_c)			**UNKNOWN**
ASTM D1557 (uncorrected)			**N/A**
ASTM D4718 (corrected)			**N/A**
OPTIMUM MOIST. CONTENT. (corrected)			**N/A**

PARTICLE SIZE ANALYSIS ASTM D7928 / C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SIEVE ANALYSIS RESULT

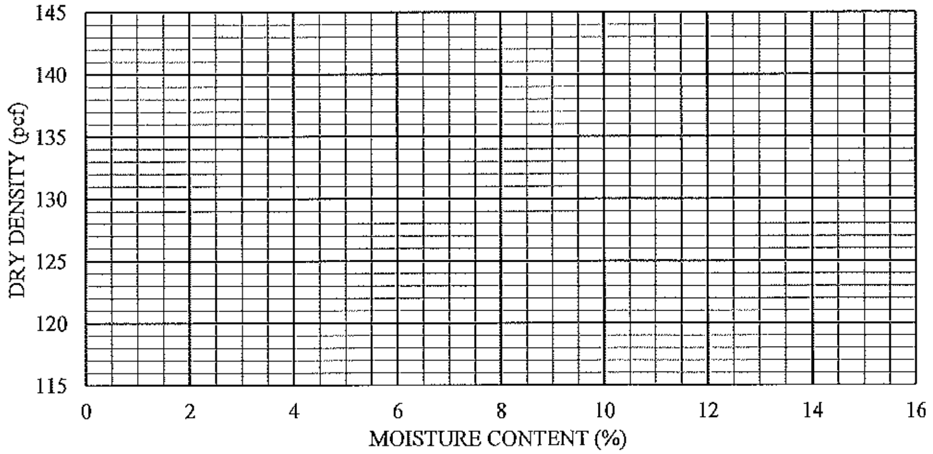
SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"		
38.10	1.5"	**100**	
19.00	3/4"	**94**	
12.70	1/2"	**91**	
9.50	3/8"	**89**	
4.75	#4	**81**	
2.00	#10	**68**	
0.85	#20	**58**	
0.43	#40	**54**	
0.25	#60	**51**	
0.15	#100	**49**	
0.075	#200	**44.5**	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

HYDRAULIC COND. (ASTM D2434)	
DEGRADATION (ATM T-313)	
ATTERBERG LIMITS ASTM 4318	

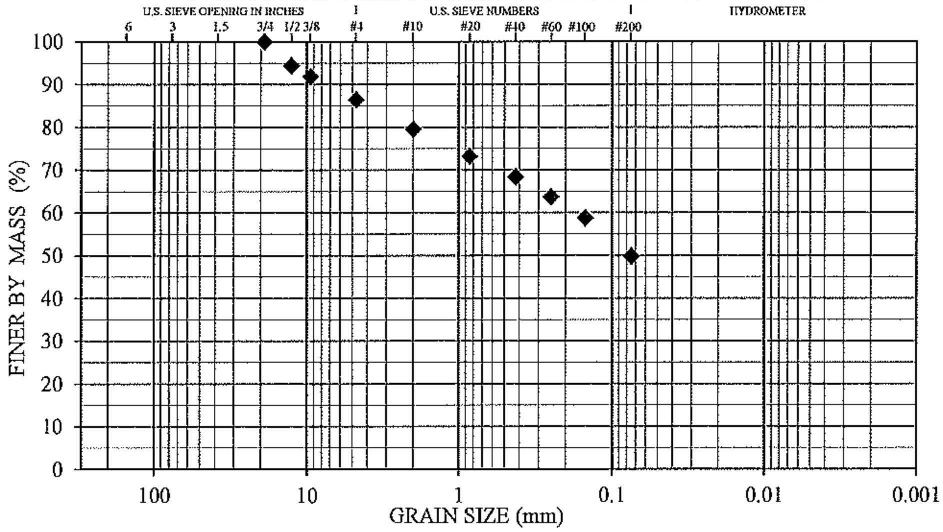
MOISTURE-DENSITY RELATIONSHIP ASTM D1557



PROJECT CLIENT:	**U.S. Army Corps of Engineers**
PROJECT NAME:	**Petersburg S. Harbor Navigation Improvements**
PROJECT NO.:	**4977-18**
SAMPLE LOC.:	**TB-12**
NUMBER/ DEPTH:	**S-1 / 0' - 2.5'**
DESCRIPTION:	**Silty sand**
DATE RECEIVED:	**4/13/2018**
TESTED BY:	**JA**
REVIEWED BY:	**RJPC**

% GRAVEL	**13.6**	USCS	**SM**
% SAND	**36.7**	USACOE FC	**N/A**
% SILT/CLAY	**49.7**	% PASS. 0.02 mm	**N/A**
% MOIST. CONTENT		% PASS. 0.002 mm	**N/A**
UNIFORMITY COEFFICIENT (C_u)			**UNKNOWN**
COEFFICIENT OF GRADATION (C_c)			**UNKNOWN**
ASTM D1557 (uncorrected)			**N/A**
ASTM D4718 (corrected)			**N/A**
OPTIMUM MOIST. CONTENT. (corrected)			**N/A**

PARTICLE SIZE ANALYSIS ASTM D7928 / C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

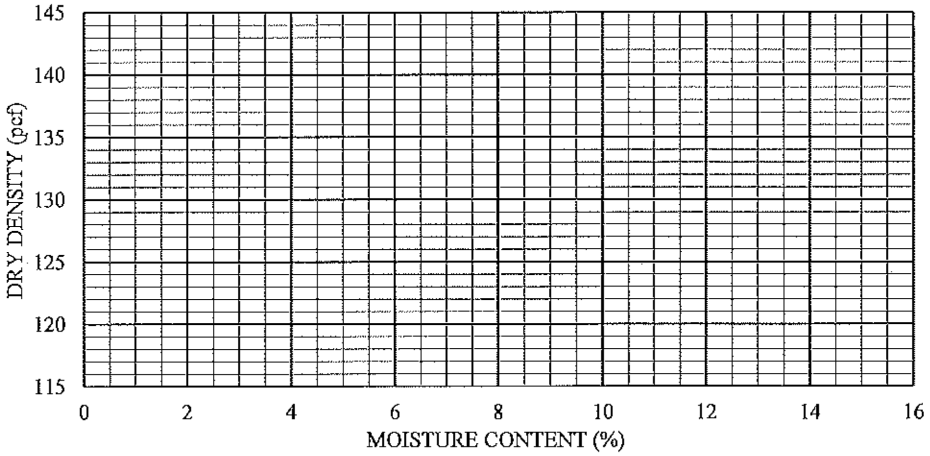
SIEVE ANALYSIS RESULT

SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"		
38.10	1.5"		
19.00	3/4"	**100**	
12.70	1/2"	**94**	
9.50	3/8"	**92**	
4.75	#4	**86**	
2.00	#10	**80**	
0.85	#20	**73**	
0.43	#40	**68**	
0.25	#60	**64**	
0.15	#100	**59**	
0.075	#200	**49.8**	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



HYDRAULIC COND. (ASTM D2434)	
DEGRADATION (ATM T-313)	
ATTERBERG LIMITS ASTM 4318	

NORTHERN GEOTECHNICAL ENGINEERING, INC. / TERRA FIRMA TESTING

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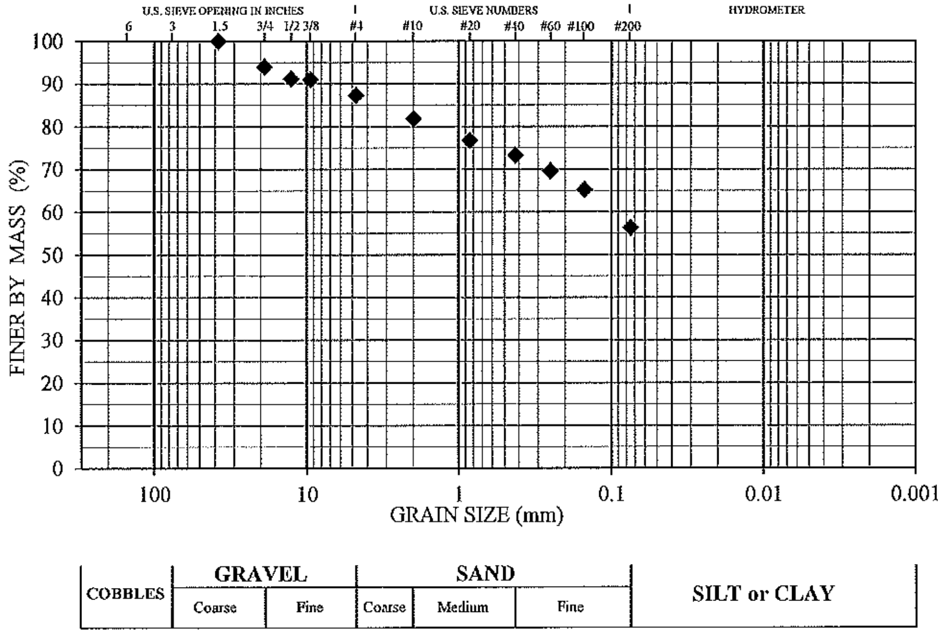
PROJECT CLIENT:	**U.S. Army Corps of Engineers**
PROJECT NAME:	**Petersburg S. Harbor Navigation Improvements**
PROJECT NO.:	**4977-18**
SAMPLE LOC.:	**TB-12A**
NUMBER/ DEPTH:	**S-1 / 0' - 1'**
DESCRIPTION:	**Sandy silt**
DATE RECEIVED:	**4/13/2018**
TESTED BY:	**JA**
REVIEWED BY:	**RJPC**

% GRAVEL	**12.6**	USCS	**ML**
% SAND	**31.1**	USACOE FC	**N/A**
% SILT/CLAY	**56.3**	% PASS. 0.02 mm	**N/A**
% MOIST. CONTENT		% PASS. 0.002 mm	**N/A**
UNIFORMITY COEFFICIENT (C_u)			**UNKNOWN**
COEFFICIENT OF GRADATION (C_c)			**UNKNOWN**
ASTM D1557 (uncorrected)			**N/A**
ASTM D4718 (corrected)			**N/A**
OPTIMUM MOIST. CONTENT. (corrected)			**N/A**

PARTICLE SIZE ANALYSIS ASTM D7928 / C136



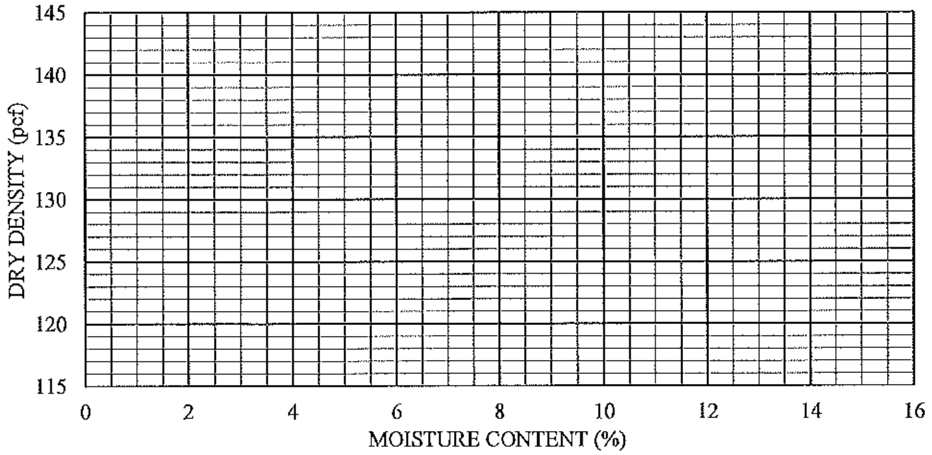
SIEVE ANALYSIS RESULT

SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"		
38.10	1.5"	**100**	
19.00	3/4"	**94**	
12.70	1/2"	**91**	
9.50	3/8"	**91**	
4.75	#4	**87**	
2.00	#10	**82**	
0.85	#20	**77**	
0.43	#40	**73**	
0.25	#60	**70**	
0.15	#100	**65**	
0.075	#200	**56.3**	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



HYDRAULIC COND. (ASTM D2434)	
DEGRADATION (ATM T-313)	
ATTERBERG LIMITS ASTM 4318	

NORTHERN GEOTECHNICAL ENGINEERING, INC. / TERRA FIRMA TESTING

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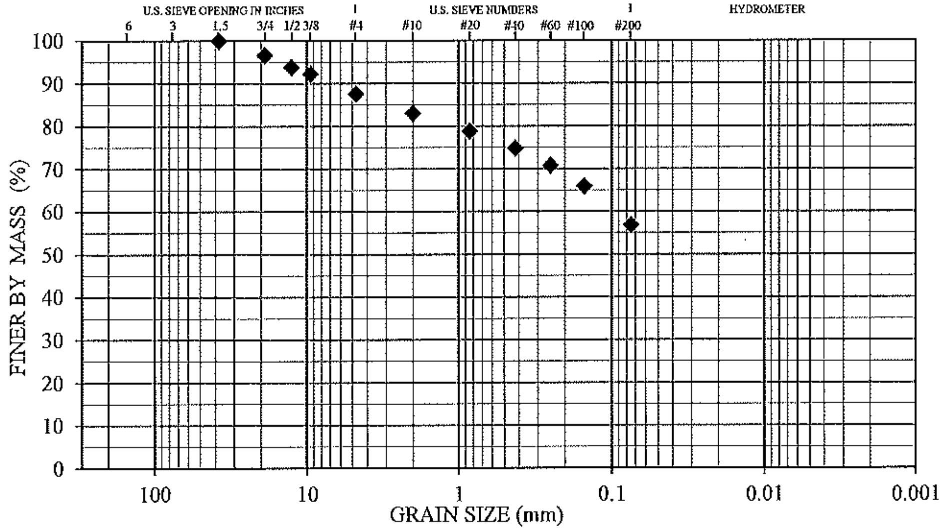
PROJECT CLIENT:	**U.S. Army Corps of Engineers**
PROJECT NAME:	**Petersburg S. Harbor Navigation Improvements**
PROJECT NO.:	**4977-18**
SAMPLE LOC.:	**TB-12A**
NUMBER/ DEPTH:	**S-2 / 1' - 2.5'**
DESCRIPTION:	**Sandy silt**
DATE RECEIVED:	**4/13/2018**
TESTED BY:	**JA**
REVIEWED BY:	**RJPC**

% GRAVEL	**12.4**	USCS	**ML**
% SAND	**30.7**	USACOE FC	**N/A**
% SILT/CLAY	**56.9**	% PASS. 0.02 mm	**N/A**
% MOIST. CONTENT		% PASS. 0.002 mm	**N/A**
UNIFORMITY COEFFICIENT (C_u)			**UNKNOWN**
COEFFICIENT OF GRADATION (C_c)			**UNKNOWN**
ASTM D1557 (uncorrected)			**N/A**
ASTM D4718 (corrected)			**N/A**
OPTIMUM MOIST. CONTENT. (corrected)			**N/A**

PARTICLE SIZE ANALYSIS ASTM D7928 / C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

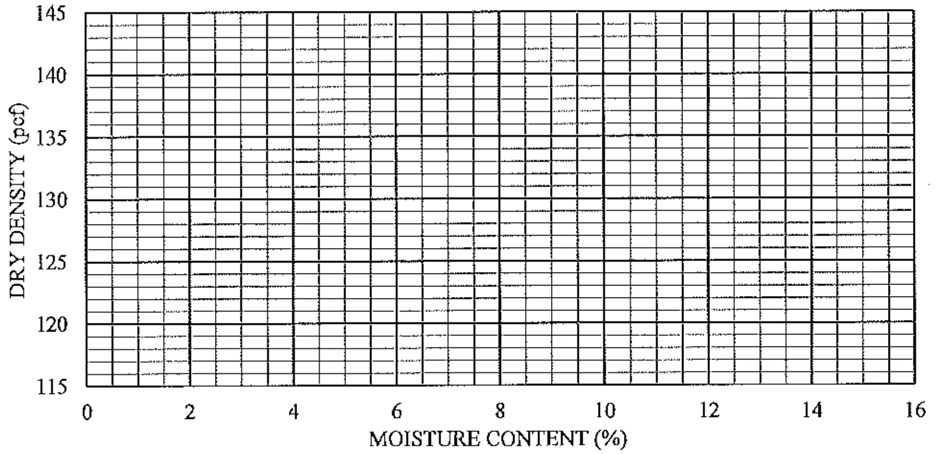
SIEVE ANALYSIS RESULT

SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"		
38.10	1.5"	**100**	
19.00	3/4"	**97**	
12.70	1/2"	**94**	
9.50	3/8"	**92**	
4.75	#4	**88**	
2.00	#10	**83**	
0.85	#20	**79**	
0.43	#40	**75**	
0.25	#60	**71**	
0.15	#100	**66**	
0.075	#200	**56.8**	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP ASTM D1557

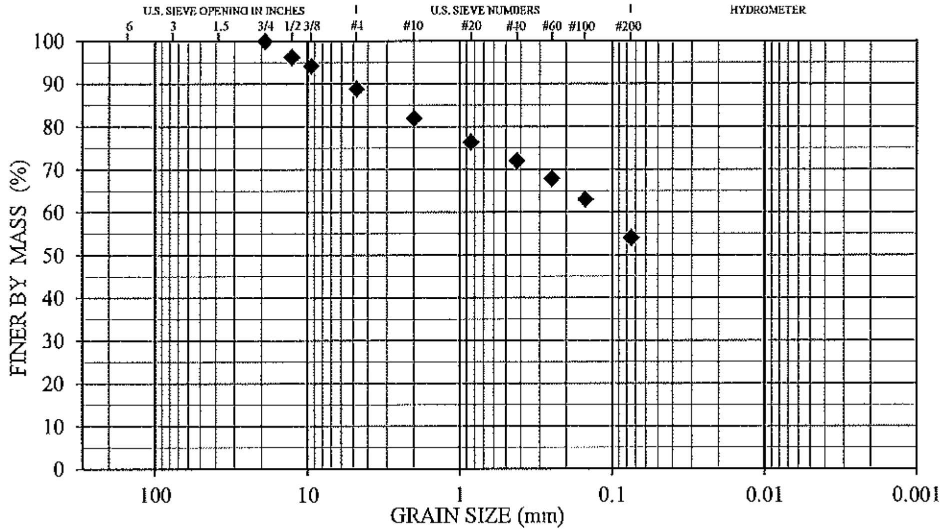


HYDRAULIC COND. (ASTM D2434)	
DEGRADATION (ATM T-313)	
ATTERBERG LIMITS ASTM 4318	**LL = 19** **PI = 3**

PROJECT CLIENT:	**U.S. Army Corps of Engineers**
PROJECT NAME:	**Petersburg S. Harbor Navigation Improvements**
PROJECT NO.:	**4977-18**
SAMPLE LOC.:	**TB-13**
NUMBER/ DEPTH:	**S-1 / 0' - 2'**
DESCRIPTION:	**Sandy silt**
DATE RECEIVED:	**4/13/2018**
TESTED BY:	**JA**
REVIEWED BY:	**RJPC**

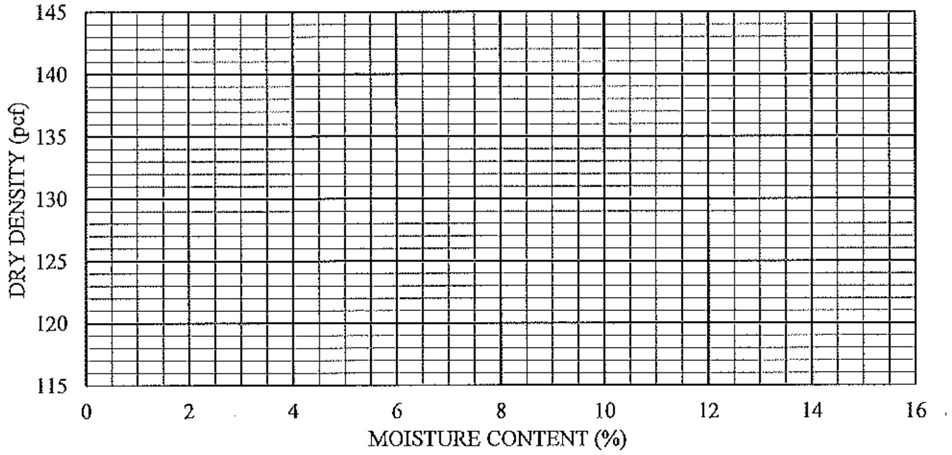
% GRAVEL	**11.2**	USCS	**ML**
% SAND	**34.8**	USACOE FC	**N/A**
% SILT/CLAY	**54.0**	% PASS. 0.02 mm	**N/A**
% MOIST. CONTENT		% PASS. 0.002 mm	**N/A**
UNIFORMITY COEFFICIENT (C_u)			**UNKNOWN**
COEFFICIENT OF GRADATION (C_c)			**UNKNOWN**
ASTM D1557 (uncorrected)			**N/A**
ASTM D4718 (corrected)			**N/A**
OPTIMUM MOIST. CONTENT. (corrected)			**N/A**

PARTICLE SIZE ANALYSIS ASTM D7928 / C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



SIEVE ANALYSIS RESULT

SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"		
38.10	1.5"		
19.00	3/4"	**100**	
12.70	1/2"	**96**	
9.50	3/8"	**94**	
4.75	#4	**89**	
2.00	#10	**82**	
0.85	#20	**76**	
0.43	#40	**72**	
0.25	#60	**68**	
0.15	#100	**63**	
0.075	#200	**54.0**	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

HYDRAULIC COND. (ASTM D2434)	
DEGRADATION (ATM T-313)	
ATTERBERG LIMITS ASTM 4318	

NORTHERN GEOTECHNICAL ENGINEERING, INC. ⁄ TERRA FIRMA TESTING

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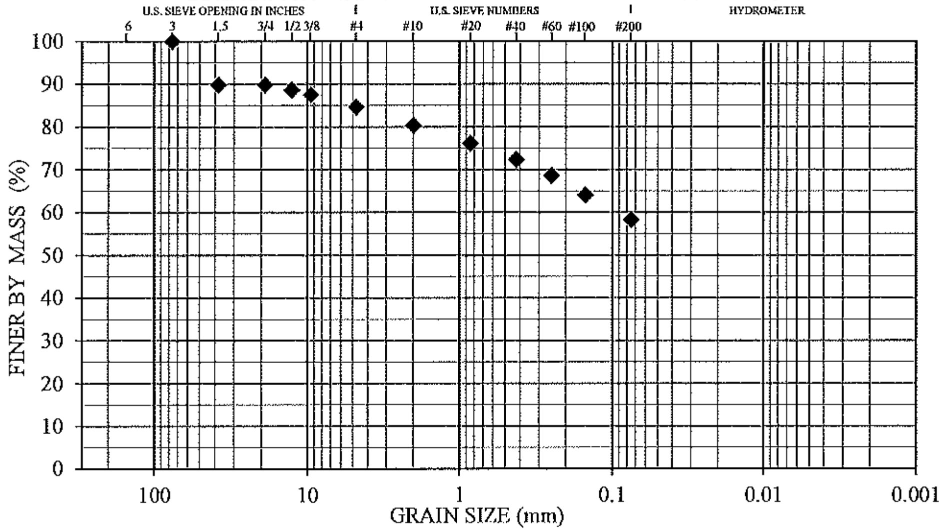
PROJECT CLIENT:	**U.S. Army Corps of Engineers**
PROJECT NAME:	**Petersburg S. Harbor Navigation Improvements**
PROJECT NO.:	**4977-18**
SAMPLE LOC.:	**TB-13**
NUMBER/ DEPTH:	**S-2 / 2' - 7'**
DESCRIPTION:	**Sandy silt w/ gravel**
DATE RECEIVED:	**4/13/2018**
TESTED BY:	**JA**
REVIEWED BY:	**RJPC**

% GRAVEL	**15.3**	USCS	**ML**
% SAND	**26.4**	USACOE FC	**N/A**
% SILT/CLAY	**58.3**	% PASS. 0.02 mm	**N/A**
% MOIST. CONTENT		% PASS. 0.002 mm	**N/A**
UNIFORMITY COEFFICIENT (C_u)			**UNKNOWN**
COEFFICIENT OF GRADATION (C_c)			**UNKNOWN**
ASTM D1557 (uncorrected)			**N/A**
ASTM D4718 (corrected)			**N/A**
OPTIMUM MOIST. CONTENT. (corrected)			**N/A**

PARTICLE SIZE ANALYSIS ASTM D7928 / C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SIEVE ANALYSIS RESULT

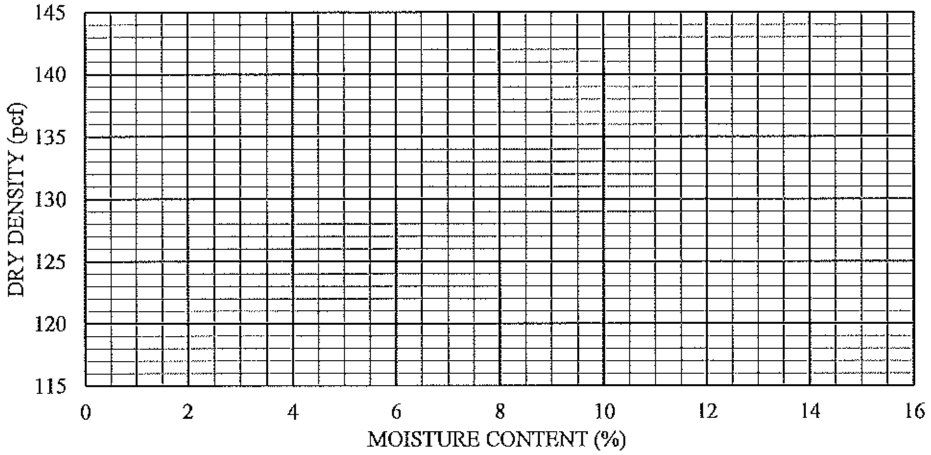
SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"	**100**	
38.10	1.5"	**90**	
19.00	3/4"	**90**	
12.70	1/2"	**89**	
9.50	3/8"	**87**	
4.75	#4	**85**	
2.00	#10	**80**	
0.85	#20	**76**	
0.43	#40	**72**	
0.25	#60	**69**	
0.15	#100	**64**	
0.075	#200	**58.2**	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

HYDRAULIC COND. (ASTM D2434)	
DEGRADATION (ATM T-313)	
ATTERBERG LIMITS ASTM 4318	**LL = 19** **PI = 3**

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



The testing services reported herein have been performed to recognized industry standards, unless otherwise noted. No other warranty is made. Should engineering interpretation or opinion be required, NGE-TFT will provide upon written request.

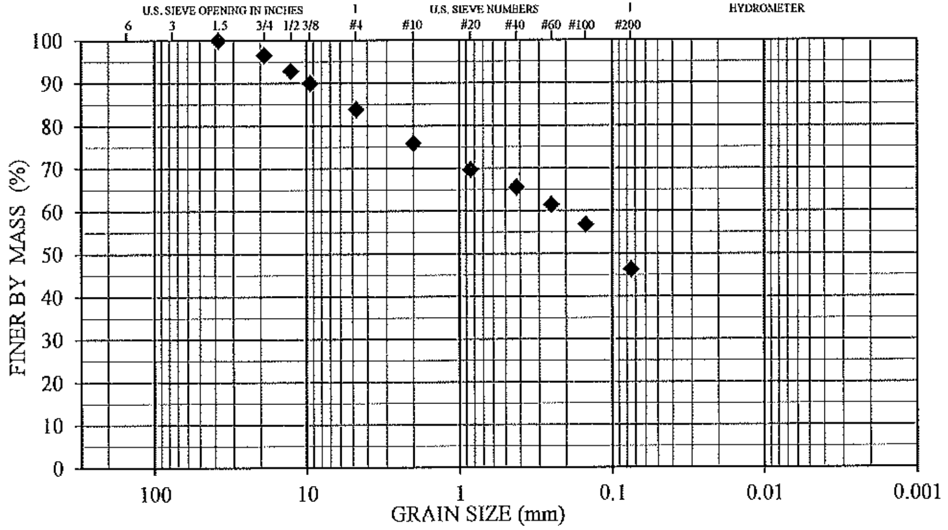
NORTHERN GEOTECHNICAL ENGINEERING, INC. / TERRA FIRMA TESTING

Laboratory Testing Geotechnical Engineering Instrumentation Construction Monitoring Services Thermal Analysis

PROJECT CLIENT:	**U.S. Army Corps of Engineers**
PROJECT NAME:	**Petersburg S. Harbor Navigation Improvements**
PROJECT NO.:	**4977-18**
SAMPLE LOC.:	**TB-14**
NUMBER/ DEPTH:	**S-1 / 0' - 1'**
DESCRIPTION:	**Silty sand w/ gravel**
DATE RECEIVED:	**4/13/2018**
TESTED BY:	**JA**
REVIEWED BY:	**RJPC**

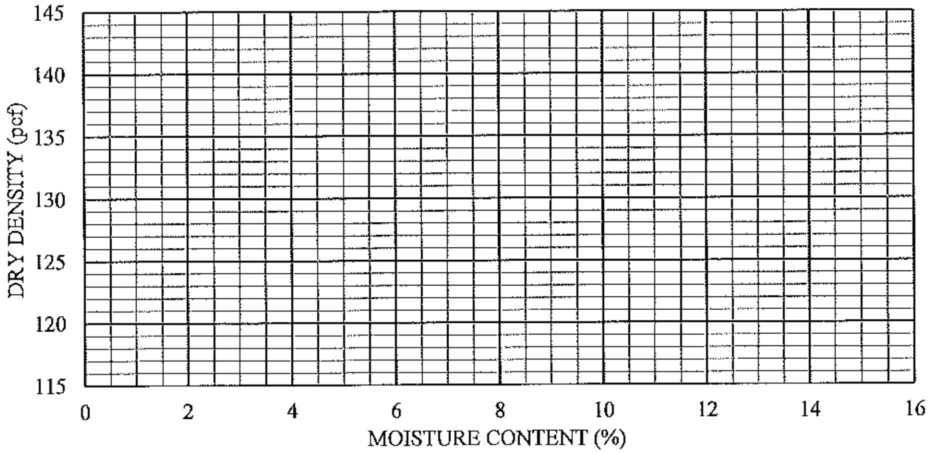
% GRAVEL	**16.2**	USCS	**SM**
% SAND	**37.5**	USACOE FC	**N/A**
% SILT/CLAY	**46.3**	% PASS. 0.02 mm	**N/A**
% MOIST. CONTENT		% PASS. 0.002 mm	**N/A**
UNIFORMITY COEFFICIENT (C_u)		**UNKNOWN**	
COEFFICIENT OF GRADATION (C_c)		**UNKNOWN**	
ASTM D1557 (uncorrected)		**N/A**	
ASTM D4718 (corrected)		**N/A**	
OPTIMUM MOIST. CONTENT. (corrected)		**N/A**	

PARTICLE SIZE ANALYSIS ASTM D7928 / C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



SIEVE ANALYSIS RESULT

SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"		
38.10	1.5"	**100**	
19.00	3/4"	**97**	
12.70	1/2"	**93**	
9.50	3/8"	**90**	
4.75	#4	**84**	
2.00	#10	**76**	
0.85	#20	**70**	
0.43	#40	**66**	
0.25	#60	**61**	
0.15	#100	**57**	
0.075	#200	**46.3**	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

HYDRAULIC COND. (ASTM D2434)	
DEGRADATION (ATM T-313)	
ATTERBERG LIMITS ASTM 4318	

NORTHERN GEOTECHNICAL ENGINEERING, INC. ⁄ TERRA FIRMA TESTING

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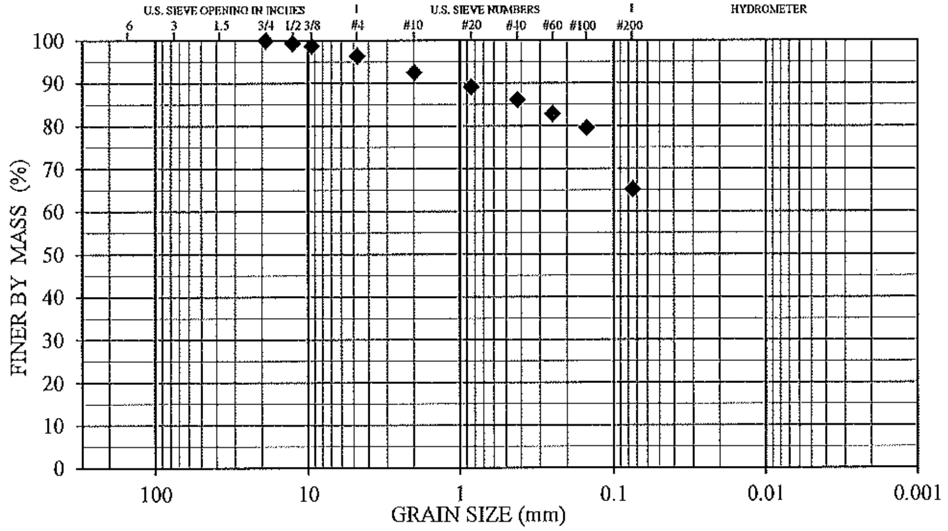
PROJECT CLIENT:	**U.S. Army Corps of Engineers**
PROJECT NAME:	**Petersburg S. Harbor Navigation Improvements**
PROJECT NO.:	**4977-18**
SAMPLE LOC.:	**TB-14**
NUMBER/ DEPTH:	**S-2 / 1' - 6'**
DESCRIPTION:	**Sandy silt**
DATE RECEIVED:	**4/13/2018**
TESTED BY:	**JA**
REVIEWED BY:	**RJPC**

% GRAVEL	**3.6**	USCS	**ML**
% SAND	**31.2**	USACOE FC	**N/A**
% SILT/CLAY	**65.2**	% PASS. 0.02 mm	**N/A**
% MOIST. CONTENT		% PASS. 0.002 mm	**N/A**
UNIFORMITY COEFFICIENT (C_u)			**UNKNOWN**
COEFFICIENT OF GRADATION (C_c)			**UNKNOWN**
ASTM D1557 (uncorrected)			**N/A**
ASTM D4718 (corrected)			**N/A**
OPTIMUM MOIST. CONTENT. (corrected)			**N/A**

PARTICLE SIZE ANALYSIS ASTM D7928 / C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

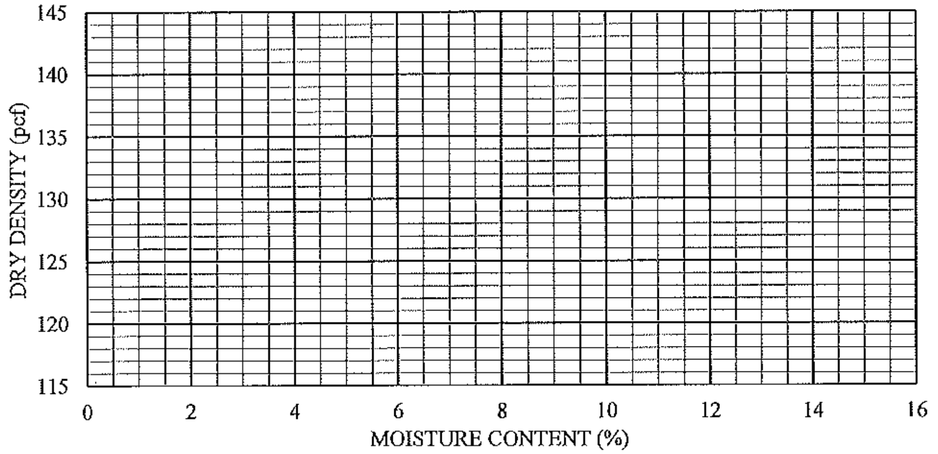
SIEVE ANALYSIS RESULT

SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"		
38.10	1.5"		
19.00	3/4"	**100**	
12.70	1/2"	**99**	
9.50	3/8"	**99**	
4.75	#4	**96**	
2.00	#10	**93**	
0.85	#20	**89**	
0.43	#40	**86**	
0.25	#60	**83**	
0.15	#100	**80**	
0.075	#200	**65.1**	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



HYDRAULIC COND. (ASTM D2434)	
DEGRADATION (ATM T-313)	
ATTERBERG LIMITS ASTM 4318	

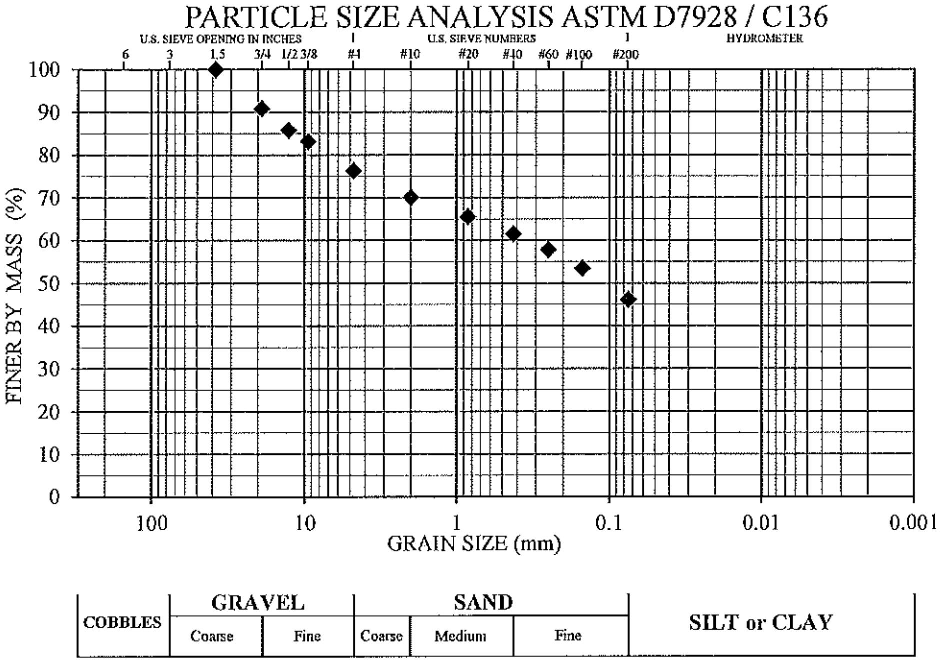
NORTHERN GEOTECHNICAL ENGINEERING, INC. / TERRA FIRMA TESTING

Laboratory Testing · Geotechnical Engineering · Instrumentation · Construction Monitoring Services · Thermal Analysis

PROJECT CLIENT:	**U.S. Army Corps of Engineers**
PROJECT NAME:	**Petersburg S. Harbor Navigation Improvements**
PROJECT NO.:	**4977-18**
SAMPLE LOC.:	**TB-15**
NUMBER/ DEPTH:	**S-1 / 0' - 1'**
DESCRIPTION:	**Silty sand w/ gravel**
DATE RECEIVED:	**4/13/2018**
TESTED BY:	**JA**
REVIEWED BY:	**RJPC**

% GRAVEL	**23.7**	USCS	**SM**
% SAND	**30.2**	USACOE FC	**N/A**
% SILT/CLAY	**46.1**	% PASS. 0.02 mm	**N/A**
% MOIST. CONTENT		% PASS. 0.002 mm	**N/A**
UNIFORMITY COEFFICIENT (C_u)			**UNKNOWN**
COEFFICIENT OF GRADATION (C_c)			**UNKNOWN**
ASTM D1557 (uncorrected)			**N/A**
ASTM D4718 (corrected)			**N/A**
OPTIMUM MOIST. CONTENT. (corrected)			**N/A**

PARTICLE SIZE ANALYSIS ASTM D7928 / C136



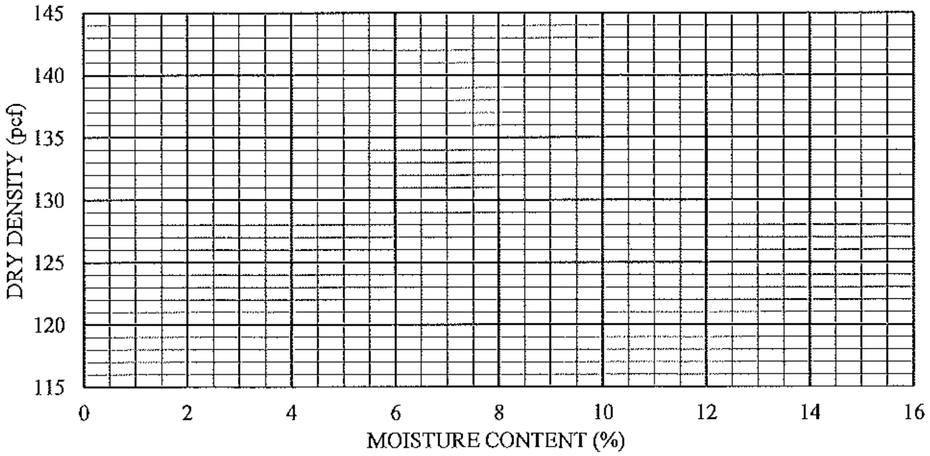
SIEVE ANALYSIS RESULT

SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"		
38.10	1.5"	**100**	
19.00	3/4"	**91**	
12.70	1/2"	**86**	
9.50	3/8"	**83**	
4.75	#4	**76**	
2.00	#10	**70**	
0.85	#20	**66**	
0.43	#40	**62**	
0.25	#60	**58**	
0.15	#100	**53**	
0.075	#200	**46.1**	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



HYDRAULIC COND. (ASTM D2434)	
DEGRADATION (ATM T-313)	
ATTERBERG LIMITS ASTM 4318	

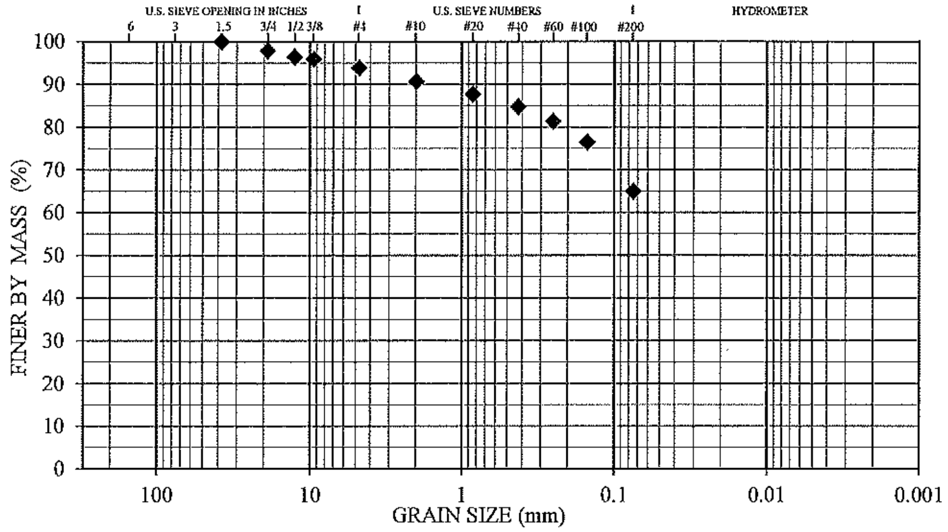
NORTHERN GEOTECHNICAL ENGINEERING, INC. ⁄ TERRA FIRMA TESTING

Laboratory Testing · Geotechnical Engineering · Instrumentation · Construction Monitoring Services · Thermal Analysis

PROJECT CLIENT:	**U.S. Army Corps of Engineers**
PROJECT NAME:	**Petersburg S. Harbor Navigation Improvements**
PROJECT NO.:	**4977-18**
SAMPLE LOC.:	**TB-15**
NUMBER/ DEPTH:	**S-2 / 1' - 10'**
DESCRIPTION:	**Sandy silty clay**
DATE RECEIVED:	**4/13/2018**
TESTED BY:	**JA**
REVIEWED BY:	**RJPC**

% GRAVEL	**6.1**	USCS	**CL-ML**
% SAND	**28.9**	USACOE FC	**N/A**
% SILT/CLAY	**65.0**	% PASS. 0.02 mm	**N/A**
% MOIST. CONTENT		% PASS. 0.002 mm	**N/A**
UNIFORMITY COEFFICIENT (C_u)			**UNKNOWN**
COEFFICIENT OF GRADATION (C_c)			**UNKNOWN**
ASTM D1557 (uncorrected)			**N/A**
ASTM D4718 (corrected)			**N/A**
OPTIMUM MOIST. CONTENT. (corrected)			**N/A**

PARTICLE SIZE ANALYSIS ASTM D7928 / C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SIEVE ANALYSIS RESULT

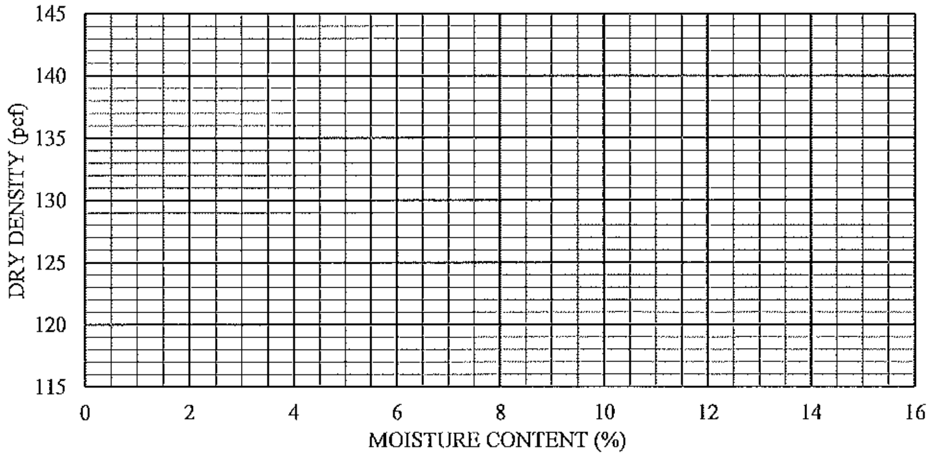
SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"		
38.10	1.5"	**100**	
19.00	3/4"	**98**	
12.70	1/2"	**96**	
9.50	3/8"	**96**	
4.75	#4	**94**	
2.00	#10	**91**	
0.85	#20	**88**	
0.43	#40	**85**	
0.25	#60	**81**	
0.15	#100	**77**	
0.075	#200	**65.0**	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

HYDRAULIC COND. (ASTM D2434)	
DEGRADATION (ATM T-313)	
ATTERBERG LIMITS ASTM 4318	**LL = 20** **PI = 5**

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



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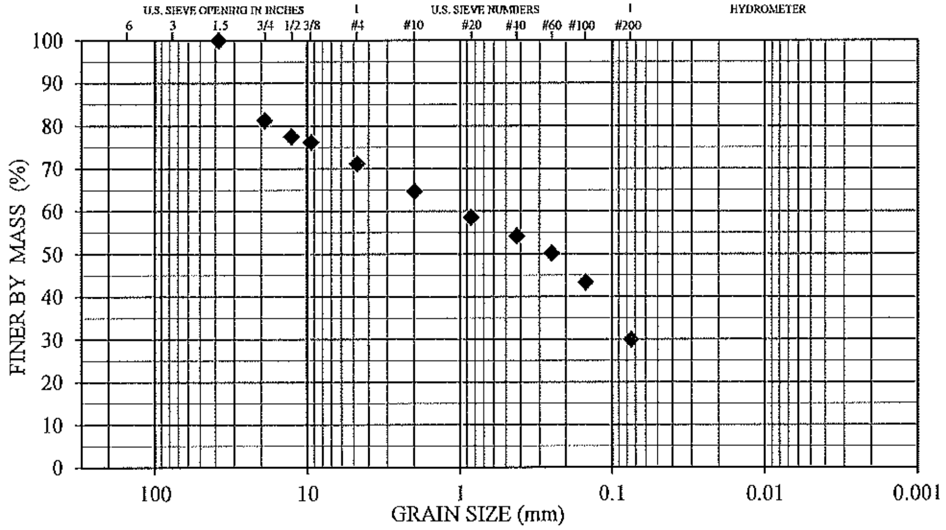
Laboratory Testing · Geotechnical Engineering · Instrumentation · Construction Monitoring Services · Thermal Analysis

PROJECT CLIENT:	**U.S. Army Corps of Engineers**
PROJECT NAME:	**Petersburg S. Harbor Navigation Improvements**
PROJECT NO.:	**4977-18**
SAMPLE LOC.:	**TB-16**
NUMBER/ DEPTH:	**S-1 / 0' - 1.6'**
DESCRIPTION:	**Silty sand w/ gravel**
DATE RECEIVED:	**4/13/2018**
TESTED BY:	**JA**
REVIEWED BY:	**RJPC**

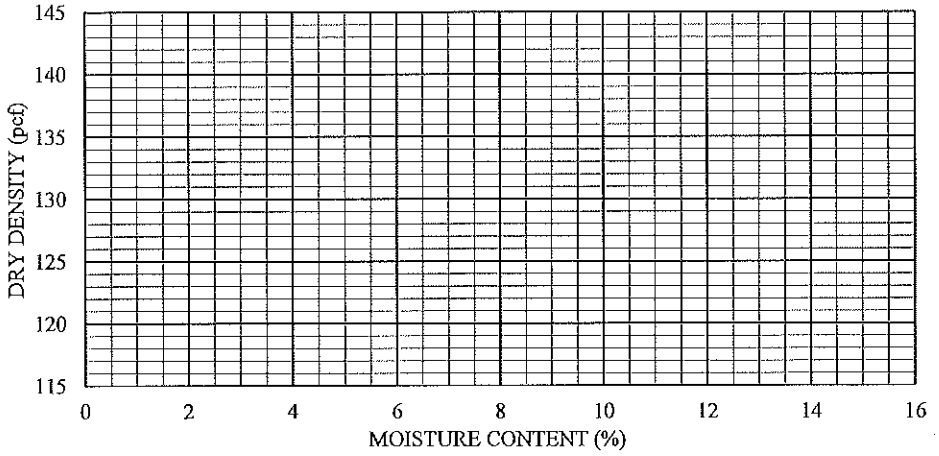
% GRAVEL	**28.9**	USCS	**SM**
% SAND	**41.2**	USACOE FC	**N/A**
% SILT/CLAY	**29.9**	% PASS. 0.02 mm	**N/A**
% MOIST. CONTENT		% PASS. 0.002 mm	**N/A**
UNIFORMITY COEFFICIENT (C_u)		**UNKNOWN**	
COEFFICIENT OF GRADATION (C_c)		**UNKNOWN**	
ASTM D1557 (uncorrected)		**N/A**	
ASTM D4718 (corrected)		**N/A**	
OPTIMUM MOIST. CONTENT. (corrected)		**N/A**	

PARTICLE SIZE ANALYSIS ASTM D7928 / C136



COBBLES	GRAVEL		SAND			SILT or CLAY
	Coarse	Fine	Coarse	Medium	Fine	

MOISTURE-DENSITY RELATIONSHIP ASTM D1557



SIEVE ANALYSIS RESULT

SIEVE SIZE (mm)	SIEVE SIZE (U.S.)	TOTAL % PASSING	SPECIFICATION (% PASSING)
152.40	6"		
76.20	3"		
38.10	1.5"	**100**	
19.00	3/4"	**81**	
12.70	1/2"	**78**	
9.50	3/8"	**76**	
4.75	#4	**71**	
2.00	#10	**65**	
0.85	#20	**59**	
0.43	#40	**54**	
0.25	#60	**50**	
0.15	#100	**43**	
0.075	#200	**29.9**	

HYDROMETER RESULT

ELAPSED TIME (MIN)	DIAMETER (mm)	TOTAL % PASSING
0		
0.5		
1		
2		
4		
8		
15		
30		
60		
250		
1440		

HYDRAULIC COND. (ASTM D2434)	
DEGRADATION (ATM T-313)	
ATTERBERG LIMITS ASTM 4318	

Appendix D

1997 Geotechnical Report

96256
PROJECT FILE

GEOTECHNICAL REPORT

PETERSBURG SOUTH HARBOR IMPROVEMENTS

PETERSBURG, ALASKA

Prepared for

City of Petersburg
Box 329
Petersburg, Alaska 99833

September 1997

Peratrovich, Nottingham & Drage, Inc.
Engineering Consultants
3220 Hospital Drive, Suite 200
Juneau, Alaska 99801
Phone: (907)586-2093 Fax: (907)586-2099

GEOTECHNICAL REPORT

PETERSBURG SOUTH HARBOR IMPROVEMENTS

PETERSBURG, ALASKA

TABLE OF CONTENTS

APPENDICES

D. Nottingham
No. 1804-E

GEOTECHNICAL REPORT

PETERSBURG SOUTH HARBOR IMPROVEMENTS

PETERSBURG, ALASKA

1.0 INTRODUCTION

1.1 Background and Scope

This report presents the findings of a geotechnical investigation performed by Peratrovich, Nottingham & Drage, Inc. (PN&D) for proposed improvements to the City of Petersburg's South Harbor in Petersburg, Alaska. The original scope of improvements was presented as part of a 1995 PN&D report titled "Petersburg Harbor Facilities Plan"[1]. The facilities plan presented a summary of harbor improvement options aimed at upgrading local services to commercial and recreational vessels. The report considered improvement options for the city's existing North, Middle and South Harbors and for a proposed future site at Scow Bay.

After studying the 1995 report the city made the decision to proceed with a first phase of improvements located within South Harbor. PN&D has since been authorized to proceed with final design engineering of these selected harbor improvements. This geotechnical investigation was conducted to provide information for the following projects:

- Extension of Floats A, B, C and D to provide additional stall space.
- A new high capacity transient float connecting to the outer end of Float C.
- Construction of a new commercial open cell sheet pile bulkhead and fill dock at the western side of the harbor.
- Dredging to increase vessel draft capacity throughout much of the harbor.
- Expansion of the uplands parking area.

The proposed improvement locations are shown on the site plan and test hole locations drawing of Appendix A, Figure A-1. The purpose of this document is to report soil conditions at the site and provide geotechnical engineering recommendations for construction of the proposed improvements.

---

[1] Petersburg Harbor Facilities Plan, Petersburg Alaska, Preliminary Design Report, Prepared for the City of Petersburg, Alaska by Peratrovich, Nottingham & Drage, Inc., Juneau, Alaska, November 1995.

1.2 Summary of Previous Geological and Geotechnical Records

Preparation of the harbor facilities plan included a review of record geotechnical information which was presented in a report titled "Survey of Geotechnical Studies and Information, Petersburg Harbor Study"[2]. The survey of previous information was originally presented to the city in October 1994 and was reviewed and updated in September 1997.

The study includes a broad range review of earlier geotechnical information relating to the city's harbor system. The portions considered most relevant to this project are summarized below:

- In 1981 the Alaska Department of Transportation and Public Facilities (ADOT&PF) drilled five test holes and conducted one penetrometer test in South Harbor to provide information for repairs and improvements. The improvements were constructed in several phases and included dredging, the South Harbor Parking area, access ramps and the installation of floats A, B, C, and D.
- Pile driving records for the South Harbor area.
- Geotechnical and environmental investigation reports for design of the recently constructed (1995-1996) ADOT&PF Petersburg Seaplane Facility. Information relating to the new seaplane facility includes a geotechnical records research report, a draft environmental sampling report, and a geotechnical investigation and records report by R&M Consultants, Inc. of Anchorage. Additional information includes pile driving records recorded during construction of the new seaplane base.
- A 1978 United States Geological Survey report titled "Reconnaissance Engineering Geology of the Petersburg Area, Southeastern, Alaska with Emphasis on Geologic Hazards"[3].

This information is available for Contractor review on request.

1.3 Dredging Characterization and Analysis

Approximately 60,000 cubic yards of dredging are anticipated within the South Harbor basin to provide sufficient water depths in the areas of the new floats and the sheet pile bulkhead dock. The proposed dredging plan involves removing materials from the harbor area and transporting them to an existing offshore dredge disposal area located approximately 2 miles away in Frederick Sound. Dredging activities

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[2] Survey of Geotechnical Studies and Information, Petersburg Harbor Study, Vol. 2., Report Prepared for the City of Petersburg, Alaska by Peratrovich, Nottingham & Drage, Inc., Revised September, 1997.

[3] Yehele, L.S. Reconnaissance Engineering Geology of the Petersburg Area, Southeastern, Alaska, With Emphasis on Geologic Hazards, U.S. Geological Survey Open File Report 78-675, 1978.

must be permitted to insure compliance with current regulations including the Alaska Coastal Management Plan.

The project was authorized in September 1996 by a Department of the Army, U.S. Army Engineer District, Alaska (Wrangell Narrows 2, M-750180). The Section 404 permit contains the following special conditions relating to dredging and dredged materials disposal activities:

> Condition 2
> "Permittee shall test the substrate (i.e. bottom sediments) of the area(s) to be dredged prior to commencement of dredging. The chemical parameters, testing protocols, and sampling procedures should be coordinated with and approved by the Alaska District Corps of Engineers."
>
> Condition 3
> " all materials discharged shall be free of toxic pollutants in toxic amounts as defined by Alaska State Law and the Toxic Pollutant list referred to as Table 1 in Section 307 of the Clean Water Act..."

A final finding of consistency with the Alaska Coastal Management Program for the project was issued by the state Division of Governmental Coordination on June 19, 1996 (9605-06JJ).

In order to comply with the permitting conditions the city authorized PN&D and Easton Environmental of Juneau to develop and conduct an initial sediment sampling and testing program. The results of the initial sampling and testing program were presented in an April 1997 report titled "Petersburg South Harbor Dredging Sediment Characterization and Analysis"[4]. Agency review of the initial report led to recommendations for additional sampling and testing which are currently in process.

---

[4] Petersburg South Harbor Dredging Sediment Characterization and Analysis, Report Prepared for the City of Petersburg, Alaska by Easton Environmental and Peratrovich, Nottingham & Drage, Inc., April 27, 1997.

2.0 REGIONAL SETTING AND SITE CONDITIONS

2.1 Location

Petersburg is located at the northwest end of Mitkof Island at the northern end of Wrangell Narrows. The community is situated approximately midway between Juneau and Ketchikan and is a mainline port for the state ferry system. Local access is provided by the state ferry system, Alaska Airlines and various land and sea based air taxi services.

The community has a population in excess of 3,300 people. Major sources of local employment include the seafood industry and federal, state and local government. Additional employment includes logging, transportation, retail and other services.

The Petersburg waterfront has three primary harbors - North, Middle and South Harbors. These harbors stretch along a half mile of the eastern shore of Wrangell Narrows immediately west of the main business district. The harbors are owned by the ADOT&PF and are operated by the City of Petersburg.

2.2 Climate

Petersburg is characterized by a maritime climate with cool summers and moderate winters. Winter conditions frequently experience numerous freeze/thaw cycles. Average January temperatures range from 22° F to 33° F. Record temperatures range from -19° F to 84° F. The mean annual precipitation is 106 inches, including 102 inches of snow.

Other significant climatic data, for the period 1937 to 1983, is presented below:

▪ Mean annual temperature	42° F
▪ Maximum monthly precipitation	16.8 inches
▪ Maximum Daily precipitation	5.7 inches

2.3 Topography and Geology

Southeast Alaska is situated on the outer margin of the Corderillian Range, an extensive coastal mountain range extending from the western edge of North America from Southern California to the Alaskan Peninsula. The Corderillian is composed of numerous rugged interconnected mountain ranges which are the product of the tectonic interaction between the North American and Pacific plates. The existing geology of Southeast Alaska bears evidence of volcanic activity, igneous intrusion, uplift, sedimentation, and glacial scouring.

The present topography and geology of Southeast Alaska occurred as the result of a prolonged major uplift, the waning stages of a world glacial epoch, and the slow, persistent movement of the ocean crust in relation to the North American Continent. Uplift of the land mass began about 50 million years ago and still continues.

The region is noted for it's extensive fjords, islands and steep mountains which were carved during the ice ages of the Pleistocene epoch (10,000 to 1 million years ago). Major fjords in the region run southeast to northwest with numerous lessor fjords and valleys cutting obliquely to the northeast. This orientation is the result of the northwest movement of the ocean crust along the periphery of the North American land mass followed by glacial scouring of weakened and broken rock along the fault zones.

The Petersburg town site is situated on a large, poorly drained flat bounded to the south by mountains approaching maximum elevations of approximately 2,500 feet. The predominate vegetation in the town site is open muskeg with frequent ponds and streams. The muskeg is composed of living and partially decomposed organic materials which is underlain by unconsolidated marine clay, glacial debris and bedrock. The local bedrock is commonly referred as Mitkof Slate, which is a gray, typically fine grained, metamorphic rock. Visible outcrops of the material occur at the airport quarry site, various locations along the shoreline of Wrangell Narrows and east of town on Frederick Sound.

The closest gravel sources to the town site are located along Wrangell Narrows some three miles from the site.

2.4 Local Seismicity

2.4.1 USGS Seismic Maps

Recent estimates of horizontal earthquake accelerations are presented in seismic mapping by Algermissen et al. of the USGS[5]. These estimates are presented for a 90 percent probability of not being exceeded for the following return periods:

Return Period	**Estimated Horizontal Accelerations in Petersburg, Alaska**
50 Years	< 0.050 g
250 Years	< 0.075 g

Algermissen et al's. estimates for 50 year return period events serve as the basis for the American Association of State Highway and Transportation Officials (AASHTO) Bridge Standards and are often utilized as a design criteria for earthquake slope stability on earthwork projects.

---

[5] Algermissen. S.T., Perkins, D.M., Thenhaus, P.C., Hanson, S.L., and Bender, B.L., Probabilistic Acceleration and Velocity Maps for the United States and Puerto Rico, Miscellaneous Field Studies Map, U.S. Geological Survey, Department of the Interior, 1990.

2.4.2 Uniform Building Code (UBC) Seismic Zone Map

The 1997 Uniform Building Code (UBC)[6] classifies seismicity throughout the United States by seismic zone. The code presents guidelines which should be utilized for the design of any onshore buildings in the harbor vicinity. The seismic zone map of UBC Figure 16.2 identifies Petersburg as a zone 2B corresponding to moderately active seismic conditions when compared to other parts of coastal Alaska.

---

[6] International Conference of Building Officials, 1997Uniform Building Code, Volume 2, Whittier, California, April 1997.

3.0 FIELD INVESTIGATION

Field drilling investigation activities were conducted during November 12-18, 1996 at offshore and onshore locations shown in Appendix A, Figure A-1.

Preparation for drilling included mobilizing equipment to allow the investigation of offshore and onshore soil conditions ranging from extremely soft marine soils to densely packed materials of glacial or alluvial origin. Bedrock coring equipment was also utilized but was not used because deep soil conditions were encountered at the site. Test hole depths varied by location and the type of design information required.

3.1 Drilling and Sampling Procedures

3.1.1 Drilling Equipment

Drilling services were provided by Denali Drilling Company of Anchorage. All test holes were drilled with a CME 55 drill rig mounted on a Nodwell track carrier. Vessel assistance for the investigation was provided by *The Boat RB* a 20 foot x 65 foot landing craft with a U.S. Coast Guard certified capacity of 50 short tons.

Offshore test holes TH-1 through TH-8 were drilled with rotary wash equipment with 4 ½ inch diameter casing, split-spoon and Shelby tube sampling. Water for the rotary wash process was provided by a diesel powered piston pump which was mobilized with the drilling equipment.

Onshore test TH-9 was drilled with 4 ¼ inch I.D. x 8 inch O.D. hollow stem augers and split-spoon sampling.

3.1.2 Soil Sampling Methods

Soil sampling was conducted with split spoon and Shelby tube samplers as summarized below:

- Standard Penetration Test (SPT) sampling utilizing of a 1.4 inch inside diameter (I.D.) /2.0 inch outside diameter (O.D.) split-spoon sampler driven by a 140 pound hammer falling 30 inches for each blow. Samples collected with this method are identified as "Ss" on the test hole logs. The Ss sampler is best suited for silts, sands and fine gravels with a maximum particle size smaller than the 1.4 inch I.D. of the sampler.
- Large Split-spoon sampling consisting of a 2.4 inch I.D./3.0 inch O.D. split-spoon sampler driven by a 340 pound hammer falling 30 inches for each blow. Samples collected with this method are identified as "Sh" on the test hole logs. The larger sampling equipment allows more material to be collected and facilitates the sampling of coarser soils.

Split-spoon samplers are typically driven a minimum of 18 inches with blow counts being recorded for each 6 inch penetration interval. The sum of the number of blow counts required to drive the sampler from 6 inches to 18 inches is presented as the final test hole logs as the "penetration resistance" (e.g. 30 blows/ft.). At sampling locations where it was not possible to drive the sampler at least 12 inches the penetration resistance is presented as the number of blows for the driving interval (e.g. 85 blows/7 inches).

PN&D's experience with the Ss and Sh sampling methods indicates that, for similar soil conditions, a minimum of 2 times as many blows are typically required to drive a Ss sampler combination as are required to drive the larger Sh sampler and hammer equipment.

- One soil location was sampled with a 3.0 inch O.D., thin walled, Shelby sampler pushed into the soil with the drill rig. The Shelby sampler is utilized for the collection of relatively undisturbed samples and is noted as "Ts" on the test hole logs.

3.2 Soil Classification Methods

Test hole logs are presented in Appendix B. Identification and classification of soils was accomplished in accordance with the Unified Soil Classification System (USCS) as noted in Appendix B, Figures B-1 and B-2.

3.3 Laboratory Testing

Selected soil samples were submitted for laboratory sieve analysis, unit weights, Atterberg Limits, and moisture contents, as well as triaxial strength and consolidation tests. The results of the laboratory testing have been added to the test hole logs and are presented in Appendix C.

4.0 INVESTIGATION RESULTS

The investigation for the South Harbor Improvements included 9 test holes advanced within the proposed harbor improvement areas. Test holes PND-1 through PND-8 were drilled in offshore and tidal zone locations using rotary wash methods. Test hole PND-9 was drilled at the edge of the existing South Harbor parking lot with hollow stem auger equipment. Complete test hole logs are presented in Appendix B.

4.1 Offshore Soil Conditions

The results of the drilling investigation for the South Harbor improvements indicates that subsurface soils consist of three general layers of varying density as indicated by split spoon sampling performance. In fine grained soils the split spoon sampling was typically conducted by alternating the standard and large equipment to provide a correlation between them. In locations where coarse grained soils were encountered the larger Sh sampler was typically utilized in order to provide more representative soil samples. Actual field blow counts, for both types of samplers, are presented on the field logs.

The surface layer of soil in the harbor improvement area consists of soft sand, silt, shell fragments and small amounts of organics. This layer was observed to be 5 feet in thickness at test hole PND-1, and between 0.5 to 1.0 feet in thickness at test holes PND-2 through PND-8. Observations during low tide also revealed scattered cobbles and boulders on the soil surface throughout the harbor area.

Soils beneath the surface layer, and extending to an average soil depth of about 20 feet, appear to consist mainly of medium dense sands, silts and clays with lesser amounts of gravel. Dredging experience, from the 1995-1996 construction of the nearby seaplane base, indicates that cobbles and boulders should also be expected in this soil layer. The majority of the dredging for the harbor improvements will be conducted within this soil layer.

Soils below an average soil depth of approximately 20 feet to a maximum drilling depth of 58 feet (at PND-6) were observed to be in a generally soft to medium dense condition as indicated by the split spoon blow counts. The soils in this interval varied from fine silts and clays to coarse sands and gravels. The total depth to which these soils extend is unknown. The inter-bedded layers of coarse and fine grain materials at these depths appear to provide numerous drainage paths throughout the soil mass. A sample of silty sand, collected from test hole PND-6, was submitted for triaxial strength testing under consolidated drained conditions and for a consolidation test. The test results (presented in full in Appendix C) indicate an effective soil strength, ϕ' of approximately 36°.

4.2 Parking Lot Fill Soil Conditions

Test hole PND-9 was drilled through the existing parking lot fill to a total depth of 40.2 feet. The test hole extended though a thin, approximately 0.3 foot thick, layer of asphalt pavement. Fill materials consisting of silty gravel grading to silty sandy gravel were encountered from 0.3 feet to 14.5 feet.

Silty clay with sand was encountered from 14.5 feet (approximate elevation of the original beach) to 32 feet. Dense to very dense silty sand with gravel was encountered from 32 feet to the termination of drilling at 40.2 feet.

5.0 GEOTECHNICAL RECOMMENDATIONS

The proposed South Harbor improvements will be constructed in several phases in order to achieve planning and budgeting goals. The following recommendations are based upon the current concepts for the South Harbor improvements and as such are expected to be modified as the project evolves or changes. Examples of possible modifications could include the substitution of differing construction materials, compaction recommendations or design options to respond to possible changes design scope, material availability, or regulatory conditions affecting the project.

Where possible the material recommendations are based upon the City of Petersburg Standard Specifications.

5.1 Harbor Dredging

The initial phase of the South Harbor improvements will consist of dredging selected portions of the harbor in and around locations where new floats will be constructed as well as the removal of the abandoned timber dock access leading to the former float plane base. Additional dredging will be conducted during later phases of the work after the new commercial dock has been constructed. Dredge elevations are expected to vary from -15 feet MLLW and-18 feet MLLW depending on location within the harbor. The majority of the materials in the dredge area are medium dense to dense soils consisting of silts and clays with varying amounts of intermixed sand, gravel, cobbles and boulders. Scattered harbor debris may also be encountered in the dredging areas.

The planned disposal location for dredge materials is located in Frederick Sound approximately 2 miles from the site. The environmental analysis of the proposed dredge soils (ref. separate dredging sediment characterization and analysis report) indicates that some of the proposed dredge spoils in the vicinity of the abandoned seaplane base may consist of soils which are too contaminated to dispose offshore. Upland disposal options for the contaminated soils may include utilizing them at other off site locations or placing them within a dedicated portion of the proposed parking lot or commercial dock fill of the South Harbor Improvements. The potential effects of these disposal options on project permitting, scheduling, and budget are currently being evaluated.

As noted above, the initial phase of the dredging activities will include the removal of the abandoned seaplane base access trestle. This portion of the work will include removal of all existing dock components such as piles, caps, bracing, stringers, decking and other items. Pile removal will include those piles in the dock structure itself and other free-standing and broken off piles in the vicinity.

Some previous contractors have encountered difficulties in dredging the dense soils in the South Harbor area. Contractors interested in performing the proposed dredging of this project should understand the importance of providing appropriate equipment to effectively dredge densely packed cohesive and non cohesive soils and to remove large cobbles, boulders and debris. Alternatives for the removal of large boulders may include blasting them into smaller sizes or rigging and floating them to the disposal area. Blasting has also reportedly been used for the dredging of dense marine soils in the Petersburg area and may be considered during development of the dredging plan for this project. In the event that blasting is proposed a blasting plan should be developed to meet the requirements of local, state and federal agencies. The blasting plan should consider potential effects on local fish stocks and existing fuel facilities in the area as well as other harbor and onshore activities.

Dredge area side slopes should be sloped at a maximum of 2(horizontal):1(vertical). The 2:1 side slopes are expected to be stable under static conditions and during small and medium magnitude earthquakes. In the event of a large magnitude earthquake some slumping may occur in the vicinity of the dredge area side slopes.

Construction oversight and survey control are important components of any dredging project. Dredging activities should be overseen by an engineer/inspector with previous dredging experience. Construction survey control of the dredge area should include bathymetric measurements combined with a dive inspection to insure the area has a uniform bottom which is excavated to the proper elevations and is free of high spots.

5.2 New Float Construction

Subsequent phases of the proposed harbor improvements will include the extension of floats A, B, C, D, a high capacity transient float connected to the north end of float C, slip floats, and a transient float associated with the new commercial dock at the west end of the harbor. Steel pipe piles will be utilized as float anchor piles. Design of float anchor piles should consider the medium dense to dense nature of the upper soil layer, the presence of softer soils at greater depths and the probability that sporadic cobbles and boulders will be encountered while driving. These conditions indicate that the float anchor piles should be equipped with open ended driving shoes for protection during installation.

Pile sizes, spacing and embedment depths will be determined during the float design process to insure optimal design of the new dock components. Freestanding float anchor piles will be designed to resist lateral loads from floats and vessels. Design criteria for freestanding float anchor piles should assume pile fixity at a soil depth of approximately 10 feet (approximate elevation equal to -28 feet MLLW in dredge areas) and a float elevation of approximately +25 feet MLLW to account for extreme high tide conditions.

Lateral load requirements at selected float locations, such as the high capacity transient float, are expected to require the use of paired piles connected with moment resisting caps to provide increased lateral capacity.

5.3 Uplands Parking and Service Facilities Expansion

The proposed harbor improvements will also include the expansion of the South Harbor parking fill to provide space for additional parking spaces and restroom facilities. This proposed improvement will include the placement of up to 10,000 cubic yards of materials including classified fill, armor rock, leveling course, and pavement. Test hole PND-9 was drilled through the existing parking lot fill adjacent to the proposed expansion area and revealed native soils consisting of silty clay overlying silty sand with gravel. The following recommendations are provided for the new fill:

Geometry: Construction of the parking lot fill expansion should match the existing design to the maximum extent possible. The existing fill was constructed with 1.5(horizontal):1(vertical) side slopes and the parking lot area was graded to a minimum slope of 1% to insure drainage of the parking surface. The new fill area should also be constructed to these side and parking surface slopes.

Structural Fill Materials: The approximate finish elevation of the new fill surface will be at or above +23 feet MLLW. The typical parking area cross section will consist of shot rock fill, leveling course and asphalt pavement as noted below:

Existing ground to 3 feet below top of pavement.	Classified Fill and Backfill, Type V in conformance with Section 20.05 and related sections of City of Petersburg Standard Specifications, Street-Drainage-Utilities-Parks, 1997 Edition. Classified Fill and Backfill should be placed in lifts with a maximum loose thickness of 24 inches each compacted with a minimum of 10 passes with a 10 ton vibratory roller.
3 feet below top of pavement to 9 inches below top of pavement.	Classified Fill and Backfill, Type II-A in conformance with Section 20.05 and related sections of City of Petersburg Standard Specifications, Street-Drainage-Utilities-Parks, 1997 Edition with the exception that the maximum particle size shall be 4 inches or less. The fill materials of this layer should be placed in a maximum lift thickness of 12 inches and compacted with a minimum of 8 passes with a 10 ton vibratory roller.

9 inches below top of pavement to bottom of pavement.	Leveling Course in conformance with Section 20.06 and related sections of City of Petersburg Standard Specifications, Street-Drainage-Utilities-Parks, 1997 Edition.
Asphalt Pavement	Asphalt Concrete Pavement, Class B in conformance with Section 40.02 and related sections of City of Petersburg Standard Specifications, Street-Drainage-Utilities-Parks, 1997 Edition. The appropriate thickness of the asphalt pavement will depend on the planned utilization of the new parking lot surface. If the area is utilized for light vehicle parking (cars and pickup trucks) a two inch thickness of asphalt pavement is expected to be adequate. If the parking area is to be utilized for long term storage of heavier vehicles and loaded boat trailers the pavement thickness should be increased to 3 inches to reduce pavement deformations.

Minor settlement, of 6 inches or less, is expected to occur within the first year after the construction of the new parking lot fill. The expected settlement suggests that the parking lot fill should be initially constructed with an unpaved surface and allowed to settle for one year. Following the settlement waiting period the leveling course may be re-graded and asphalt pavement may by placed.

Erosion Control: The outer edges of the fill slope should be protected by a 2 foot thickness of Riprap, Class II in conformance with Section 20.24 and related sections of City of Petersburg Standard Specifications, Street-Drainage-Utilities-Parks, 1997 Edition.

5.4 Commercial Dock

The proposed commercial dock is currently planned as a final phase of the South Harbor improvements. The commercial dock will be a fill structure combined with an open cell sheet pile bulkhead to service vessels. Construction will involve the placement of approximately 110,000 cubic yards of fill materials to a maximum elevation of approximately +23 feet MLLW. The utilization of sheet pile and embankment construction will provide an economical dock surface with a high service load capacity. A vessel service float will be constructed on the eastern side of the structure to facilitate vessel loading and access. Construction of the commercial dock may be conducted in several stages with initial activities consisting of sheet pile installation and fill placement followed by the construction of reinforced concrete perimeter aprons and paving during later stages.

Current plans are to dredge along the north and east sides of the new dock to an approximate bottom elevation of -18 feet MLLW. Sheet piling for the dock structure should be embedded a minimum of 10 feet below final dredge elevations, to an elevation of -28 feet MLLW or deeper, to insure that the base of the structure is protected against scour.

Embankment side slopes for the commercial dock may be constructed to maximum slopes of 1(horizontal):1.5(vertical) using the materials and erosion control methods noted for the Structural Fill Materials note in section 5.3.

The placement of fill materials should be conducted in two stages to allow for the initial consolidation and the dissipation of pore water pressure build-up in the native soils underlying the new fill. Preliminary plans for the fill placement staging are discussed below:

Stage 1: Initial fill placement should be conducted to a maximum elevation of approximately +12 feet MLLW. Upon reaching the +12 feet MLLW elevation the fill should be graded, protected from erosion and allowed to settle for an initial consolidation/monitoring period of approximately 28 days prior to the placement of additional materials. Settlement should be monitored at least once a week and additional fill materials should not be placed until approved by the engineer.

Stage 2: After the 28 day monitoring period has elapsed additional fill materials may be placed until final elevations are reached.

A preliminary estimate of soil settlement at the outer end of the commercial dock fill indicates that total settlements could approach 1.5 feet. Lesser settlements are expected in near shore fill areas where more shallow fill materials will be placed. The majority of the soil settlement is expected to occur within one year of the soil placement and should be monitored during the construction process to allow measurement of in place fill quantities and the rate of settlement. Monitoring may be conducted by placing settlement plates at selected locations in the fill area to allow measurement throughout the construction process. The current plans for construction phasing will allow for the majority of the estimated soil settlement to be complete prior to the construction of the reinforced concrete dock aprons and pavements.

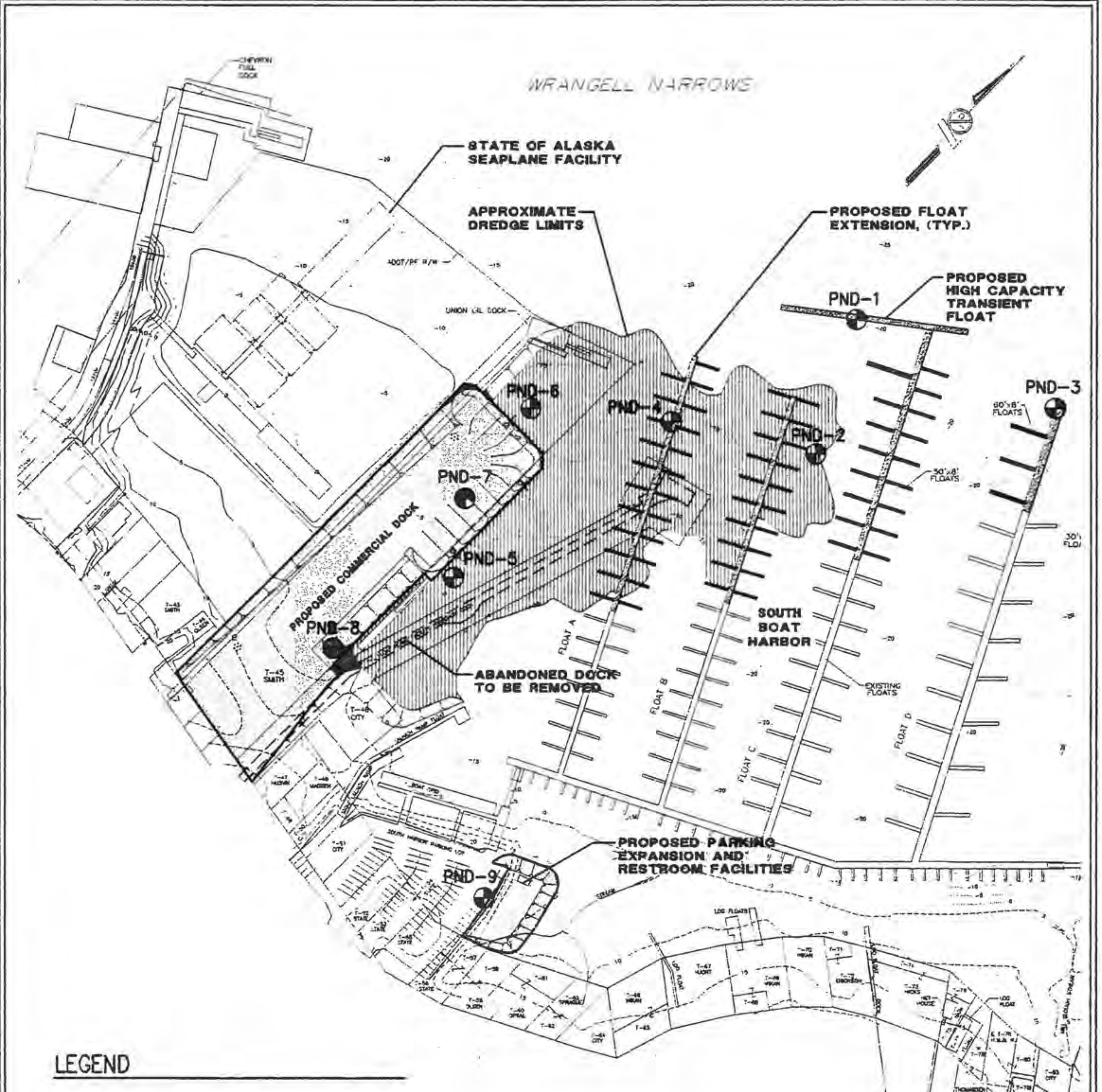
Construction of the dock will include the demolition of most of the existing Union Oil Dock access trestle and the protection or relocation of existing fuel transfer lines which are supported by it. The portion of the Union Oil Dock which is to remain is an old and fragile structure which will require protection during all phases of construction.

6.0 LIMITATIONS

This report was prepared by PN&D for use on this project only. The proposed improvements, which are discussed in this document, are also being designed by PN&D and as such continuing communication and review is on-going among the design team. Additional information has been attached, in Appendix D, which addresses appropriate use and limitations of the geotechnical information presented in this document.

APPENDIX A

SITE PLAN AND TEST HOLE LOCATION DRAWING



LEGEND

PND-2 ◒ TEST HOLE

PROPOSED FLOATS

☐ APPROX. FILL AREA

▥ APPROX. DREDGE AREA

SCALE IN FEET

0 200 400 FT.

SOUTH HARBOR EXPANSION
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PN&D PROJECT NO. 96256

SITE PLAN AND
TEST HOLE LOCATIONS

FIGURE A-1

Peratrovich, Nottingham & Drage, Inc.
August, 1997

APPENDIX B

PN&D TEST HOLE LOGS

SOILS

CLASSIFICATION, CONSISTENCY AND SYMBOLS

CLASSIFICATION: Identification and classification of the soil is accomplished in general accordance with the ASTM version of the Unified Soil Classification System (USCS) as presented in ASTM Standard D 2487-93. The standard is a qualitative method of classifying soil into the following major divisions (1) coarse grained (2) fine-grained, and (3) highly organic soils. Classification is performed on the soils passing the 75 mm (3 inch) sieve and if possible the amount of oversize material (> 75 mm particles) is noted on the soil logs. This is not always possible for drilled test holes because the oversize particles are typically too large to be captured in the sampling equipment. Oversize materials greater than 300 mm (12 inches) are termed boulders, while materials between 75 mm and 300 mm are termed cobbles. Coarse grained soils are those having 50% or more of the non-oversize soil retained on the No. 200 sieve; if a greater percentage of the coarse grains is retained on the No. 4 sieve the coarse grained soil is classified as gravel, otherwise it is classified as sand. Fine grained soils are those having more than 50% of the non-oversize material passing the No. 200 sieve; these may be classified as silt or clay depending their Atterberg liquid and plastic limits or observations of field consistency. Refer to ASTM D 2487-93 for a complete discussion of the classification method.

SOIL CONSISTENCY - CRITERIA: Soil consistency as defined below and determined by normal field and laboratory methods applies only to non-frozen material. For these materials, the influence of such factors as soil structure,, i.e. fissure systems, shinkage cracks, slickensides, etc., must be taken into consideration in making any correlation with the consistency values listed below. In permafrost zones, the consistency and strength of frozen soils may vary significantly and unexplainably with ice content, thermal regime and soil type.

Relative Density of Sands According to results of Standard Penetration Test

	N*(blows/ft)	Relative Density
Loose	0 - 10	0 - 40%
Medium Dense	10 - 30	40 - 70%
Dense	30 - 60	70 - 90%
Very Dense	>60	90 - 100%

Consistency of Clay in Terms of Unconfined Compressive Strength (tsf)

Very Soft	0 - 0.25
Soft	0.25 - 0.5
Stiff	0.5 - 1.0
Firm	1.0 - 2.0
Very Firm	2.0 - 4.0
Hard	> 4.0

* Standard Penetration, "N": Blows per foot of a 140-pound hammer falling 30 inches on a 1.4" ID split-spoon sampler except where noted.

DRILLING SYMBOLS

WO: Wash Out
WL: Water Level
WCI: Wet Cave In
DCI: Dry Cave In
WS: While Sampling

WD: While Drilling
BCR: Before Casing Removal
ACR: After Casing Removal
AB: After Boring
TD: Total Depth

Note: Water levels indicated on the boring logs are the levels measured in the boring at the time(s) indicated. In pervious unfrozen soils, the indicated elevations are considered to represent actual ground water conditions. In impervious and frozen soils, accurate determinations of ground water elevations cannot be obtained within a limited period of observation and other evidence of ground water elevations and conditions are required.

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TEST HOLE LOGS

FIGURE B-1

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SAMPLER TYPE SYMBOLS

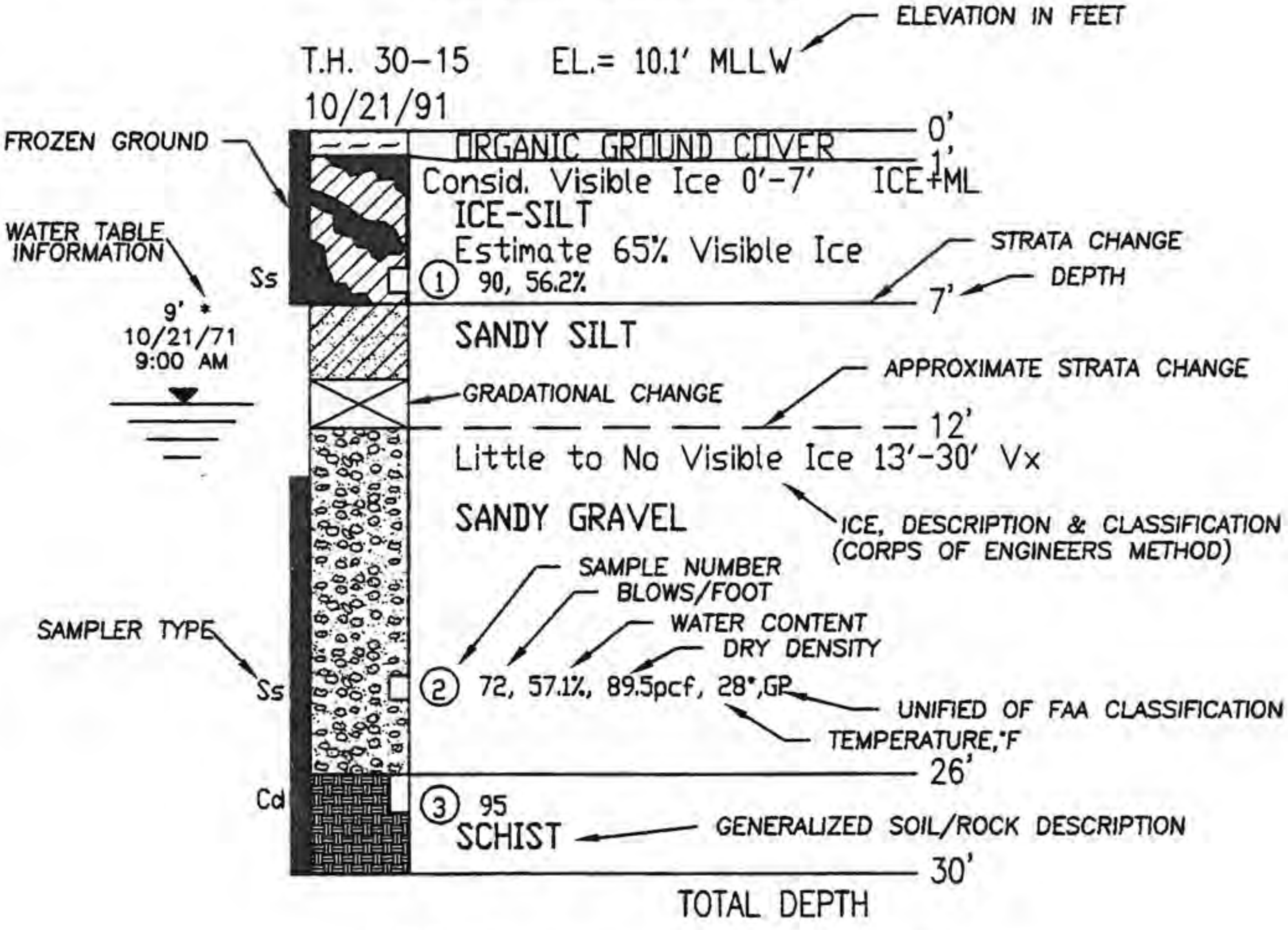
St . . . 1.4" SPLIT SPOON W/ 47# HAMMER
Ss . . . 1.4" SPLIT SPOON W/ 140# HAMMER
Sl . . . 2.5" SPLIT SPOON W/ 140# HAMMER
Sm . . . 2.5" SPLIT SPOON W/ 300# HAMMER
Sh . . . 2.5" SPLIT SPOON W/ 340# HAMMER
Sp . . . 2.5" SPLIT SPOON, PUSHED
Hs . . . 1.4" SPLIT SPOON DRIVEN W/ AIR HAMMER
Hl . . . 2.5" SPLIT SPOON DRIVEN W/ AIR HAMMER
Sx . . . 2" SPLIT SPOON DRIVEN W/ 140# HAMMER

Ts . . . SHELBY TUBE
Tm . . . MODIFIED (2.5'O.D.) SHELBY TUBE
Pb . . . PITCHER BARREL
Cs . . . CORE BARREL W/ SINGLE TUBE
Cd . . . CORE BARREL W/ DOUBLE TUBE
Bs . . . BULK SAMPLE
A . . . AUGER SAMPLE
G . . . GRAB SAMPLE

NOTES: 1. SAMPLER TYPES ARE EITHER NOTED ABOVE THE BORING LOG OR ADJACENT TO IT AT THE RESPECTIVE DEPTH.

2. SPLIT SPOON SAMPLER SIZES PRESENTED ABOVE REFER TO THE INSIDE DIAMETER OF THE SAMPLER.

TYPICAL BORING LOG



* W.D. – WHILE DRILLING, A.B. – AFTER DRILLING

SOUTH HARBOR EXPANSION
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TEST HOLE LOGS

FIGURE B-2

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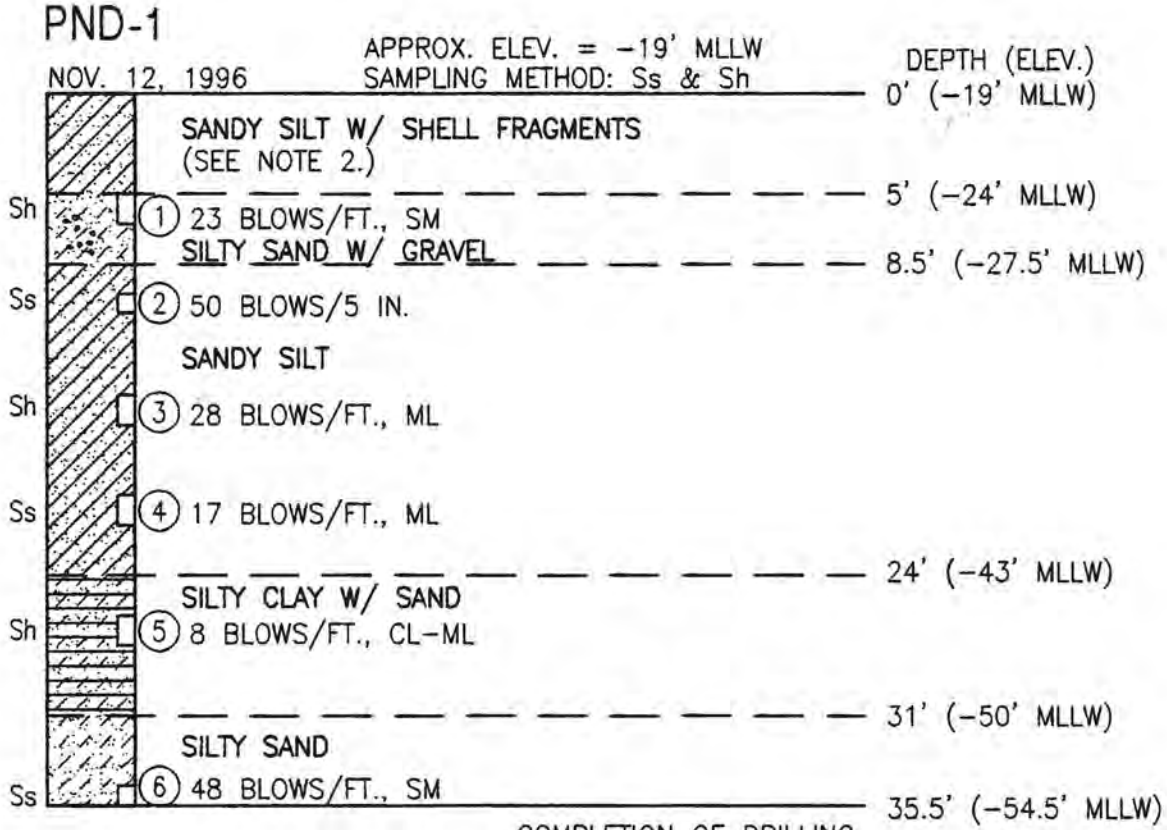

NOTE(S)

1. TEST HOLE DRILLED WITH ROTARY WASH AND CASING EQUIPMENT.
2. IDENTIFICATION OF SOILS FROM 0' TO 5' WAS BASED ON OBSERVATION OF ROTARY WASH CUTTINGS.

SOUTH HARBOR EXPANSION
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TEST HOLE LOGS

FIGURE B-3

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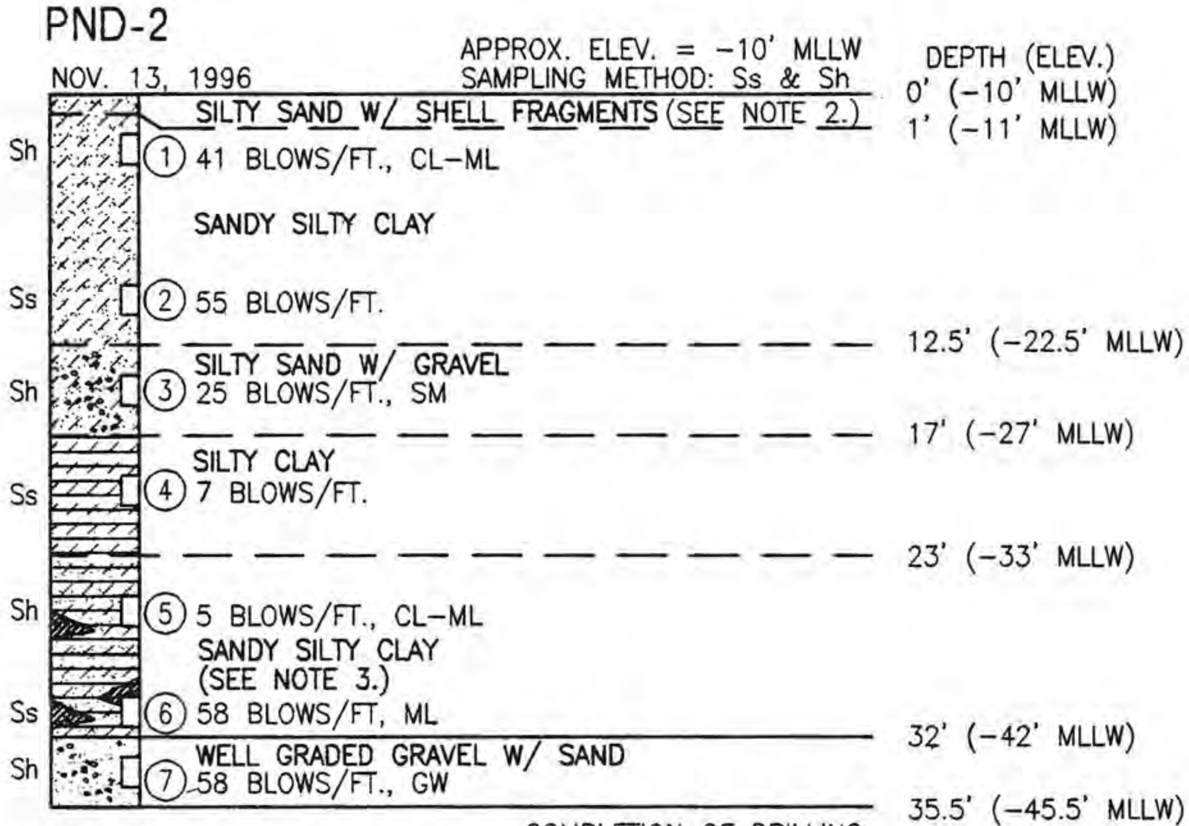

NOTE(S)

1. TEST HOLE DRILLED WITH ROTARY WASH AND CASING EQUIPMENT.
2. IDENTIFICATION OF SOILS FROM 0' TO 1' WAS BASED ON OBSERVATION OF ROTARY WASH CUTTINGS.
3. OCCASIONAL LENSES OF GRAVELLY SANDY SILT WERE ENCOUNTERED BETWEEN SOIL DEPTHS 26' TO 32'.

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PN&D PROJECT NO. 96256

TEST HOLE LOGS

FIGURE B-4

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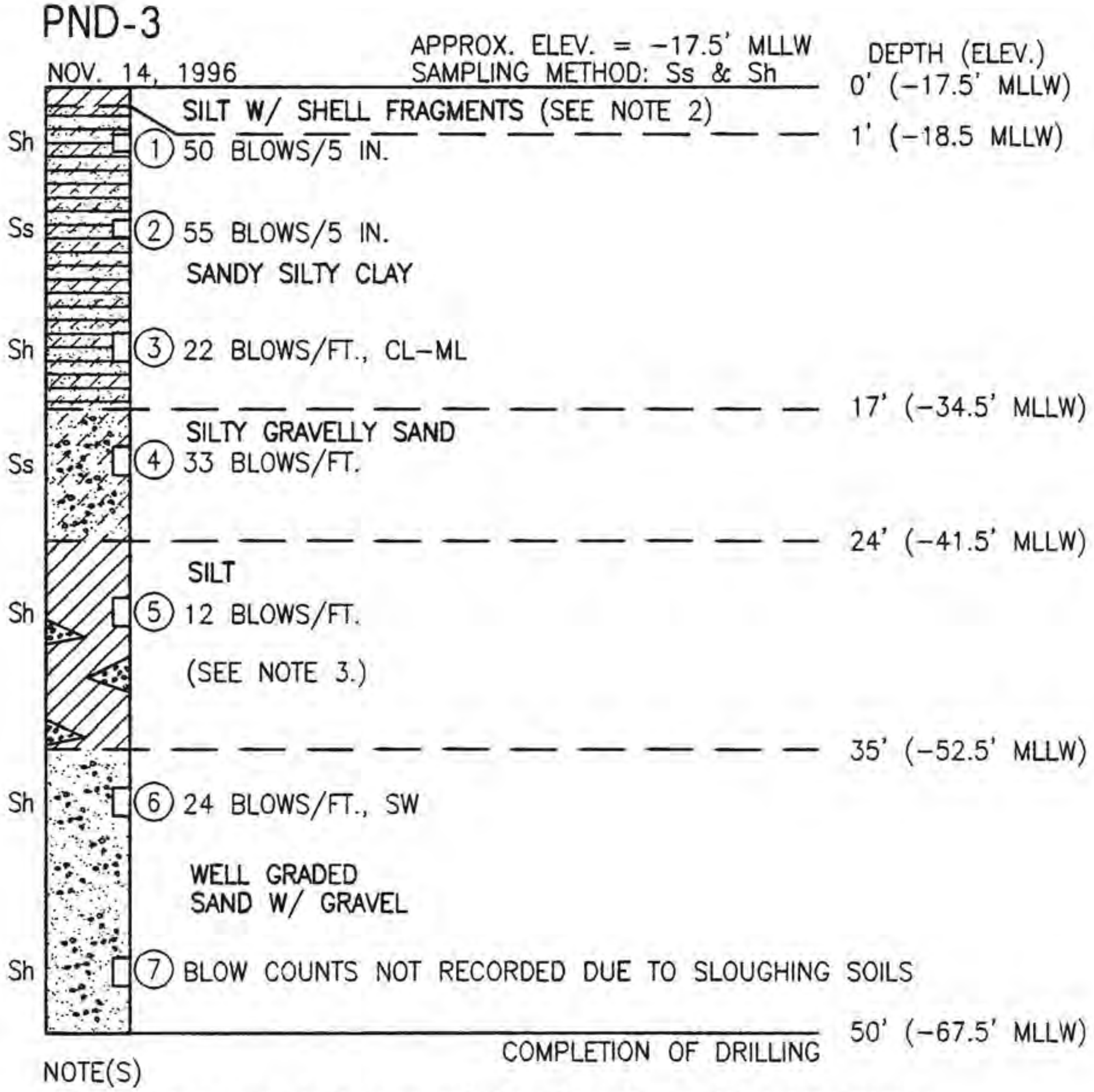
PND-3



NOTE(S)

1. TEST HOLE DRILLED WITH ROTARY WASH AND CASING EQUIPMENT.
2. IDENTIFICATION OF SOILS FROM 0' TO 1' WAS BASED ON OBSERVATION OF ROTARY WASH CUTTINGS.
3. OCCASIONAL LENSES OF GRAVEL WERE INDICATED BY DRILLING BETWEEN SOIL DEPTHS OF 29' TO 35'.

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TEST HOLE LOGS

FIGURE B–5

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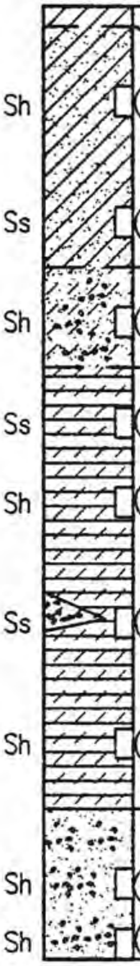
PND-4

NOV. 15, 1996

APPROX. ELEV. = −10' MLLW
SAMPLING METHOD: Ss & Sh

DEPTH (ELEV.)



0' (−10' MLLW)

SILT W/ SHELL FRAGMENTS (SEE NOTE 2.)

1' (−11' MLLW)

Sh ① 38 BLOWS/FT., ML

SILT W/ SAND

Ss ② 45 BLOWS/FT.

13' (−23' MLLW)

SILTY SAND W/ GRAVEL

Sh ③ 26 BLOWS/FT., SM

18' (−28' MLLW)

Ss ④ 16 BLOWS/FT.

Sh ⑤ 11 BLOWS/FT.

SILTY CLAY

Ss ⑥ 25 BLOWS/FT., LENS OF SAND
W/ SOME GRAVEL & TRACE SILT

Sh ⑦ 5 BLOWS/FT.

40' (−50' MLLW)

WELL GRADED GRAVEL W/ SAND

Sh ⑧ 22 BLOWS/FT.

Sh ⑨ BLOW COUNT NOT RECORDED DUE TO COLLAPSING SOILS, GW

COMPLETION OF DRILLING 47.5' (−57.5' MLLW)

NOTE(S)

1. TEST HOLE DRILLED WITH ROTARY WASH AND CASING EQUIPMENT.
2. IDENTIFICATION OF SOILS FROM 0' TO 1' WAS BASED ON OBSERVATION OF ROTARY WASH CUTTINGS.

SOUTH HARBOR EXPANSION
GEOTECHNICAL INVESTIGATION
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TEST HOLE LOGS

FIGURE B−6

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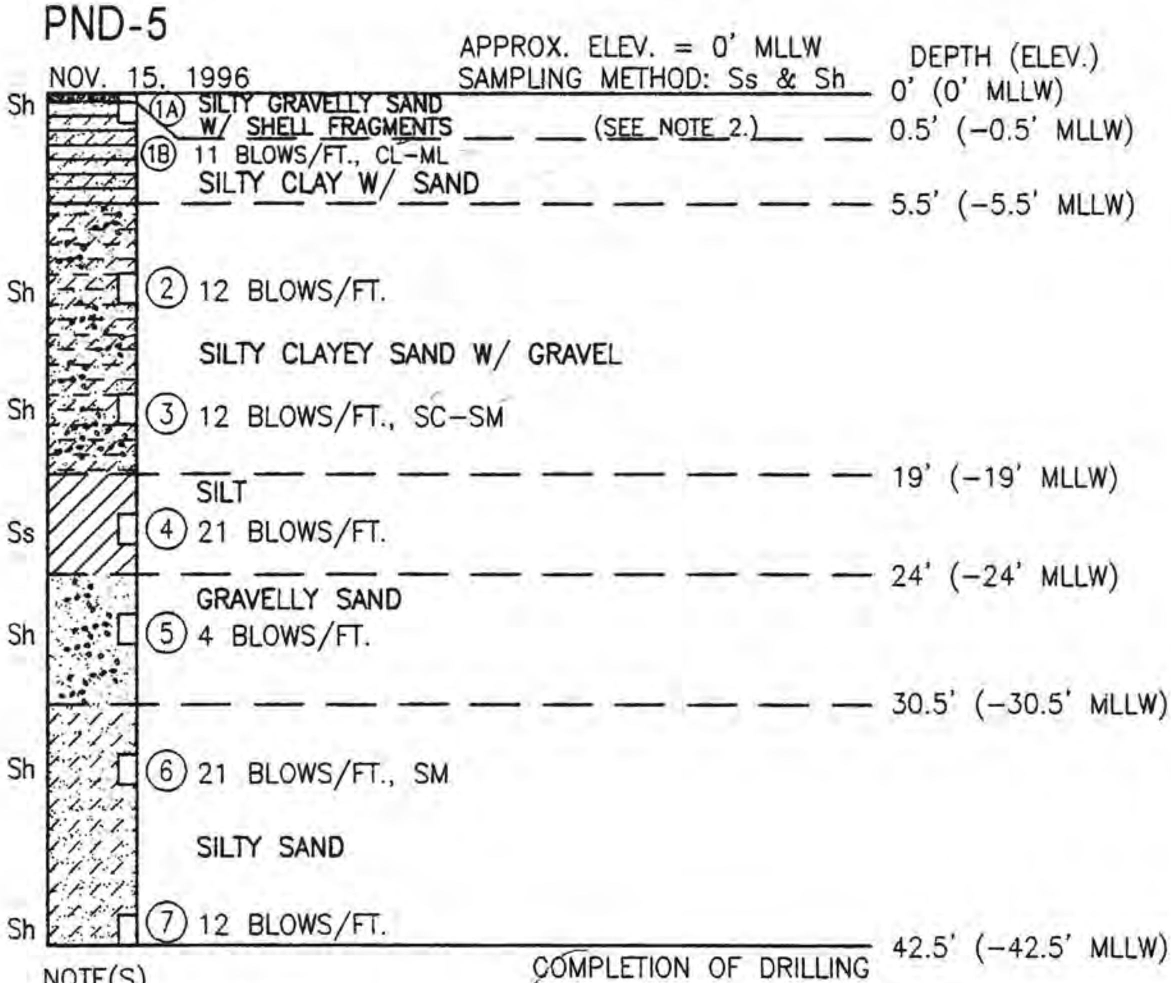

NOTE(S)

1. TEST HOLE DRILLED WITH ROTARY WASH AND CASING EQUIPMENT.
2. IDENTIFICATION OF SOILS FROM 0' TO 1' WAS BASED ON OBSERVATION OF ROTARY WASH CUTTINGS.

SOUTH HARBOR EXPANSION
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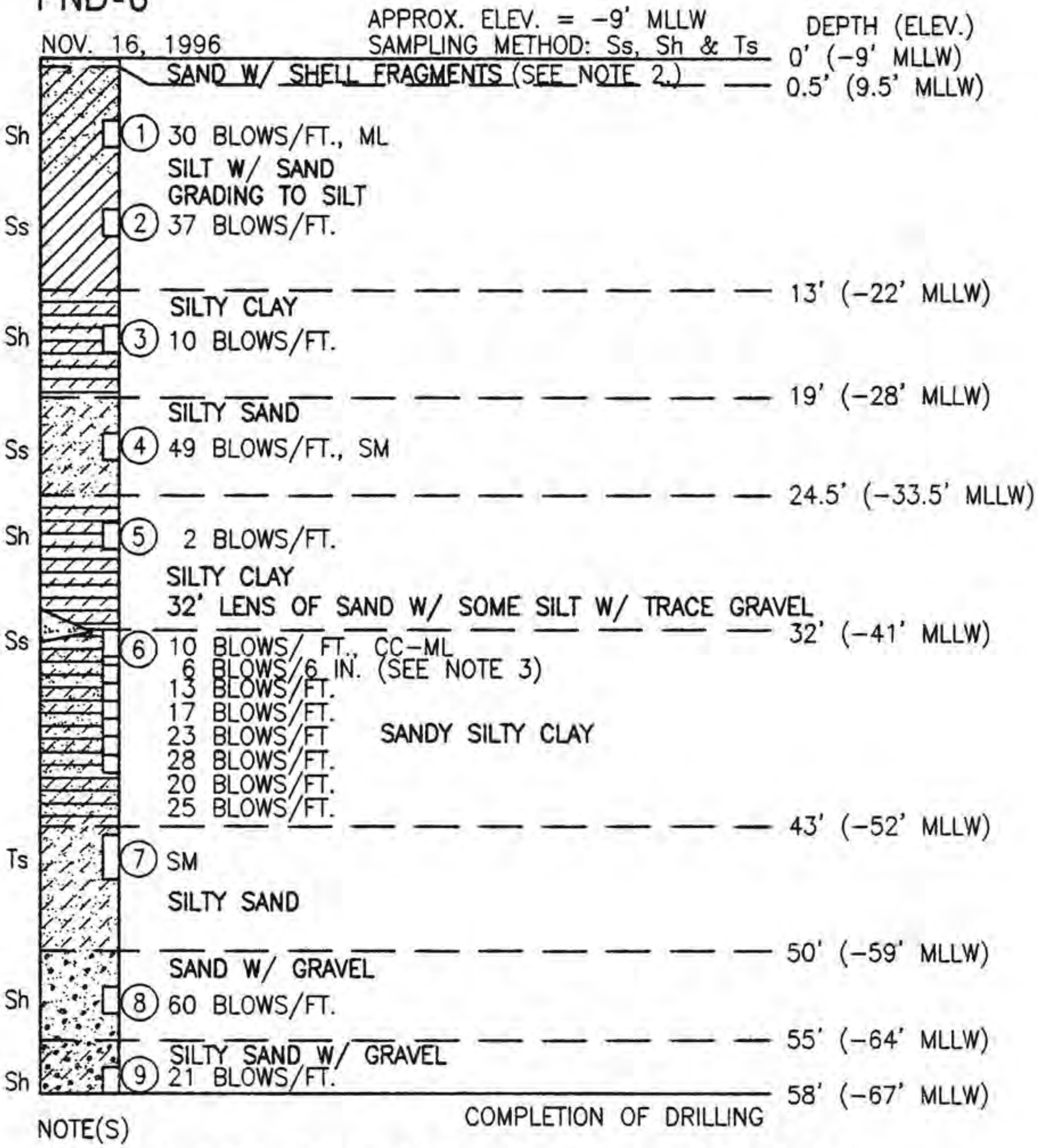
TEST HOLE LOGS

FIGURE B-7

PND-6



NOTE(S)

1. TEST HOLE DRILLED WITH ROTARY WASH AND CASING EQUIPMENT.
2. IDENTIFICATION OF SOILS FROM 0' TO 5' WAS BASED ON OBSERVATION OF ROTARY WASH CUTTINGS.
3. SAMPLE 6 WAS DRIVEN FROM 32' TO 40' TO PROVIDE ADDITIONAL BLOW COUNT INFORMATION.

SOUTH HARBOR EXPANSION
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TEST HOLE LOGS

FIGURE B-8

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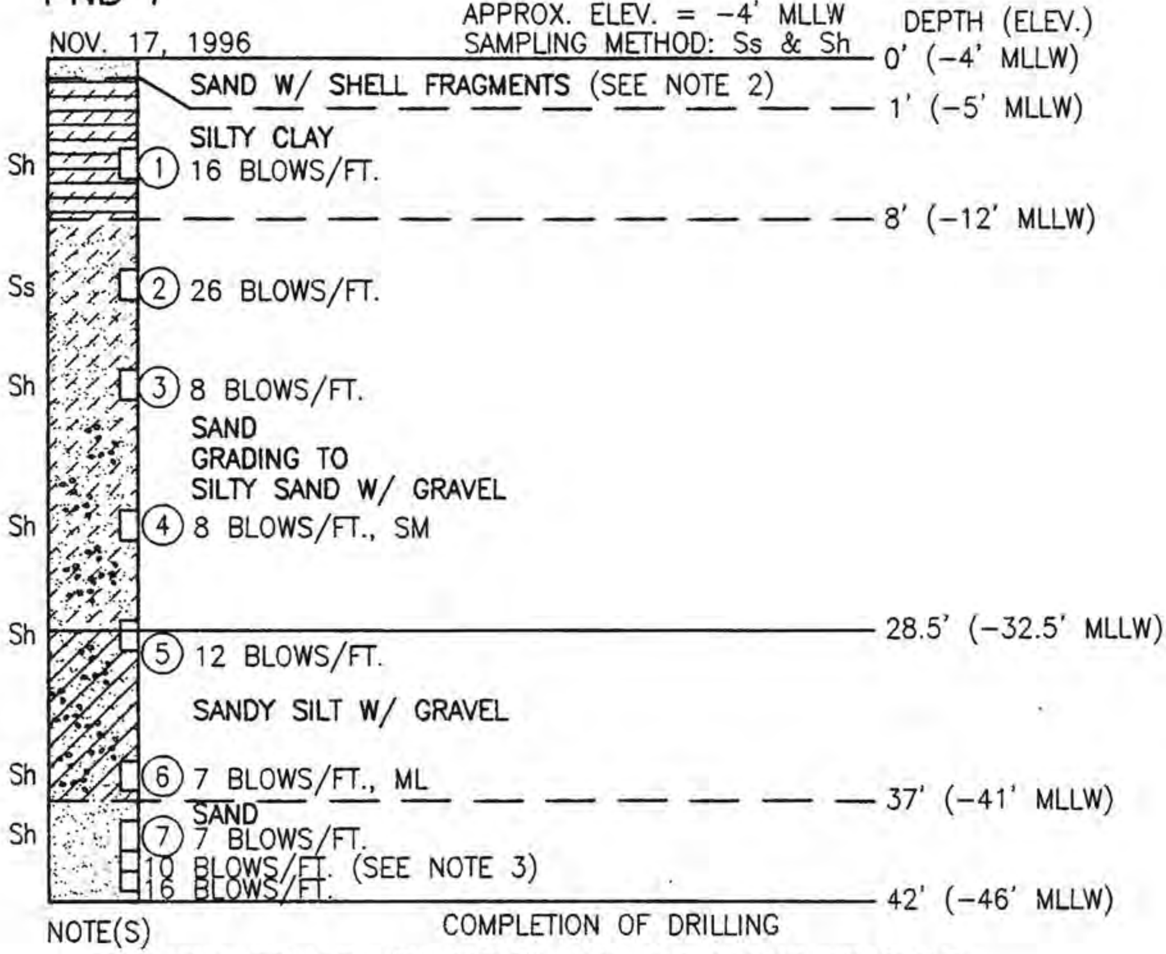
PND-7



NOTE(S)

1. TEST HOLE DRILLED WITH ROTARY WASH AND CASING EQUIPMENT.
2. IDENTIFICATION OF SOILS FROM 0' TO 1' WAS BASED ON OBSERVATION OF ROTARY WASH CUTTINGS.
3. SAMPLE 7 WAS DRIVEN FROM 38' TO 41.5' TO PROVIDE ADDITIONAL BLOW COUNT INFORMATION.

SOUTH HARBOR EXPANSION
GEOTECHNICAL INVESTIGATION
PN&D PROJECT NO. 96256

TEST HOLE LOGS

FIGURE B-9

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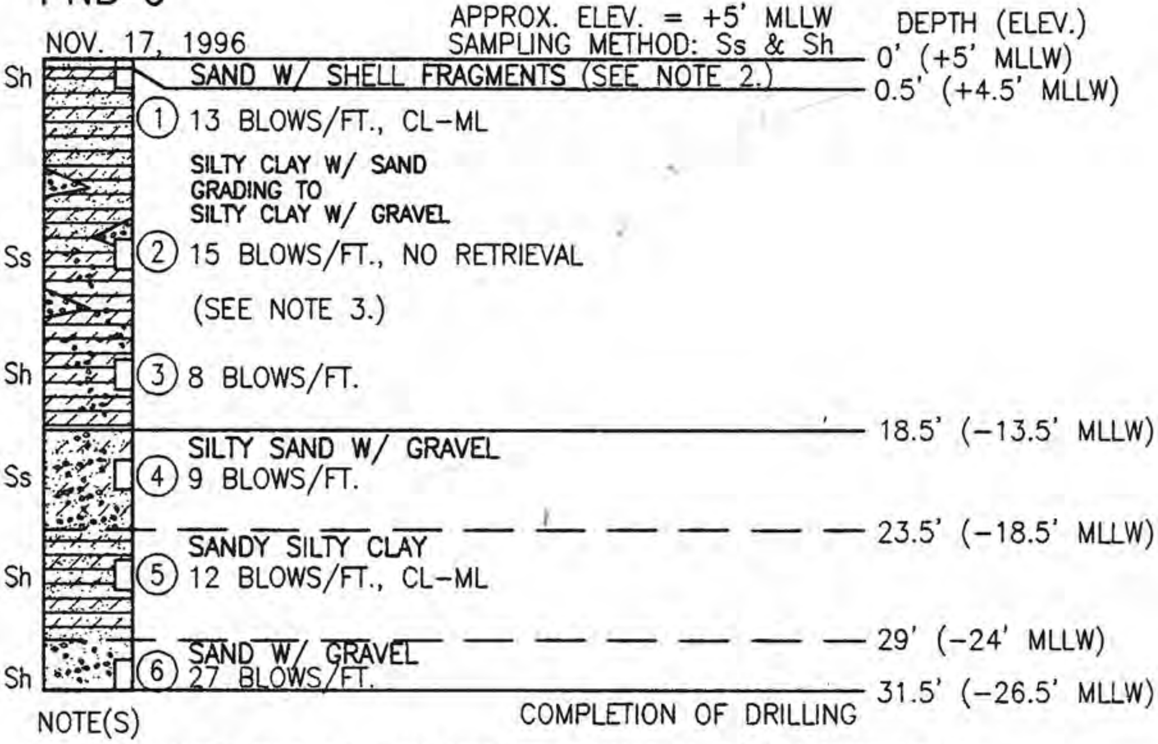
PND-8



NOTE(S)

1. TEST HOLE DRILLED WITH ROTARY WASH AND CASING EQUIPMENT.
2. IDENTIFICATION OF SOILS FROM 0' TO 0.5' WAS BASED ON OBSERVATION OF ROTARY WASH CUTTINGS.
3. OCCASIONAL LENSES OF GRAVEL WERE INDICATED BY DRILLING BETWEEN SOIL DEPTHS OF 6' TO 13'.

SOUTH HARBOR EXPANSION
GEOTECHNICAL INVESTIGATION
PN&D PROJECT NO. 96256

TEST HOLE LOGS

FIGURE B-10

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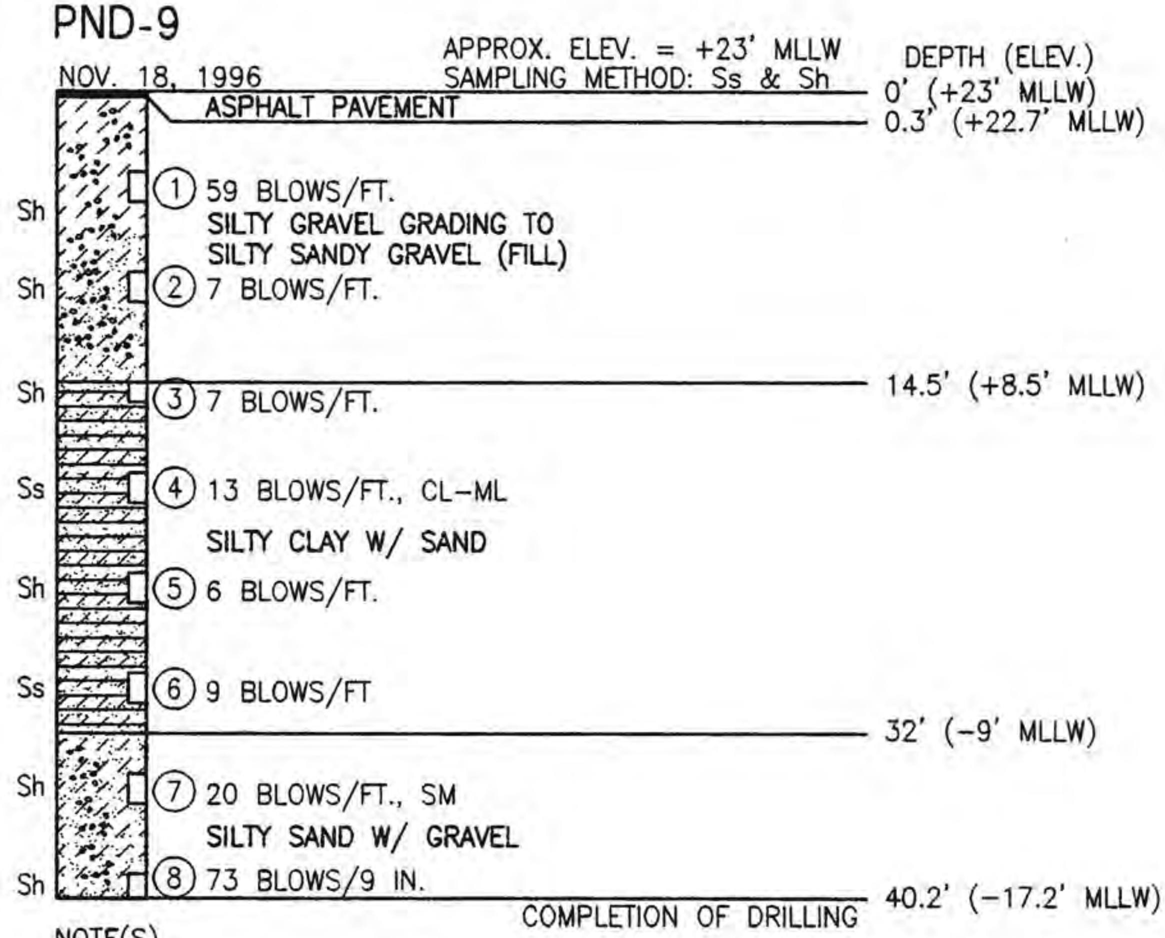

NOTE(S)

1. TEST HOLE DRILLED WITH HOLLOW STEM AUGER EQUIPMENT.

SOUTH HARBOR EXPANSION
GEOTECHNICAL INVESTIGATION
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TEST HOLE LOGS

FIGURE B-11

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APPENDIX C

LABORATORY TEST RESULTS

ALASKA
T E S T L A B
A Division of DOWL, Incorporated

AASHTO ACCREDITED
CONSTRUCTION
MATERIALS TESTING
LABORATORY

W.O. A27160
March 10, 1997

Peratrovich Nottingham & Drage
1506 2 36th Ave., Suite 101
Anchorage, Alaska 99503

Attention: Jim Heumann

Subject: Consolidated Drained Triaxial Testing and a Consolidation Test

Dear: Mr. Heumann:

We received a sample of soil from you contained in a Shelby tube on February 26, 1997. We were instructed to perform a consolidation test and three consolidated drained triaxial tests on the material. The test was performed in accordance with ASTM D2435 "One-dimensional Consolidation Properties of Soils" and ASTM 4767 "Consolidated-Undrained Triaxial Compression Test on Cohesive Soils" except the test was allowed to drain and no pour water pressures were taken.

The dry density of the samples used to perform the triaxial tests vary due to the variation in the amount of gravel and sand from sample to sample. The dry density of the sample that was tested at 64 psi is 115.0 pcf. This sample had a large 1 inch gravel with several 3/4 inch gravels. The sample performed at 16 psi has a dry density of 108.7 pcf. This sample had a seam of 2 inches of very coarse sand with #4 gravel. The sample with a dry density of 97.9 pcf had less gravel than the other two samples.

Attached are the time rate of consolidation curves, the compression curve for e verses log p, the compression curve of percent compression verses log p, the Mohr diagram and the triaxial compression curves. All the sieve analyses, Atterbergs, moistures and unit weight results are attached. The sieve analysis that corresponds with the triaxial test is lab number 311.

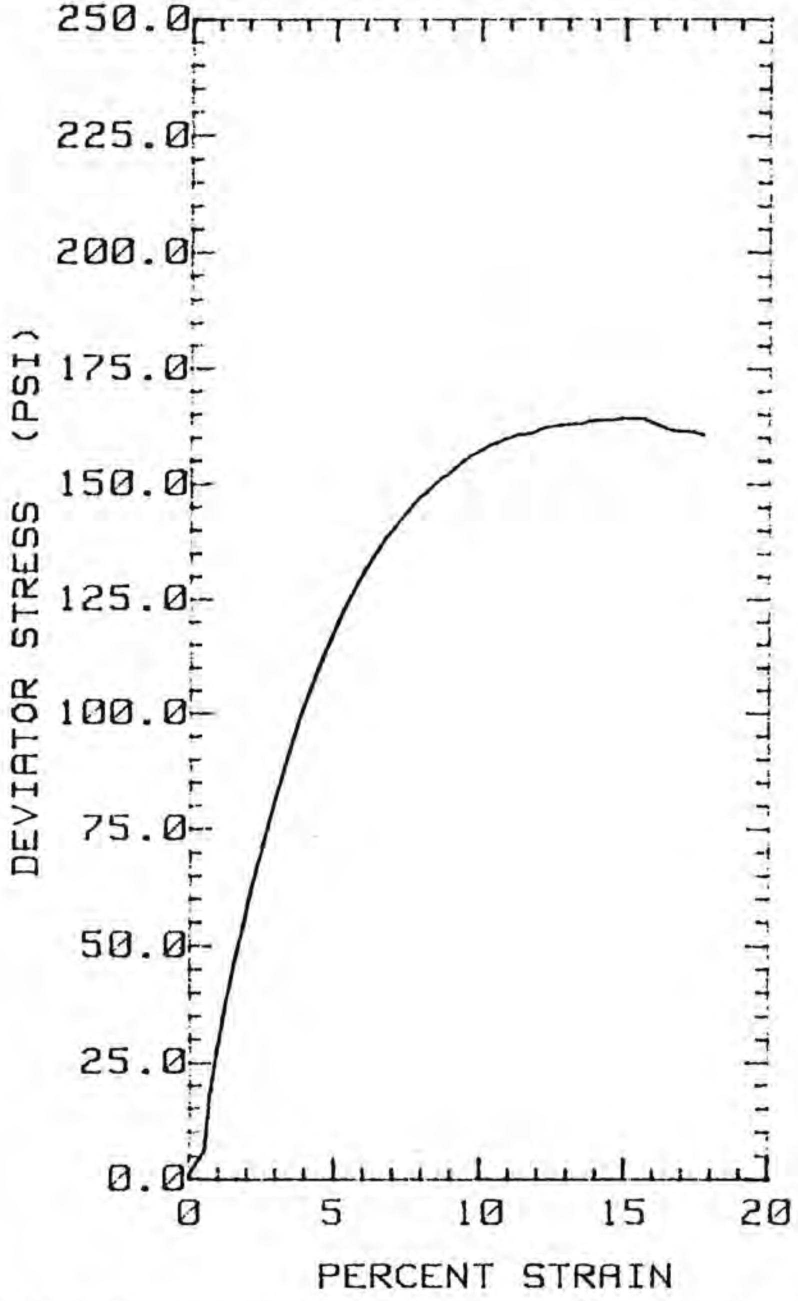
If you have any questions regarding these results , please call me.

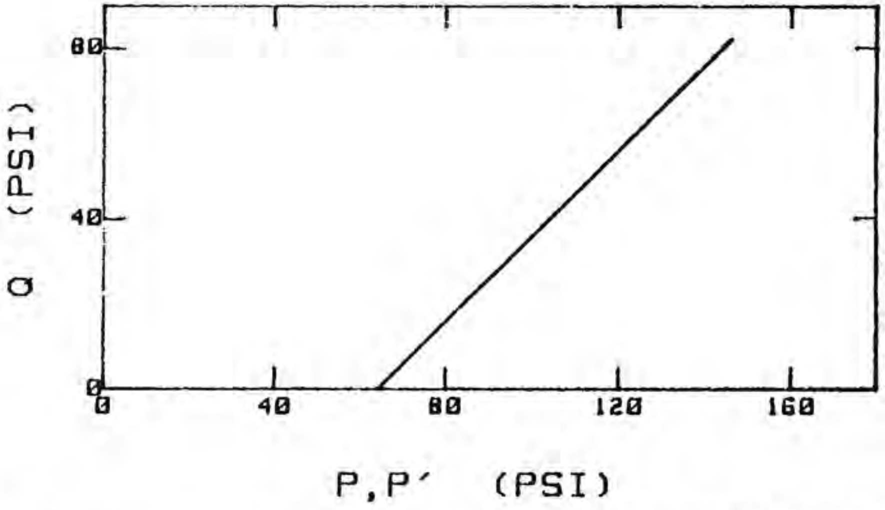
Sincerely,
ALASKA TESTLAB

David Andersen

David L. Andersen, P.E.
Laboratory Supervisor

PROJECT : PETERSBURG HARBOR 96256-02
CLIENT : PN&D
WO # A27160
BORING # 6 DEPTH : 43.5'-46.0'
SAMPLE # 7
INITIAL DRY DENSITY: 115.0 pcf
EFFECTIVE CONFINING PRESSURE: 64.0 psi
FINAL MOISTURE CONTENT: 10.3 percent
LABORATORY # T97004
DATE: 7 Mar 1996 08:36:38

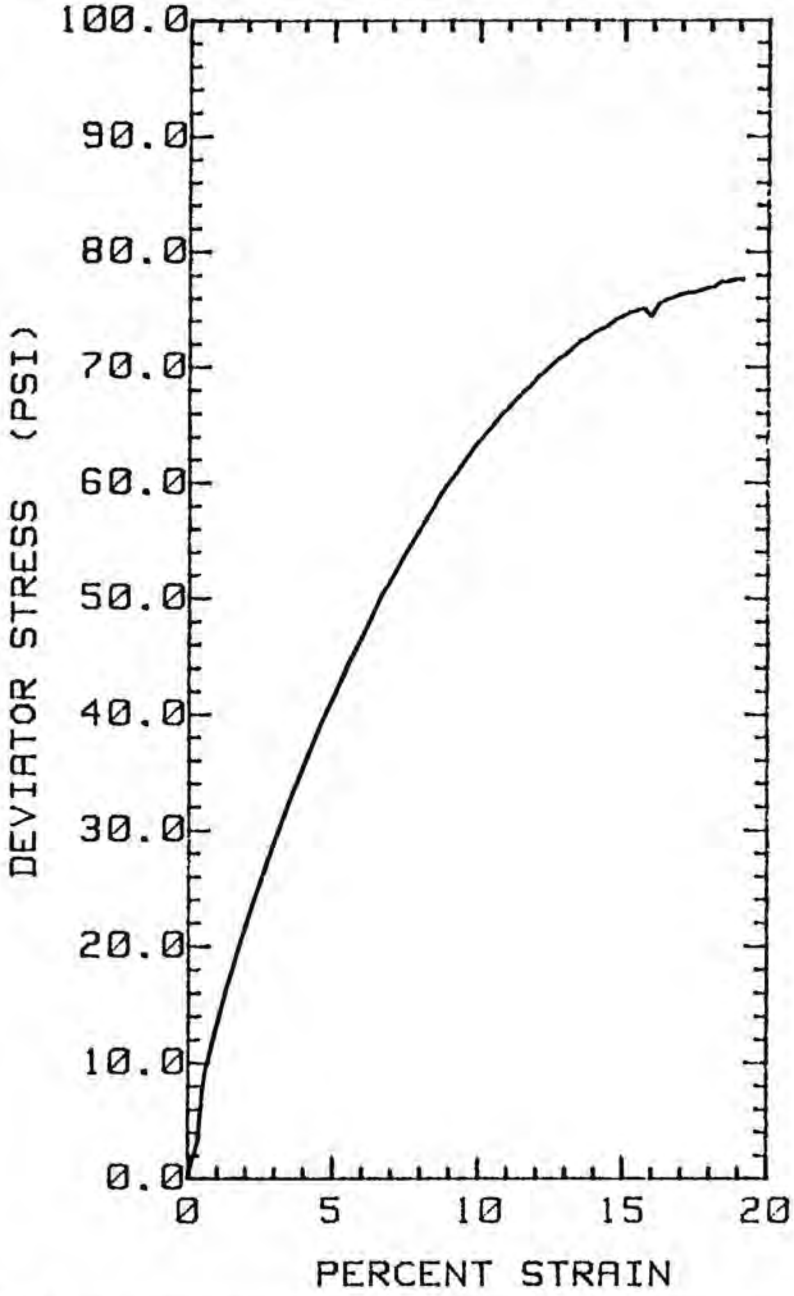




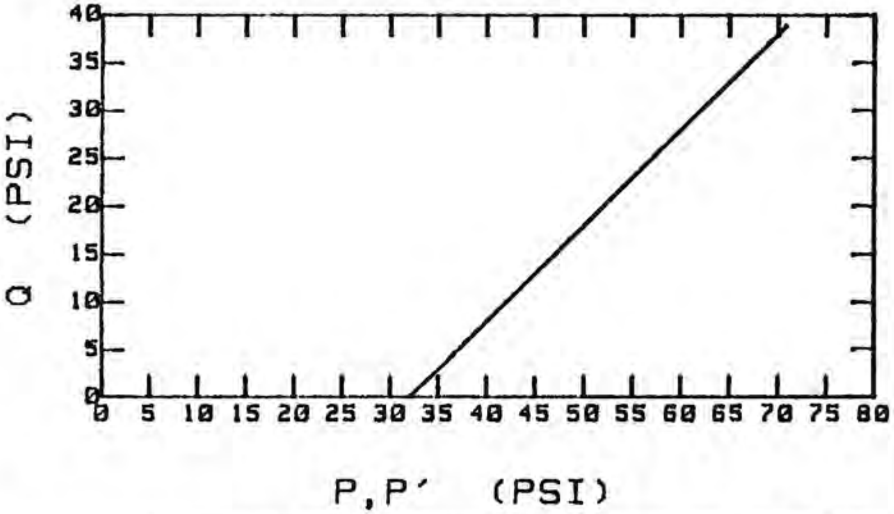
ALASKA TESTLAB

Consolidated Drained Triaxial Compression

WO # A27160
FIGURE



PROJECT : PETERSBURG HARBOR 96256-02
CLIENT : PN&D
WO # A27160
BORING # 6 DEPTH : 43.5'-46.0'
SAMPLE # 7
INITIAL DRY DENSITY: 97.9 pcf
EFFECTIVE CONFINING PRESSURE: 32.0 psi
FINAL MOISTURE CONTENT: 15.0 percent
LABORATORY # T97003
DATE: 6 Mar 1996 17:47:21

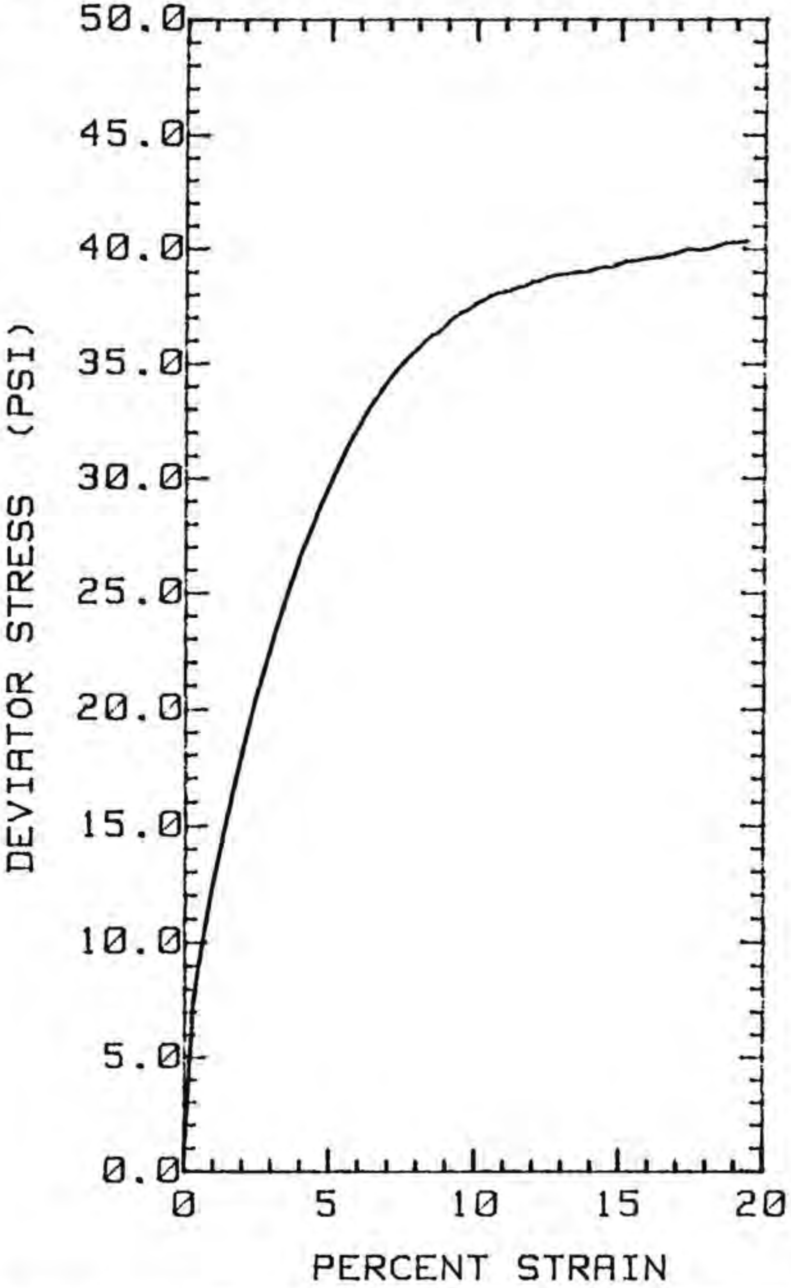


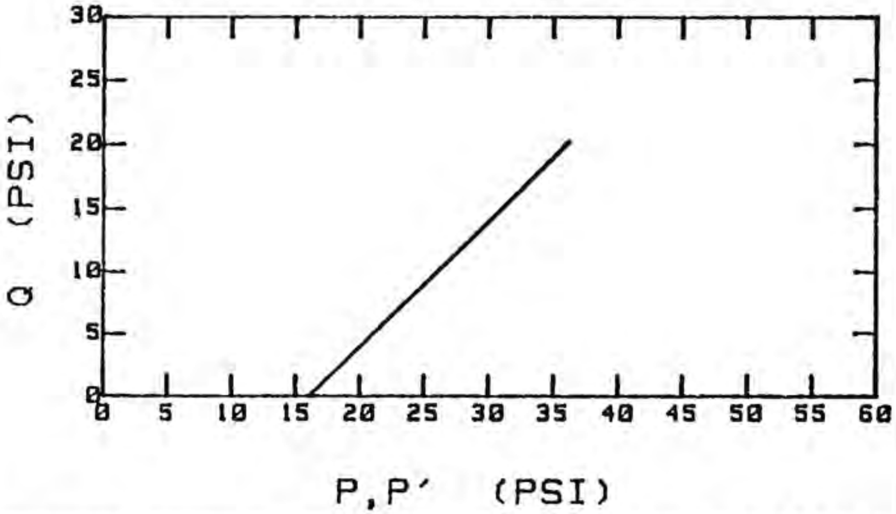
ALASKA TESTLAB

Consolidated Drained Triaxial Compression

WO # A27160
FIGURE

PROJECT : PETERSBURG HARBOR 96256.02
CLIENT : PN&D
WO # A27160
BORING # 6 DEPTH : 43.5′-46.0′
SAMPLE # 7
INITIAL DRY DENSITY: 108.7 pcf
EFFECTIVE CONFINING PRESSURE: 16.0 psi
FINAL MOISTURE CONTENT: 13.9 percent
LABORATORY # T97002
DATE: 6 Mar 1996 08:19:24





ALASKA TESTLAB

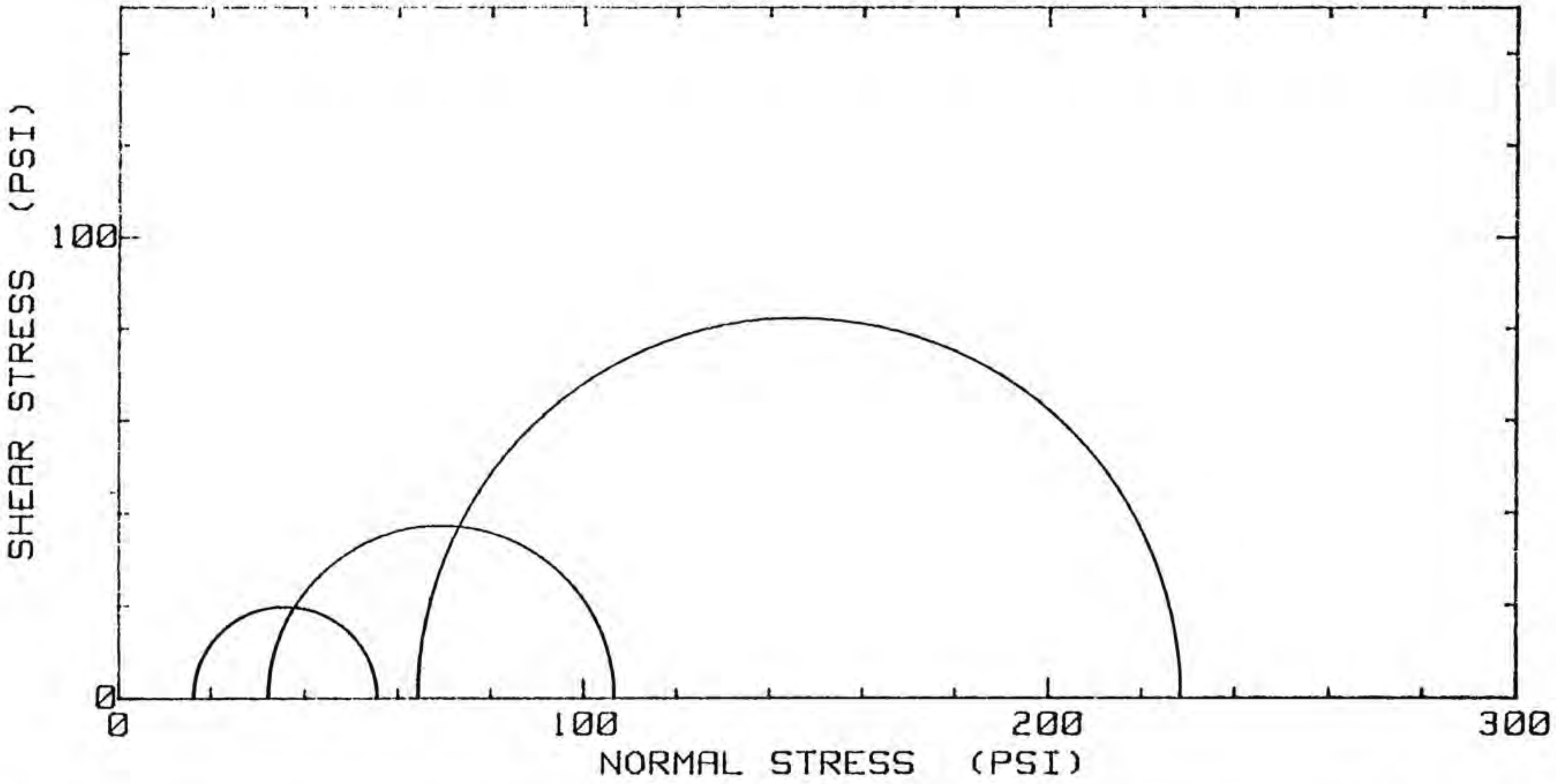
Consolidated Drained Triaxial Compression

WO # A27160
FIGURE

PROJECT : PETERSBURG HARBOR 96256-02
CLIENT : PN&D
W.O. # A27160
BORING # 6
SAMPLE # 7
DEPTH: 43.5′-46.0′

DATE : 7 Mar 1996 08:36:38

LAB # T97004; σ_3 = 64.0 psi; γ_d = 115.0 pcf
LAB # T97003; σ_3 = 32.0 psi; γ_d = 97.9 pcf
LAB # T97002; σ_3 = 16.0 psi; γ_d = 108.7 pcf

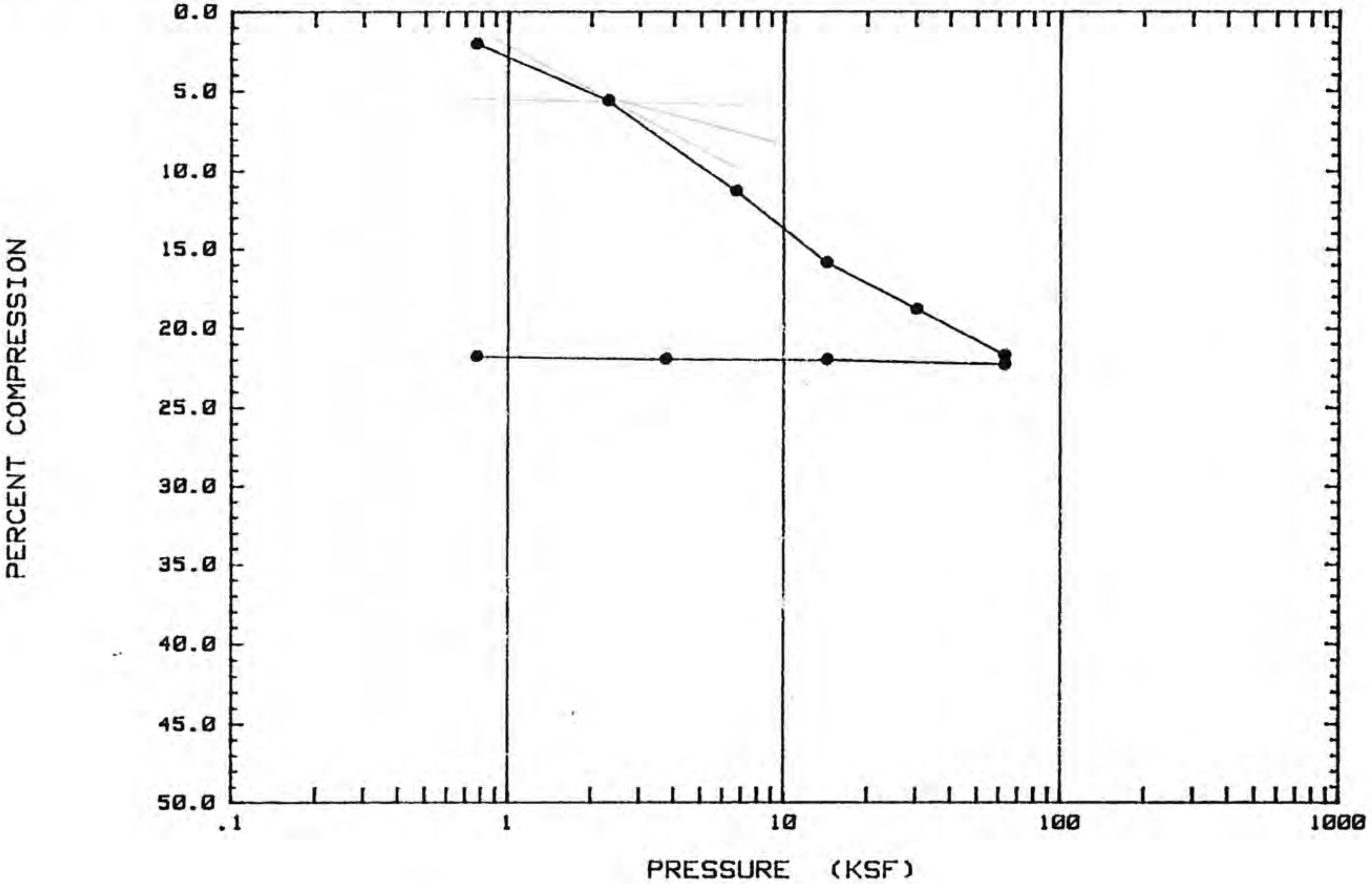


ALASKA TESTLAB

Mohr Diagram - CD Tests

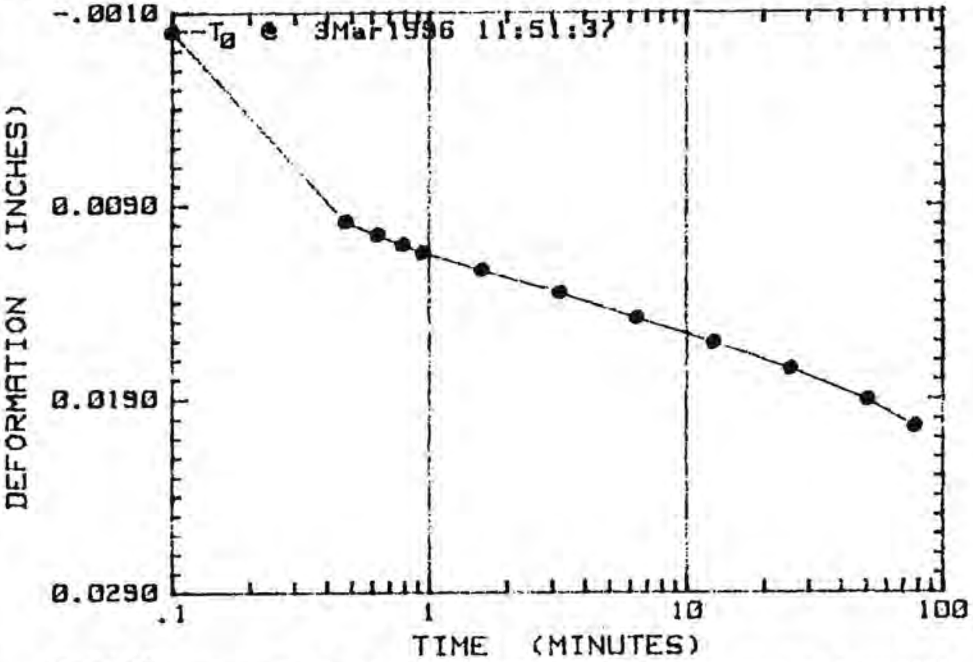
WO # A27160
FIGURE

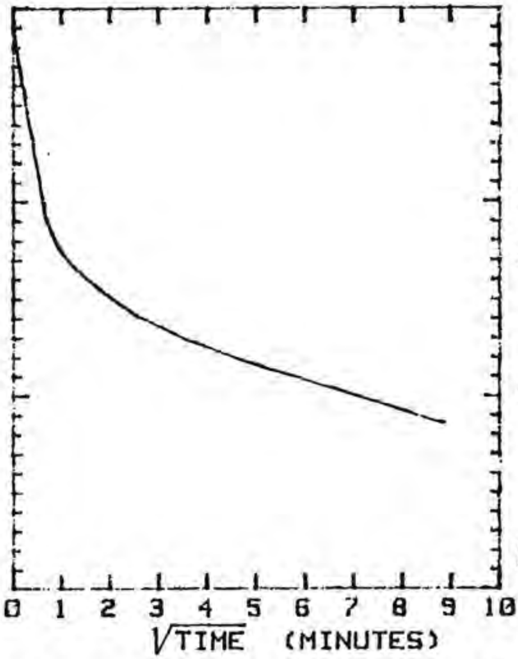
PROJECT : PETERSBURG HARBOR 96256.02 CLIENT : PN&D
BORING # 6
SAMPLE # 7 DEPTH: 33.5-36 LABORATORY # C97004



ALASKA TESTLAB *Compression Curve (%Comp. vs. Log P)*

WO # A27160
FIGURE

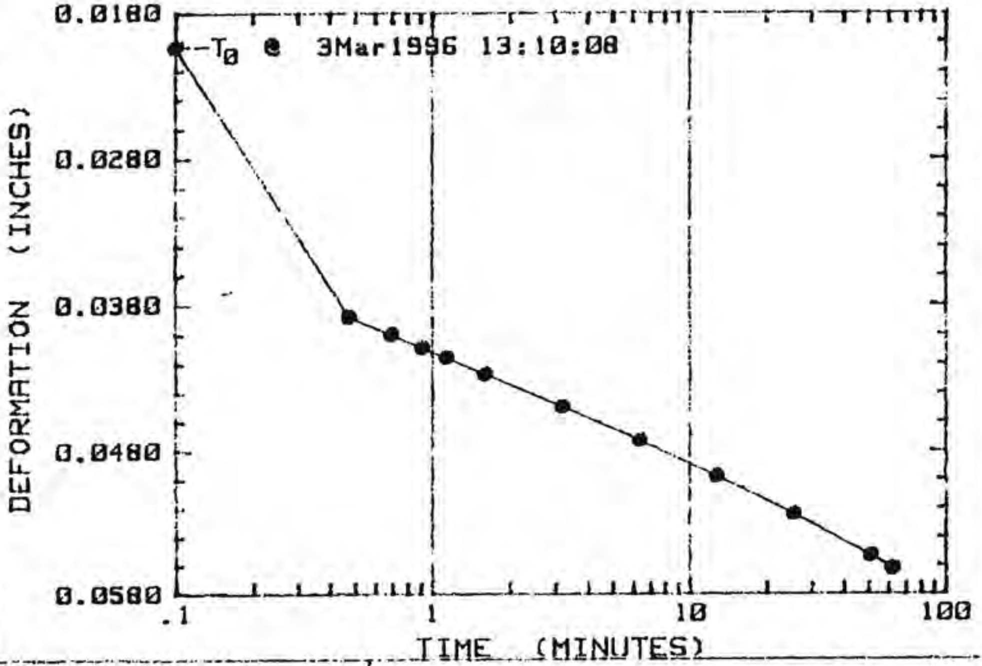


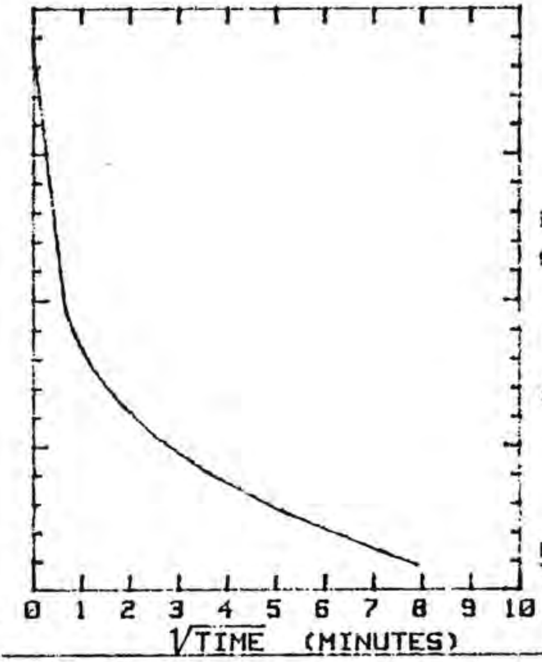


WO #A27160
BORING #6
SAMPLE #7
PART # 0
DEPTH :33.5-36

(SUBTRACT A CORRECTION
OF 0.0002"
FROM EACH READING)

PRESSURE: 767 PSF





WO #A27160
BORING #6
SAMPLE #7
PART # 0
DEPTH :33.5-36

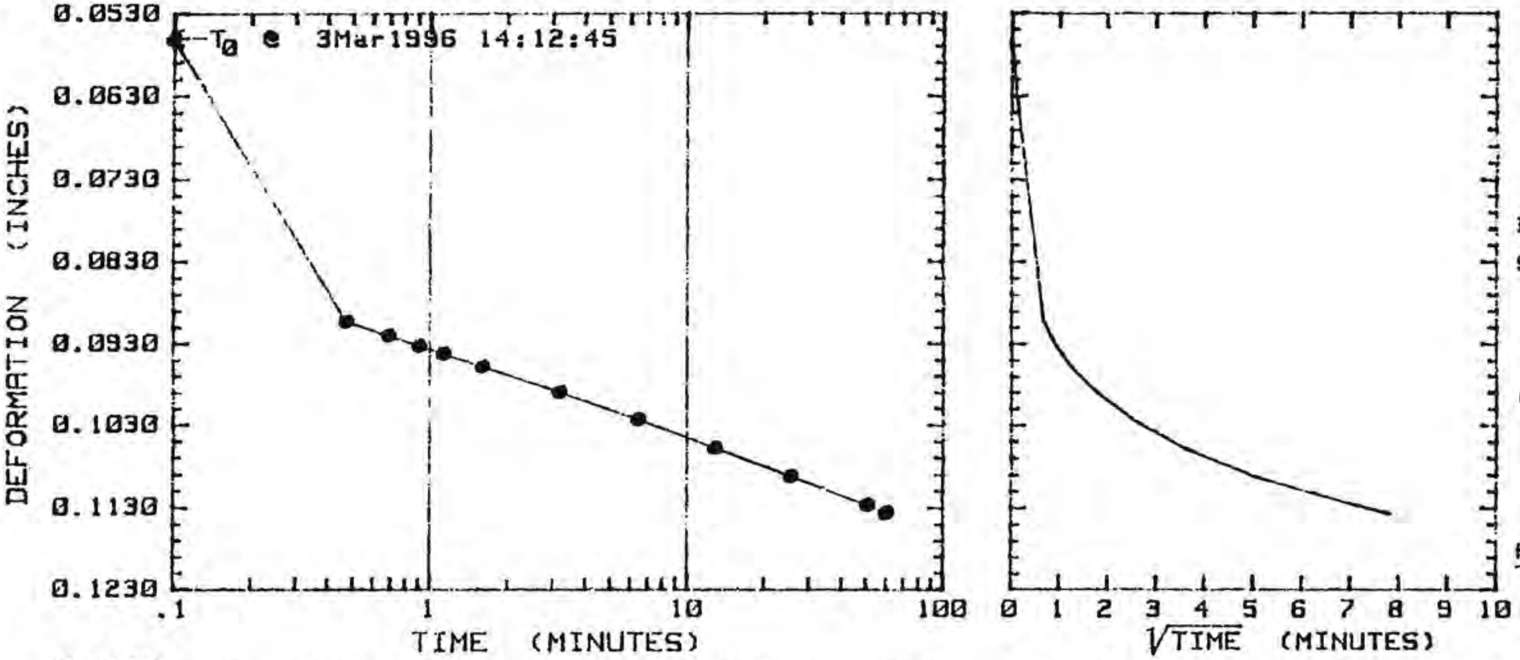
(SUBTRACT A CORRECTION
OF 0.0008"
FROM EACH READING)

PRESSURE: 2310 PSF

ALASKA TESTLAB

Time Rate of Consolidation

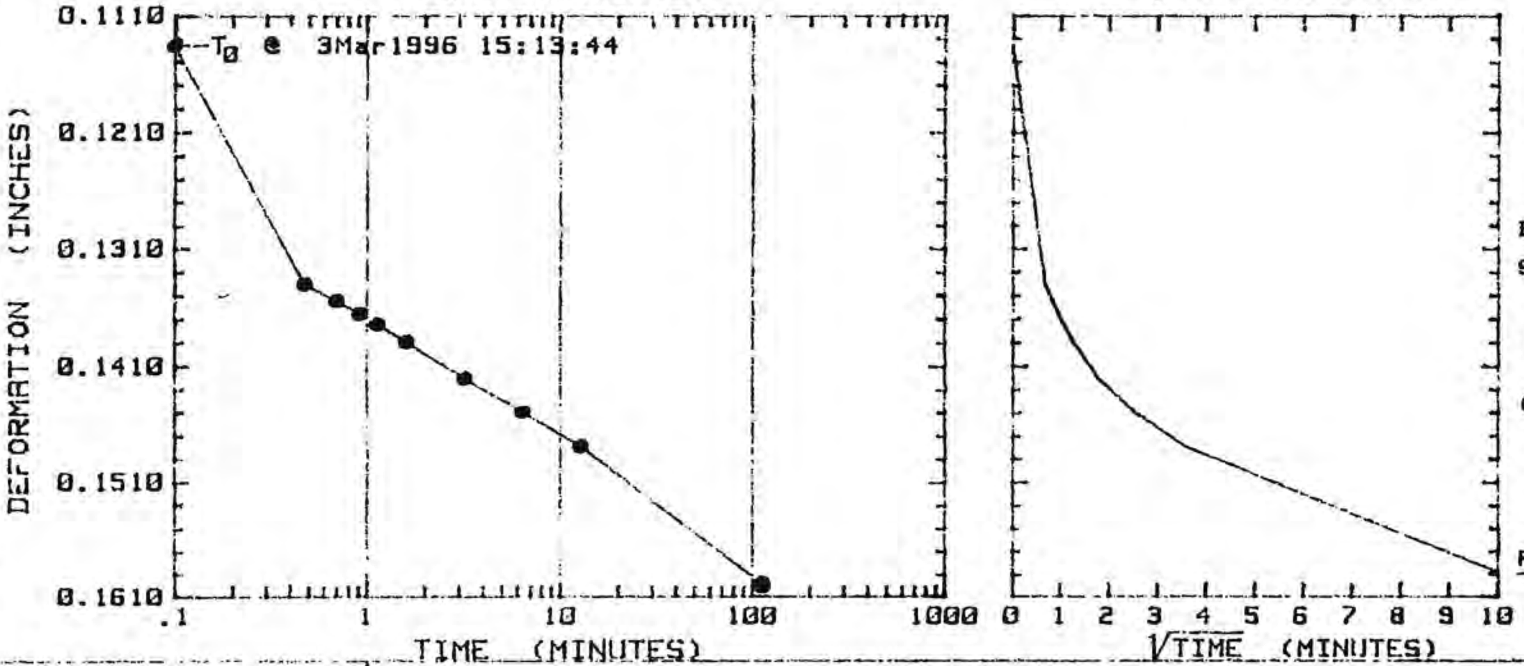
WO # A27160
FIGURE



WO #A27160
BORING #6
SAMPLE #7
PART # 0
DEPTH :33.5-36

(SUBTRACT A CORRECTION
OF 0.0015"
FROM EACH READING)

PRESSURE: 6710 PSF

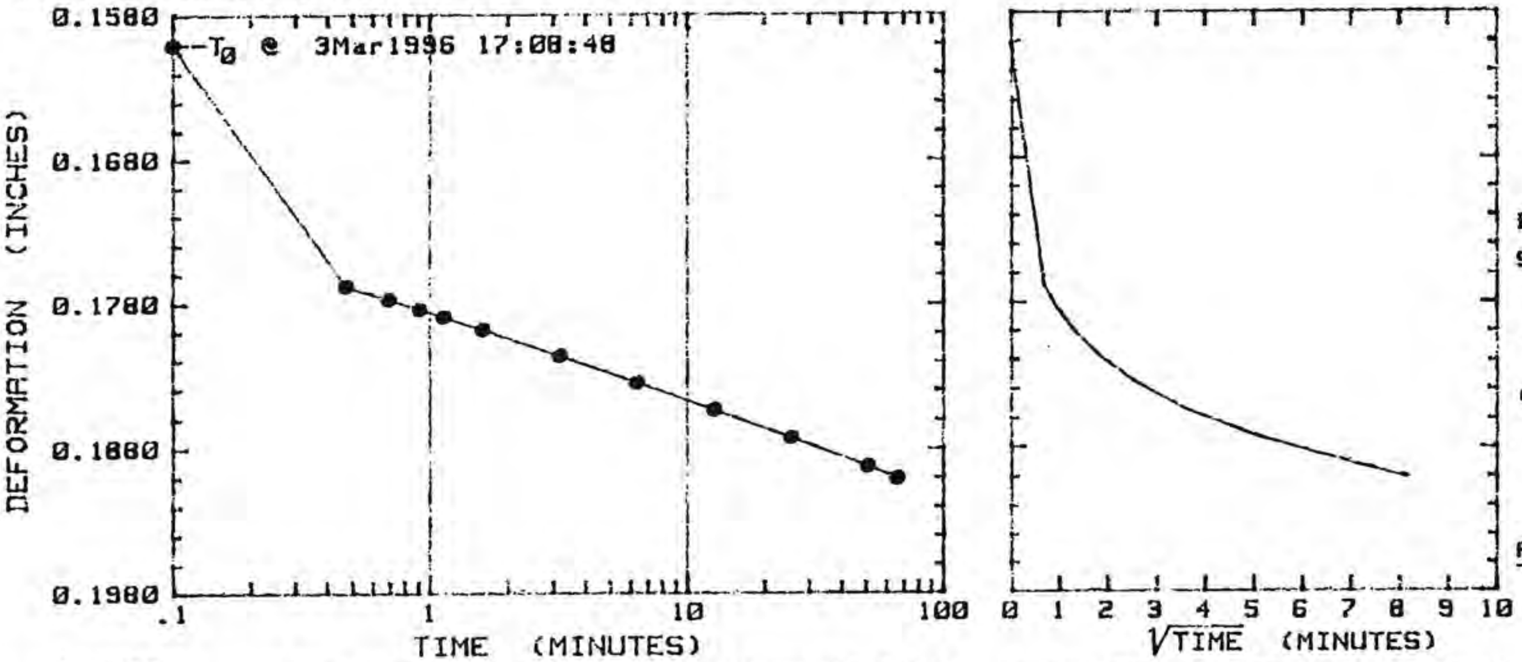


WO #A27160
BORING #6
SAMPLE #7
PART # 0
DEPTH :33.5-36

(SUBTRACT A CORRECTION
OF 0.0021"
FROM EACH READING)

PRESSURE: 14300 PSF

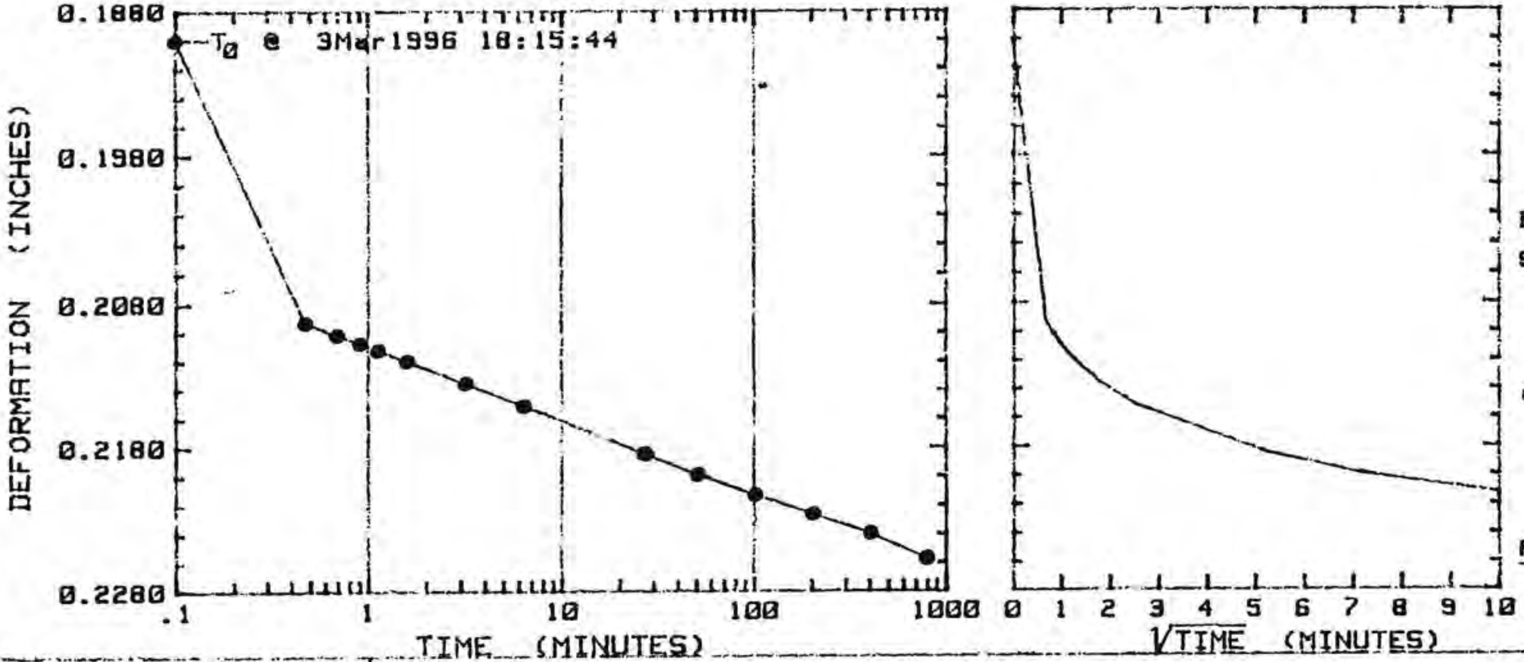
ALASKA TESTLAB	*Time Rate of Consolidation*	WO # A27160 FIGURE



WO #A27160
BORING #6
SAMPLE #7
PART # 0
DEPTH :33.5-36

(SUBTRACT A CORRECTION
OF 0.0028"
FROM EACH READING)

PRESSURE: 30200 PSF



WO #A27160
BORING #6
SAMPLE #7
PART # 0
DEPTH :33.5-36

(SUBTRACT A CORRECTION
OF 0.0035"
FROM EACH READING)

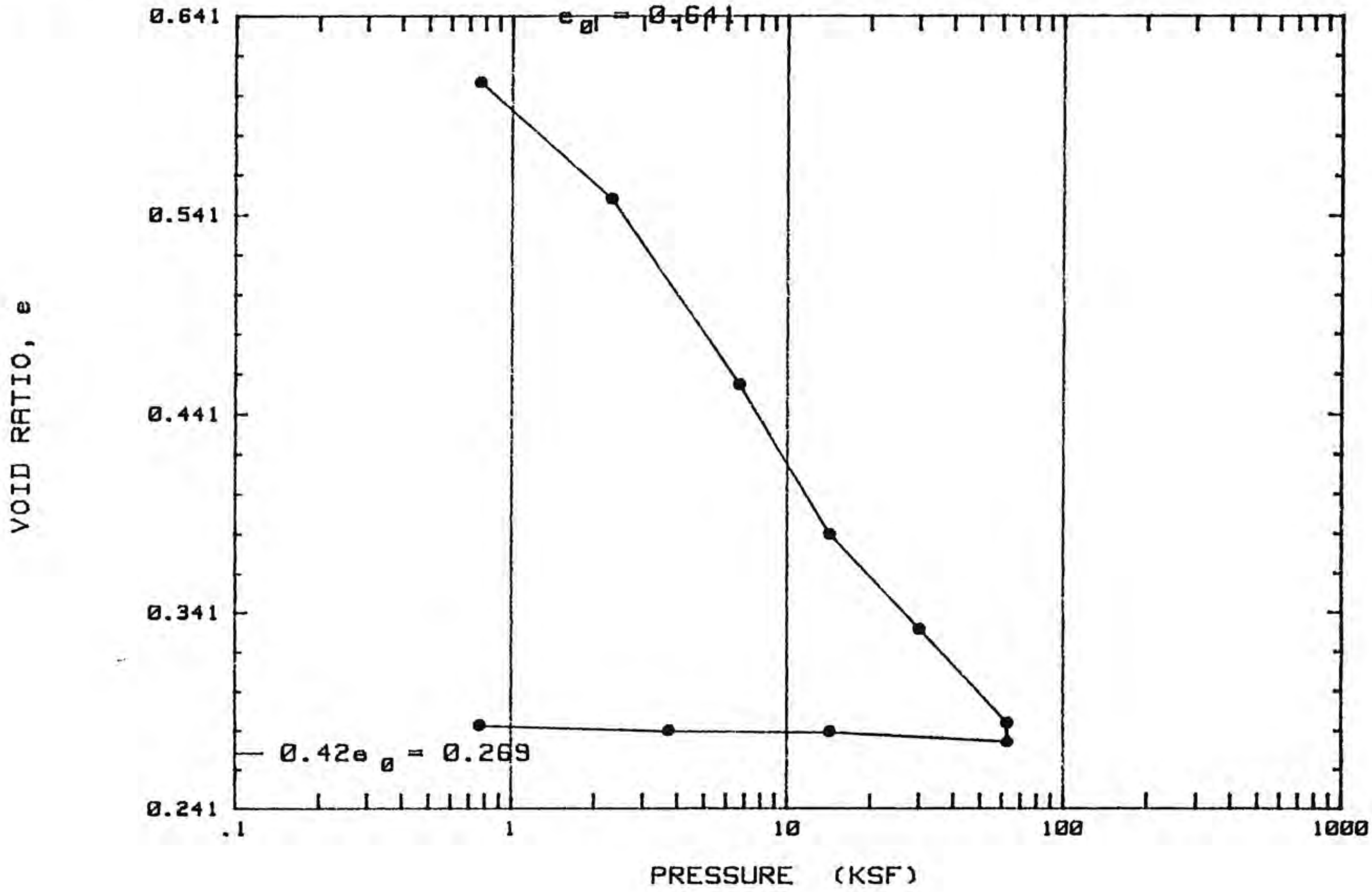
PRESSURE: 62800 PSF

ALASKA TESTLAB

Time Rate of Consolidation

WO # A27160
FIGURE

PROJECT : PETERSBURG HARBOR 96256.02 CLIENT : PN&D
BORING # 6
SAMPLE # 7 DEPTH: 33.5-36 LABORATORY # C97004



ALASKA TESTLAB

Compression Curve (e vs. Log P)

WO # A27160
FIGURE

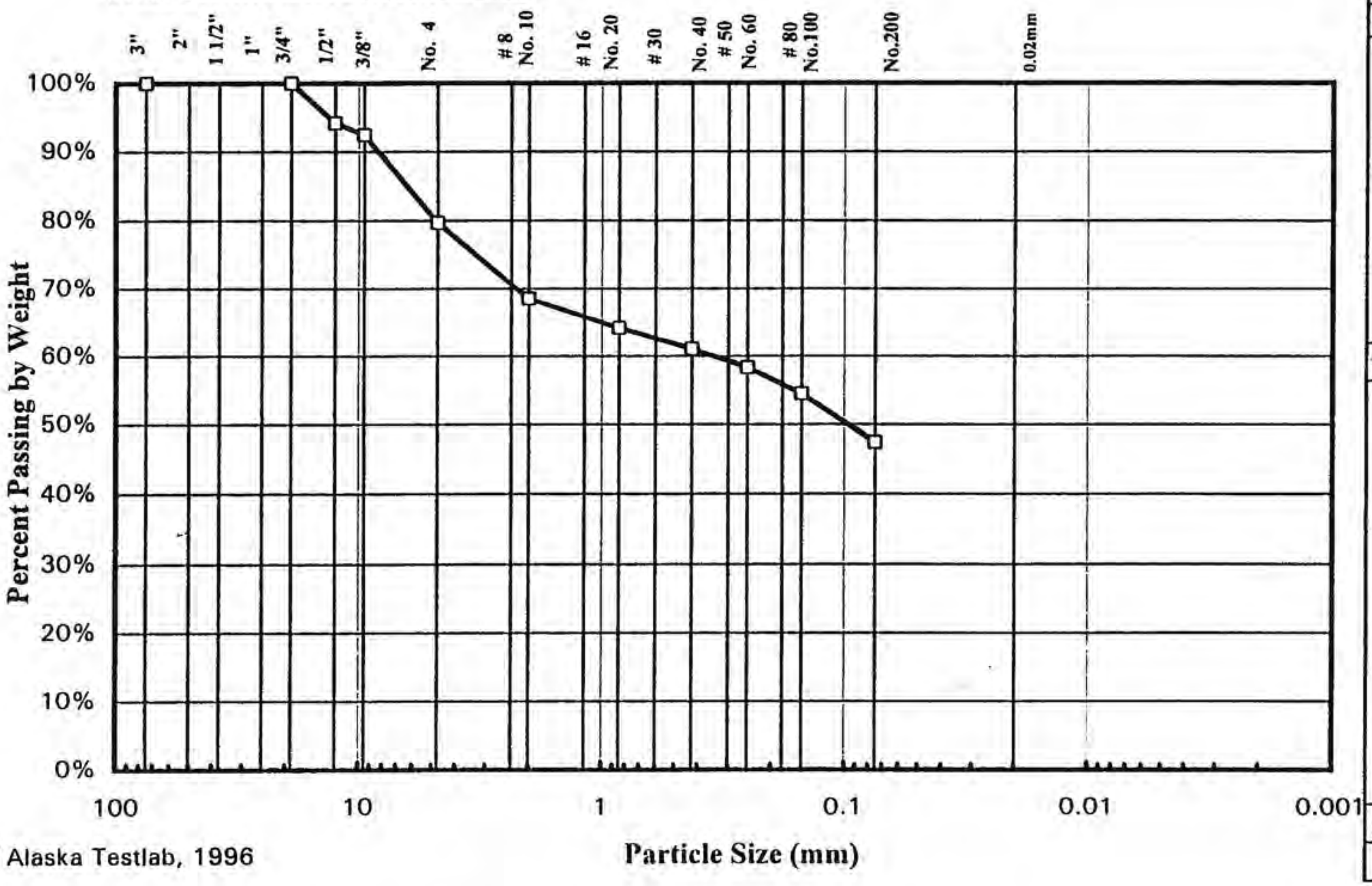
ALASKA TESTLAB
A Division of DOWL, Incorporated
4040 B Street Anchorage, Alaska 99503
(907) 562-2000 FAX (907) 563-3953

Client: Peratrovich Nottingham & Drage
Project: Petersburg Harbor GEO No. 96256.02
Location: TH-1, SA-1 @ 6.0'-6.5'
Submitted by Client

PARTICLE-SIZE DISTRIBUTION

W.O. A27160
Lab No. 290
Received: February 26, 1997

Engineering Classification: Silty SAND with Gravel, SM ✓
Frost Classification: Not Measured



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"	100%	
1/2"	94%	
3/8"	92%	
No. 4	80%	
Total Wt. of Coarse Fraction = 526.6g		
No. 8		
No. 10	69%	
No. 16		
No. 20	64%	
No. 30		
No. 40	61%	
No. 50		
No. 60	58%	
No. 80		
No.100	54%	
No.200	47%	
Total Wt. of Fine Fraction = 419.5g		
0.02 mm		

Howard K. Weston, P.E. Technical Director
David L. Andersen, P.E. Laboratory Supervisor

ALASKA
T E S T L A B
A Division of DOWL, Incorporated
4040 B Street Anchorage, Alaska 99503
(907) 562-2000 FAX (907) 563-3953

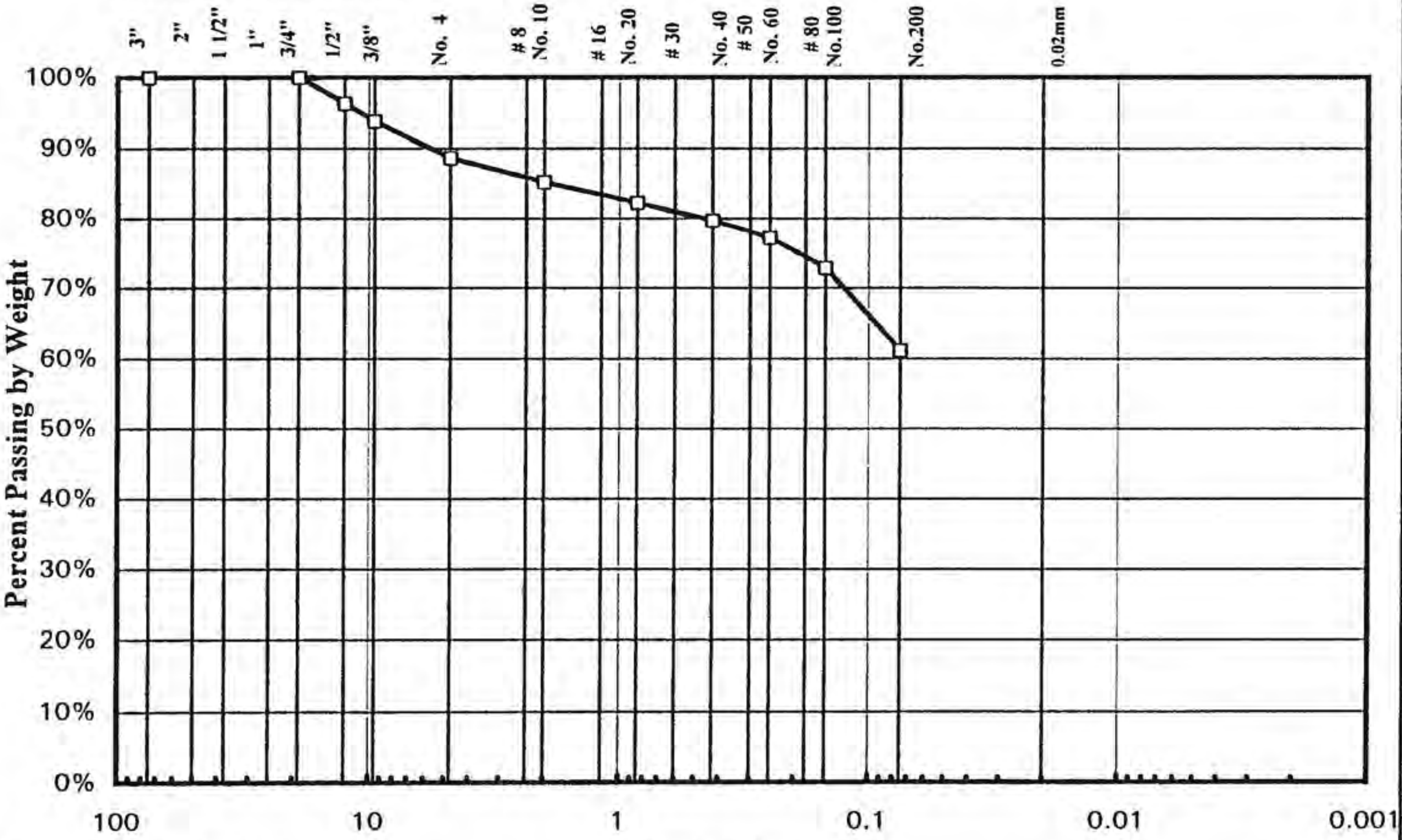
Client: Peratrovich Nottingham & Drage
Project: Petersburg Harbor GEO No. 96256.02

Location: TH-1, SA-3 @ 15.5'-16.5'
Submitted by Client

PARTICLE-SIZE DISTRIBUTION

W.O. A27160
Lab No. 291
Received: February 26, 1997

Engineering Classification: Sandy SILT, ML✓
Frost Classification: F4



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"	100%	
1/2"	96%	
3/8"	94%	
No. 4	89%	
Total Wt. of Coarse Fraction = 1091g		
No. 8		
No. 10	85%	
No. 16		
No. 20	82%	
No. 30		
No. 40	80%	
No. 50		
No. 60	77%	
No. 80		
No.100	73%	
No.200	61%	
Total Wt. of Fine Fraction = 328.7g		
0.02 mm		

Howard K. Weston, P.E. Technical Director
David L. Andersen, P.E. Laboratory Supervisor

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T E S T L A B
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4040 B Street Anchorage, Alaska 99503
(907) 562-2000 FAX (907) 563-3953

Client: Peratrovich Nottingham & Drage
Project: Petersburg Harbor GEO No. 96256.02

Location: TH-1, SA-4 @ 20.5'-21.5'
Submitted by Client

PARTICLE-SIZE DISTRIBUTION

W.O. A27160
Lab No. 292
Received: February 26, 1997

Engineering Classification: Sandy SILT, ML✓

Frost Classification: F4

SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"		
1/2"	100%	
3/8"	99%	
No. 4	97%	
Total Wt. of Coarse Fraction = 310.4g		
No. 8		
No. 10	95%	
No. 16		
No. 20	94%	
No. 30		
No. 40	92%	
No. 50		
No. 60	91%	
No. 80		
No.100	85%	
No.200	62%	
Total Wt. of Fine Fraction = 300.8g		
0.02 mm		

Howard K. Weston, P.E. Technical Director
David L. Andersen, P.E. Laboratory Supervisor

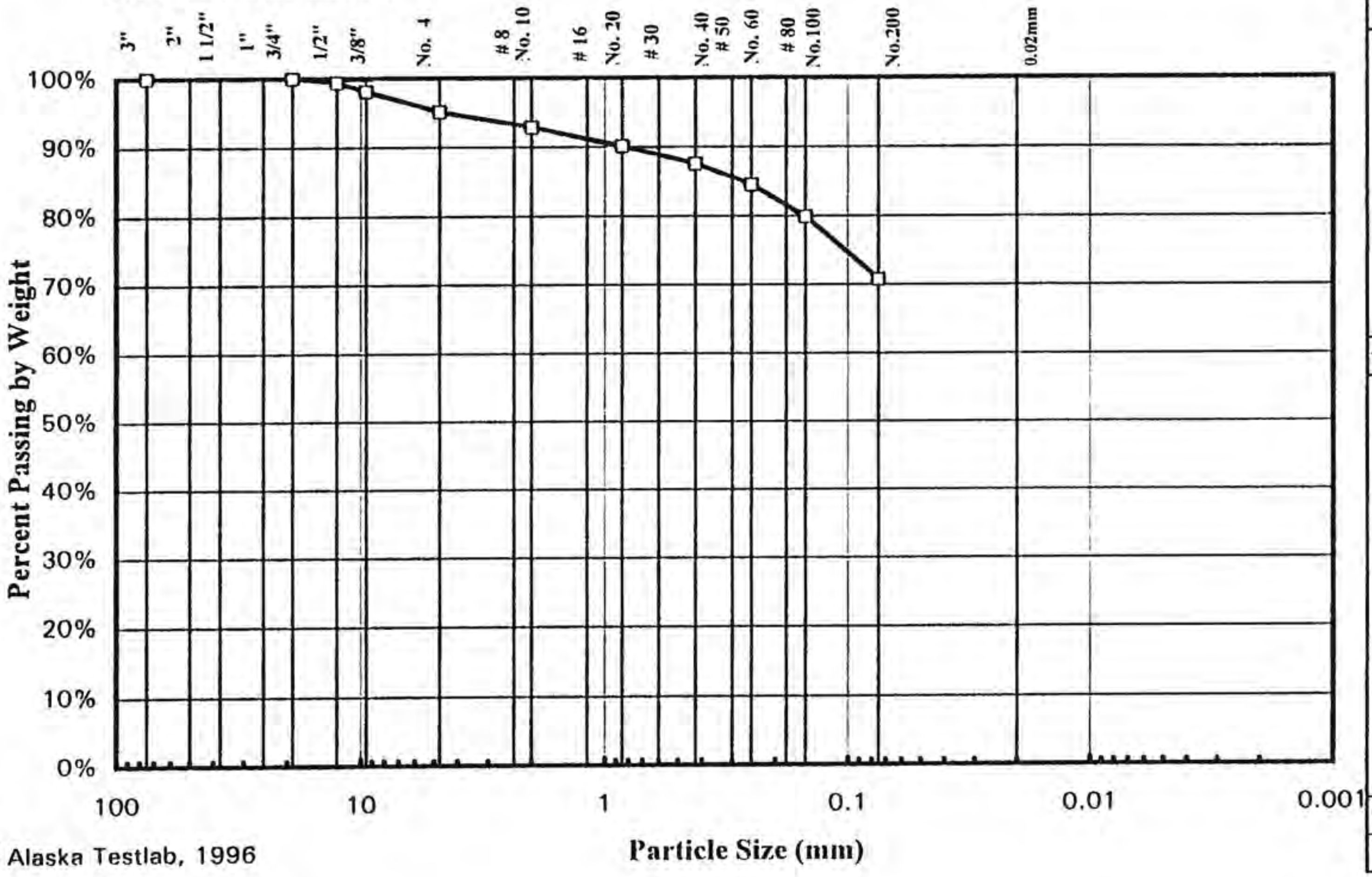
ALASKA
TESTLAB
A Division of DOWL, Incorporated
4040 B Street Anchorage, Alaska 99503
(907) 562-2000 FAX (907) 563-3953

Client: Peratrovich Nottingham & Drage
Project: Petersburg Harbor GEO No. 96256.02
Location: TH-1, SA-5 @ ~~36.5'-37.5'~~ 26.5 -27.5'
Submitted by Client

PARTICLE-SIZE DISTRIBUTION

W.O. A27160
Lab No. 293
Received: February 26, 1997

Engineering Classification: Silty CLAY w/ Sand, CL-ML
Frost Classification: F4



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"	100%	
1/2"	99%	
3/8"	98%	
No. 4	95%	
Total Wt. of Coarse Fraction = 1144.8g		
No. 8		
No. 10	93%	
No. 16		
No. 20	90%	
No. 30		
No. 40	88%	
No. 50		
No. 60	84%	
No. 80		
No.100	80%	
No.200	71%	
Total Wt. of Fine Fraction = 331.8g		
0.02 mm		

Howard K. Weston, P.E. Technical Director
David L. Andersen, P.E. Laboratory Supervisor

ALASKA TESTLAB

A Division of DOWL, Incorporated
4040 B Street Anchorage, Alaska 99503
(907) 562-2000 FAX (907) 563-3953

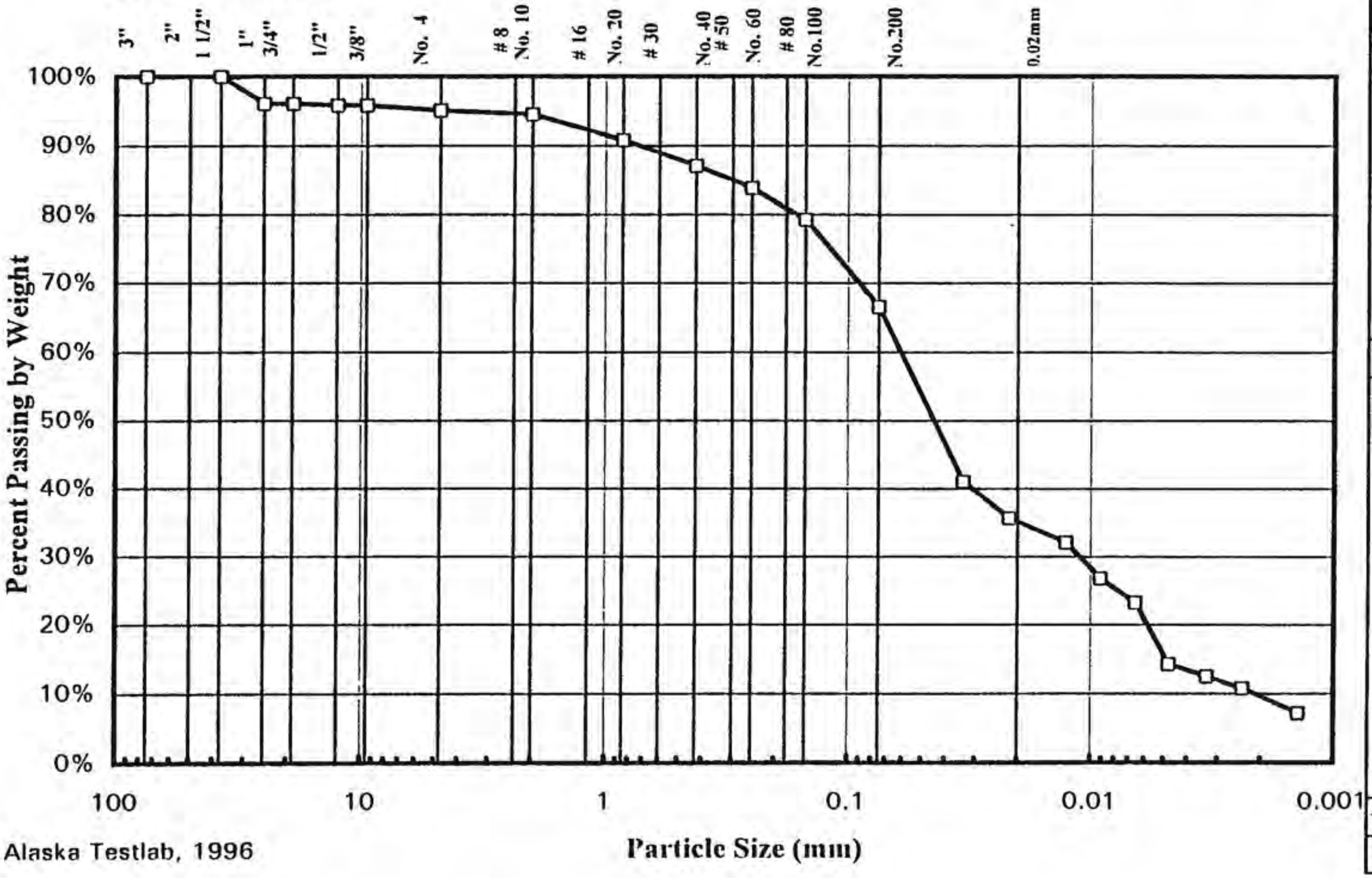
Client: Peratrovich Nottingham & Drage
Project: Petersburg Harbor GEO No. 96256.02

Location: TH-2, SA-1 @ 2.5'-3.5'
Submitted by Client

PARTICLE-SIZE DISTRIBUTION

W.O. A27160
Lab No. 295
Received: February 26, 1997

Frost Classification: F4



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"	100%	
1"	96%	
3/4"	96%	
1/2"	96%	
3/8"	96%	
No. 4	95%	
Total Wt. of Coarse Fraction = 1768.5g		
No. 8		
No. 10	95%	
No. 16		
No. 20	91%	
No. 30		
No. 40	87%	
No. 50		
No. 60	84%	
No. 80		
No.100	79%	
No.200	67%	
Total Wt. of Fine Fraction = 0g		
0.02 mm	35.1%	

Howard K. Weston, P.E. Technical Director
David L. Andersen, P.E. Laboratory Supervisor

ALASKA
TESTLAB
A Division of DOWL, Incorporated
4040 B Street Anchorage, Alaska 99503
(907) 562-2000 FAX (907) 563-3953

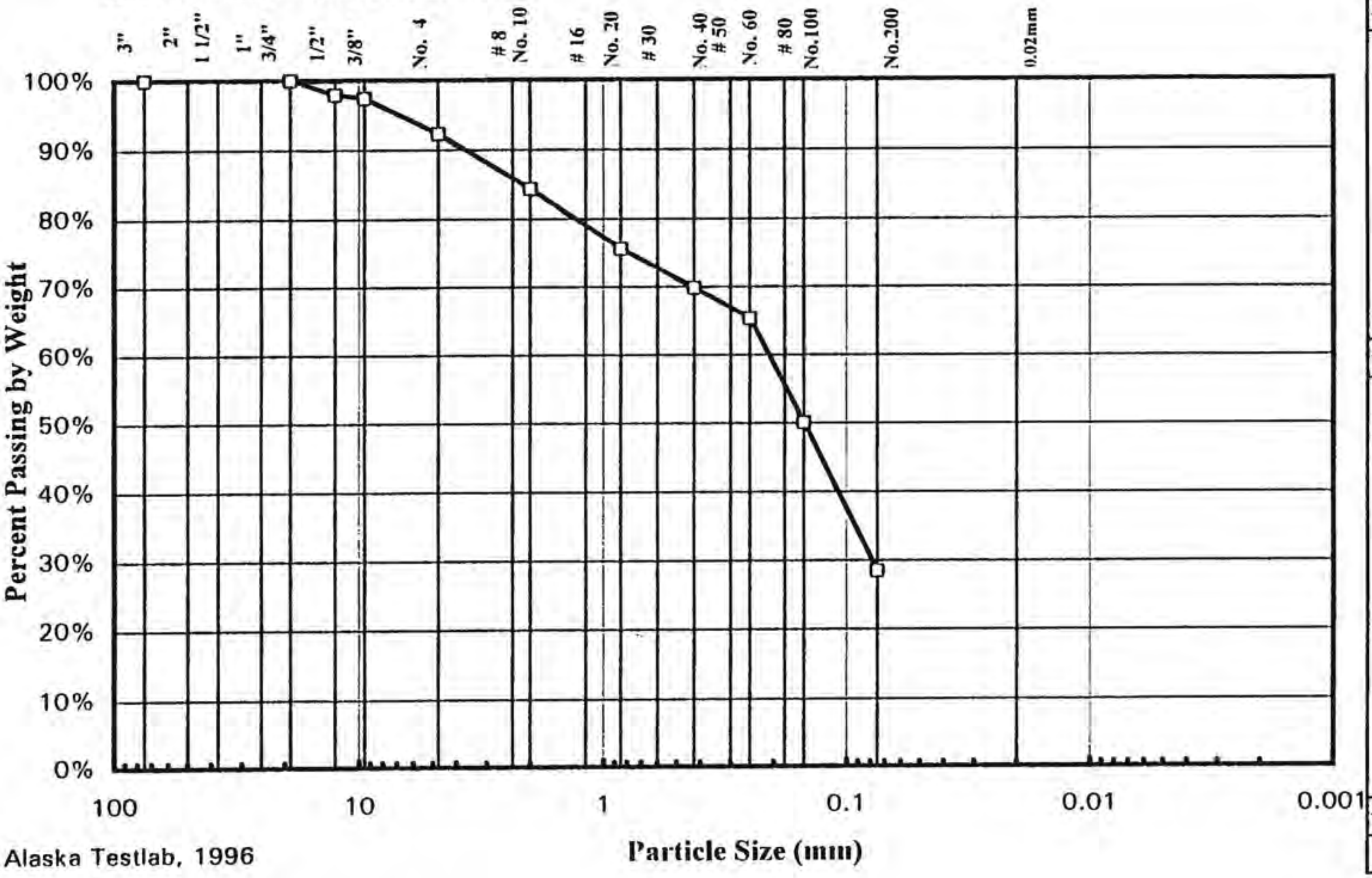
Client: Peratrovich Nottingham & Drage
Project: Petersburg Harbor GEO No. 96256.02

Location: TH-1, SA-6 @ 34.5'-35.5'
Submitted by Client

PARTICLE-SIZE DISTRIBUTION

W.O. A27160
Lab No. 294
Received: February 26, 1997

Engineering Classification: Silty SAND , SM✓
Frost Classification: Not Measured



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"	100%	
1/2"	98%	
3/8"	97%	
No. 4	92%	
Total Wt. of Coarse Fraction = 668.8g		
No. 8		
No. 10	84%	
No. 16		
No. 20	76%	
No. 30		
No. 40	70%	
No. 50		
No. 60	65%	
No. 80		
No.100	50%	
No.200	28%	
Total Wt. of Fine Fraction = 313.5g		
0.02 mm		

Howard K. Weston, P.E. Technical Director
David L. Andersen, P.E. Laboratory Supervisor

ALASKA
T E S T L A B
A Division of DOWL, Incorporated
4040 B Street Anchorage, Alaska 99503
(907) 562-2000 FAX (907) 563-3953

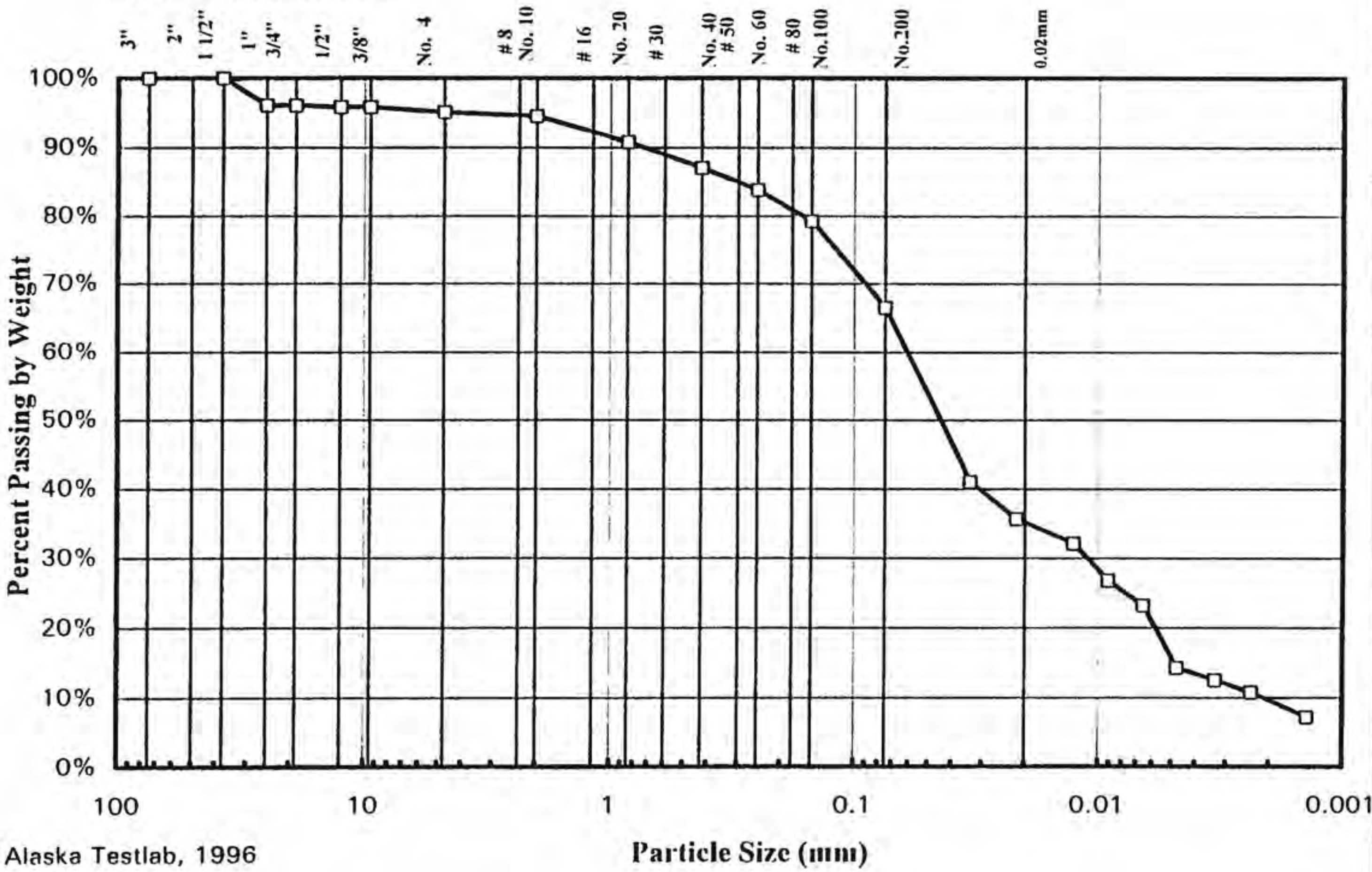
Client: Peratrovich Nottingham & Drage
Project: Petersburg Harbor GEO No. 96256.02

Location: TH-2, SA-1 @ 2.5'-3.5'
Submitted by Client

PARTICLE-SIZE DISTRIBUTION

W.O. A27160
Lab No. 295
Received: February 26, 1997

Engineering Classification: Sandy Clayey Silt, CL-ML
Frost Classification: F4



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"	100%	
1"	96%	
3/4"	96%	
1/2"	96%	
3/8"	96%	
No. 4	95%	
Total Wt. of Coarse Fraction = 1768.5g		
No. 8		
No. 10	95%	
No. 16		
No. 20	91%	
No. 30		
No. 40	87%	
No. 50		
No. 60	84%	
No. 80		
No.100	79%	
No.200	67%	
Total Wt. of Fine Fraction = 0g		
0.02 mm	35.1%	

Howard K. Weston, P.E. Technical Director
David L. Andersen, P.E. Laboratory Supervisor

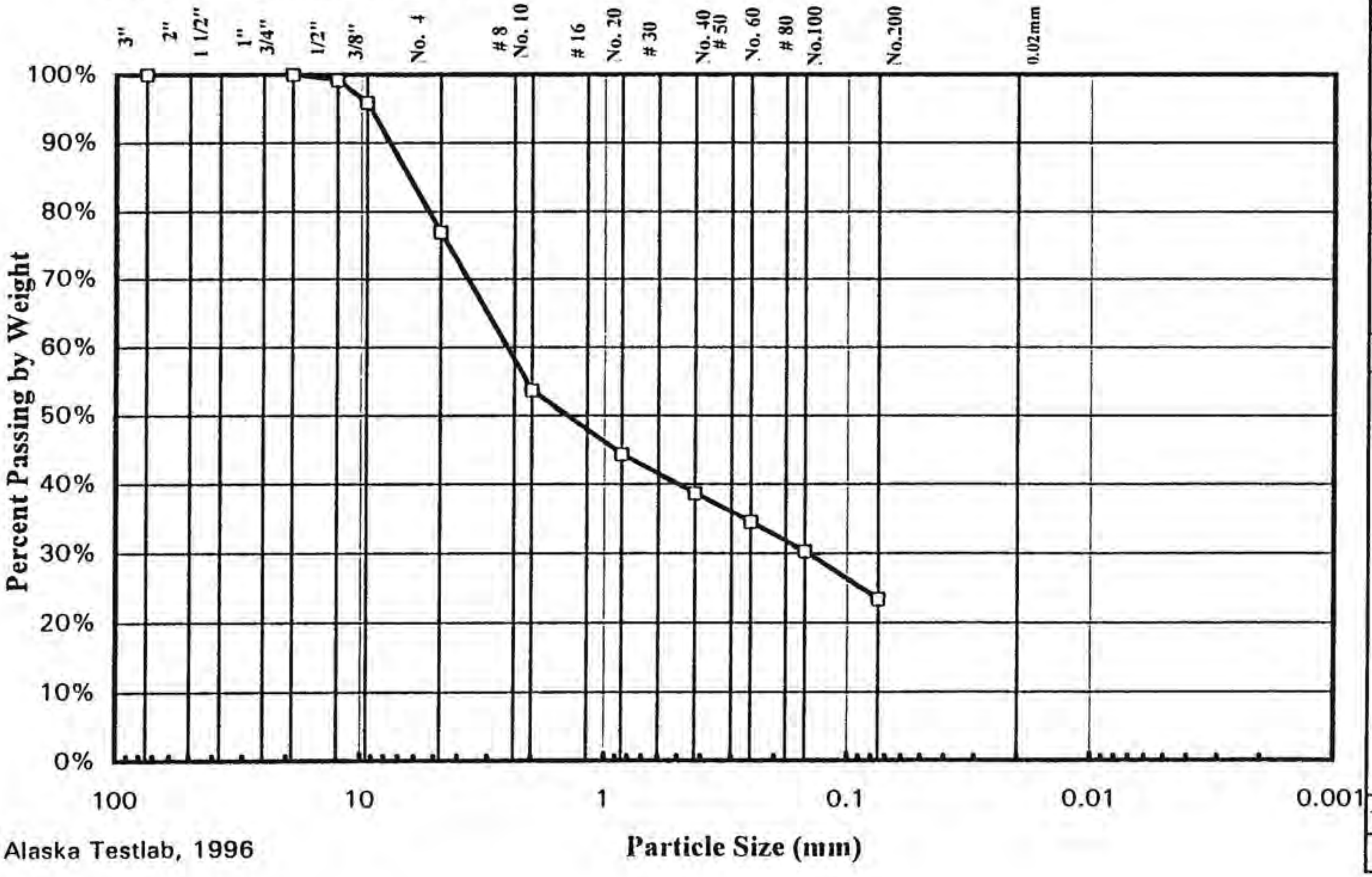
ALASKA
T E S T L A B
A Division of DOWL, Incorporated
4040 B Street Anchorage, Alaska 99503
(907) 562-2000 FAX (907) 563-3953

Client: Peratrovich Nottingham & Drage
Project: Petersburg Harbor GEO No. 96256.02
Location: TH-2, SA-3 @ 14.0'-14.5'
Submitted by Client

PARTICLE-SIZE DISTRIBUTION

W.O. A27160
Lab No. 296
Received: February 26, 1997

Engineering Classification: Silty SAND with Gravel, SM ✓
Frost Classification: Not Measured



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"	100%	
1/2"	99%	
3/8"	96%	
No. 4	77%	
Total Wt. of Coarse Fraction = 245.1g		
No. 8		
No. 10	54%	
No. 16		
No. 20	44%	
No. 30		
No. 40	39%	
No. 50		
No. 60	35%	
No. 80		
No.100	30%	
No.200	23%	
Total Wt. of Fine Fraction = 188.5g		
0.02 mm		

Howard K. Weston, P.E. Technical Director
David L. Andersen, P.E. Laboratory Supervisor

ALASKA
T E S T L A B
A Division of DOWL, Incorporated
4040 B Street Anchorage, Alaska 99503
(907) 562-2000 FAX (907) 563-3953

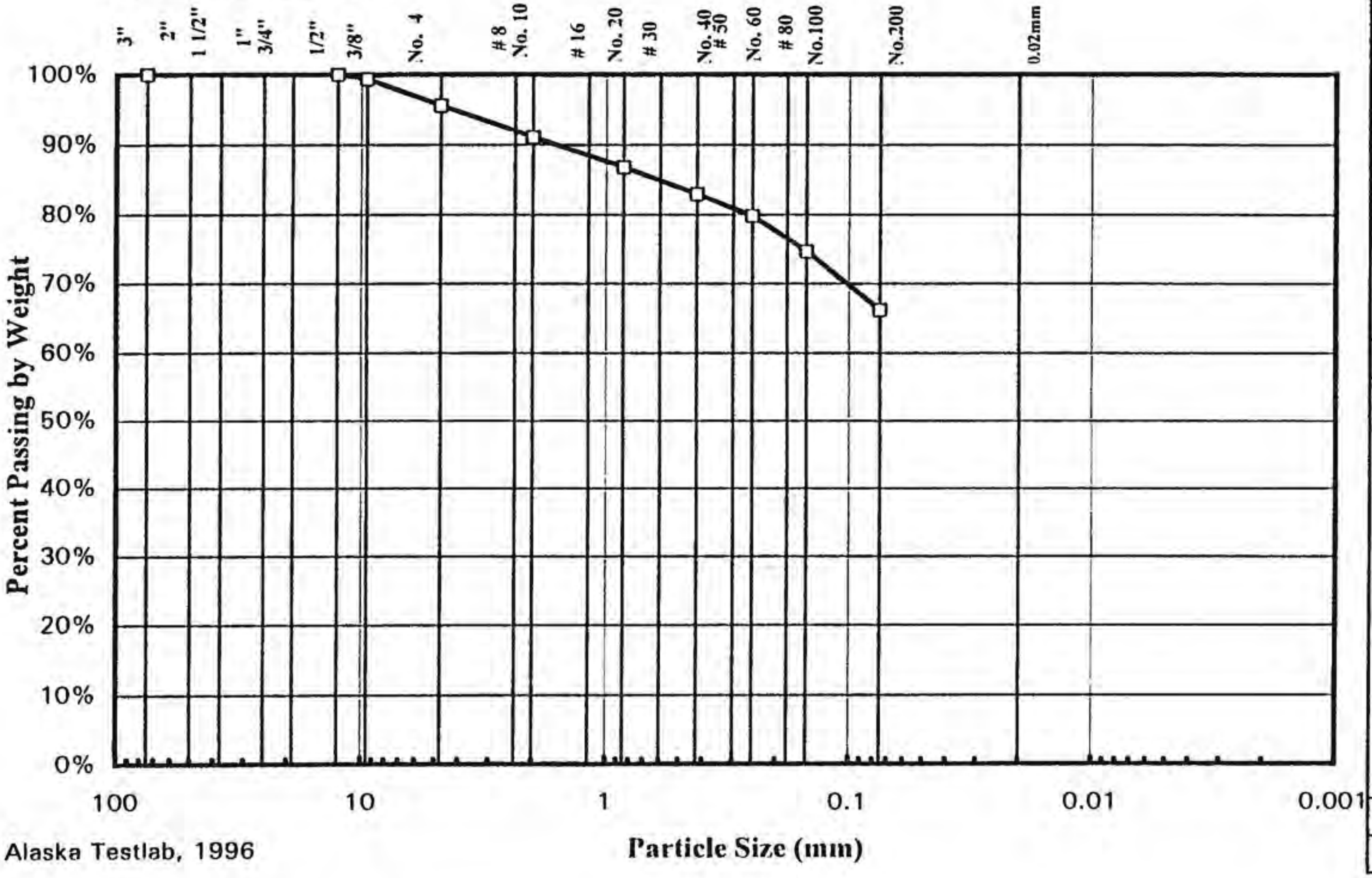
Client: Peratrovich Nottingham & Drage
Project: Petersburg Harbor GEO No. 96256.02

Location: TH-2, SA-5 @ 25.0'-26.0'
Submitted by Client

PARTICLE-SIZE DISTRIBUTION

W.O. A27160
Lab No. 297
Received: February 26, 1997

Engineering Classification: Sandy Silty CLAY, CL-ML
Frost Classification: F4



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"		
1/2"	100%	
3/8"	99%	
No. 4	96%	
Total Wt. of Coarse Fraction = 905.4g		
No. 8		
No. 10	91%	
No. 16		
No. 20	87%	
No. 30		
No. 40	83%	
No. 50		
No. 60	80%	
No. 80		
No.100	75%	
No.200	66%	
Total Wt. of Fine Fraction = 310.5g		
0.02 mm		

Howard K. Weston, P.E. Technical Director
David L. Andersen, P.E. Laboratory Supervisor

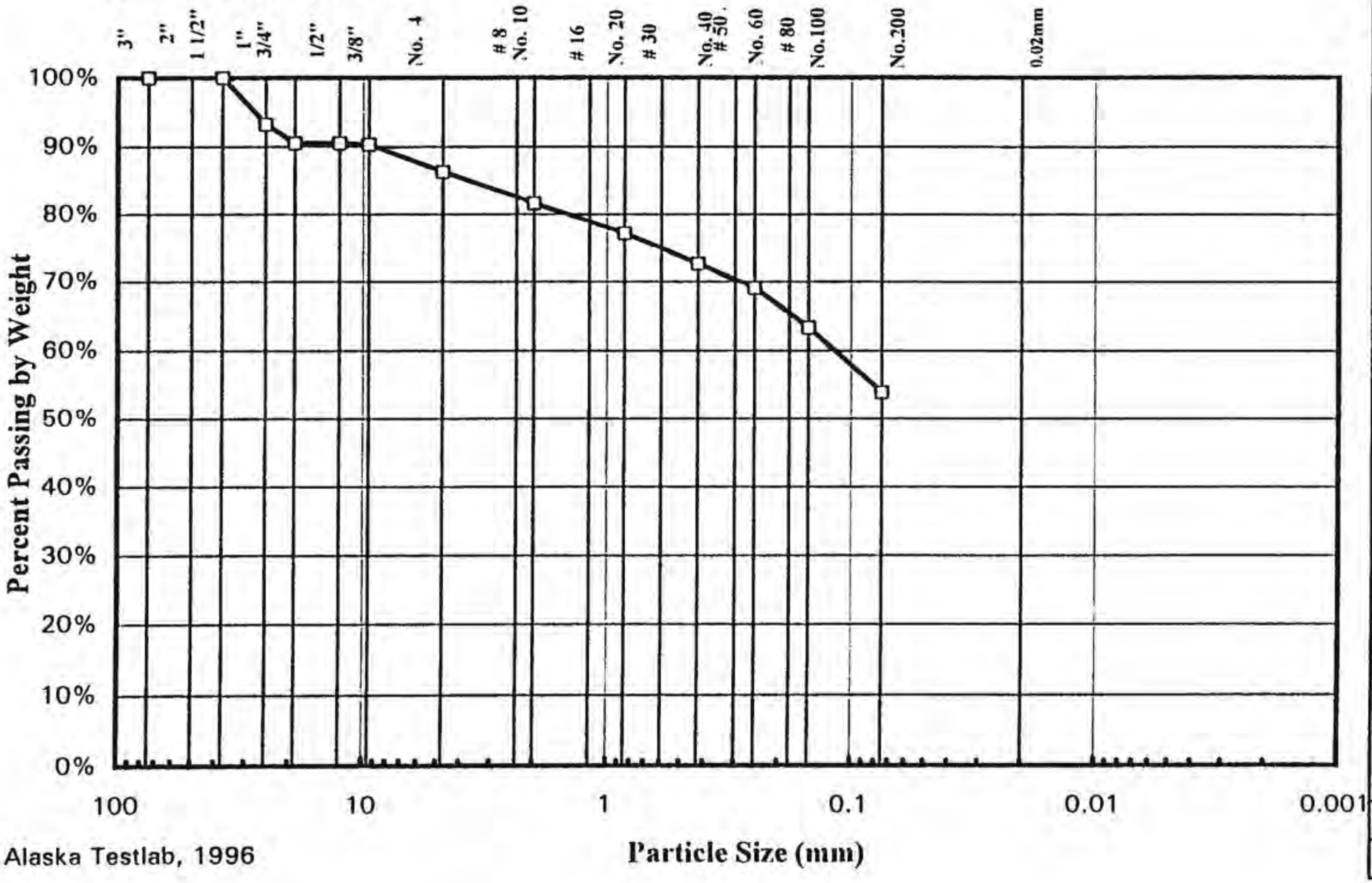
ALASKA TESTLAB
A Division of DOWL, Incorporated
4040 B Street Anchorage, Alaska 99503
(907) 562-2000 FAX (907) 563-3953

Client: Peratrovich Nottingham & Drage
Project: Petersburg Harbor GEO No. 96256.02
Location: TH-2, SA-6R@ 30.0'-31.0'
Submitted by Client

PARTICLE-SIZE DISTRIBUTION

W.O. A27160
Lab No. 298
Received: February 26, 1997

Engineering Classification: Sandy Silty CLAY, CL-ML
Frost Classification: F4



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"	100%	
1"	93%	
3/4"	90%	
1/2"	90%	
3/8"	90%	
No. 4	86%	
Total Wt. of Coarse Fraction = 782.2g		
No. 8		
No. 10	82%	
No. 16		
No. 20	77%	
No. 30		
No. 40	73%	
No. 50		
No. 60	69%	
No. 80		
No.100	63%	
No.200	54%	
Total Wt. of Fine Fraction = 331.7g		
0.02 mm		

Howard K. Weston, P.E. Technical Director
David L. Andersen, P.E. Laboratory Supervisor

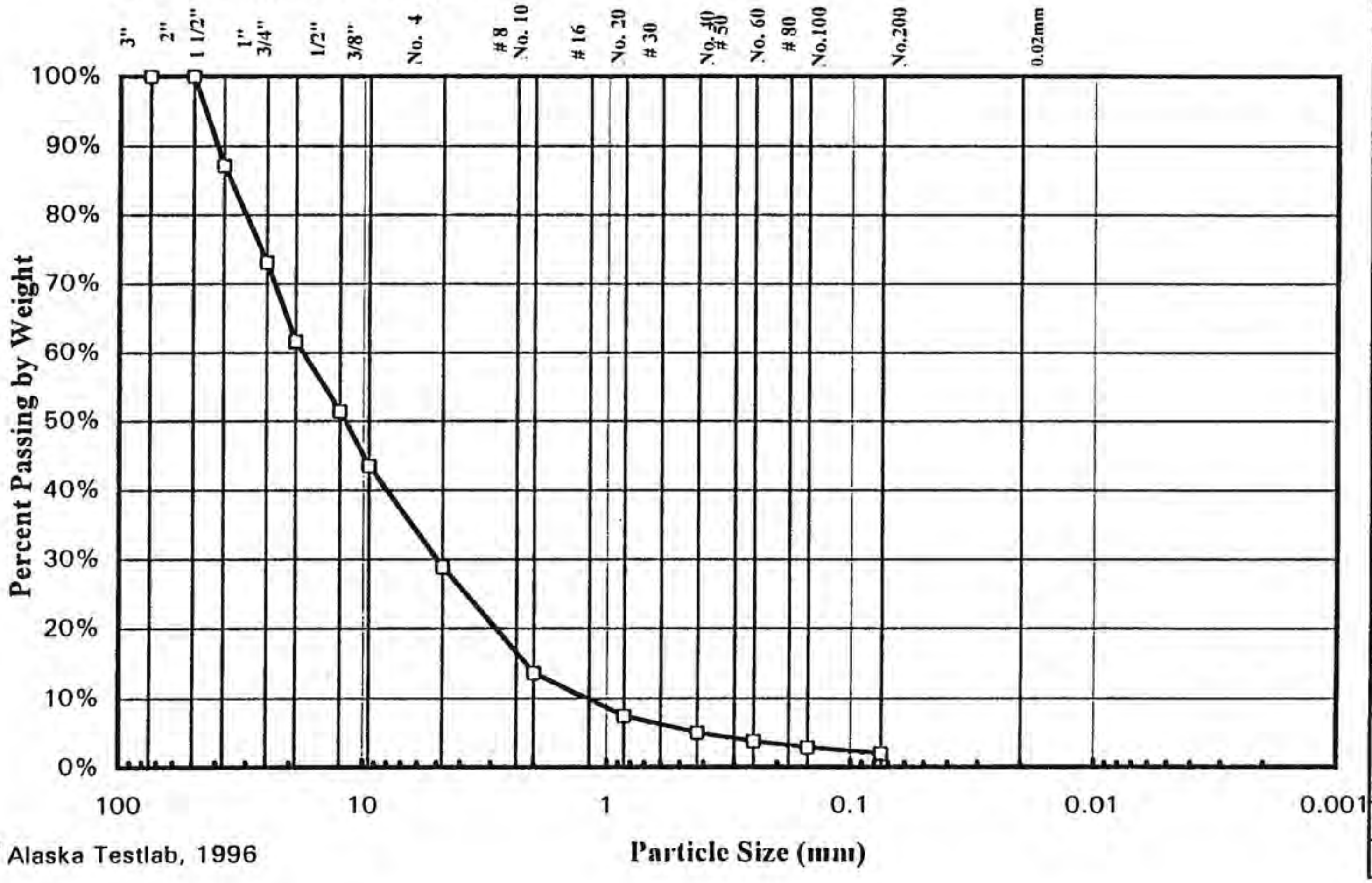
ALASKA
T E S T L A B
A Division of DOWL, Incorporated
4040 B Street Anchorage, Alaska 99503
(907) 562-2000 FAX (907) 563-3953

Client: Peratrovich Nottingham & Drage
Project: Petersburg Harbor GEO No. 96256.02
Location: TH-2, SA-7 @ 33.0'-34.5'
Submitted by Client

PARTICLE-SIZE DISTRIBUTION

W.O. A27160
Lab No. 299
Received: February 26, 1997

Engineering Classification: Well Graded GRAVEL with Sand, GW ✓
Frost Classification: NFS (MOA)



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"	100%	
1 1/2"	87%	
1"	73%	
3/4"	62%	
1/2"	51%	
3/8"	43%	
No. 4	29%	
Total Wt. of Coarse Fraction = 1142.7g		
No. 8		
No. 10	14%	
No. 16		
No. 20	7%	
No. 30		
No. 40	5%	
No. 50		
No. 60	4%	
No. 80		
No.100	3%	
No.200	2%	
Total Wt. of Fine Fraction = 329.4g		
0.02 mm		

Howard K. Weston, P.E. Technical Director
David L. Andersen, P.E. Laboratory Supervisor

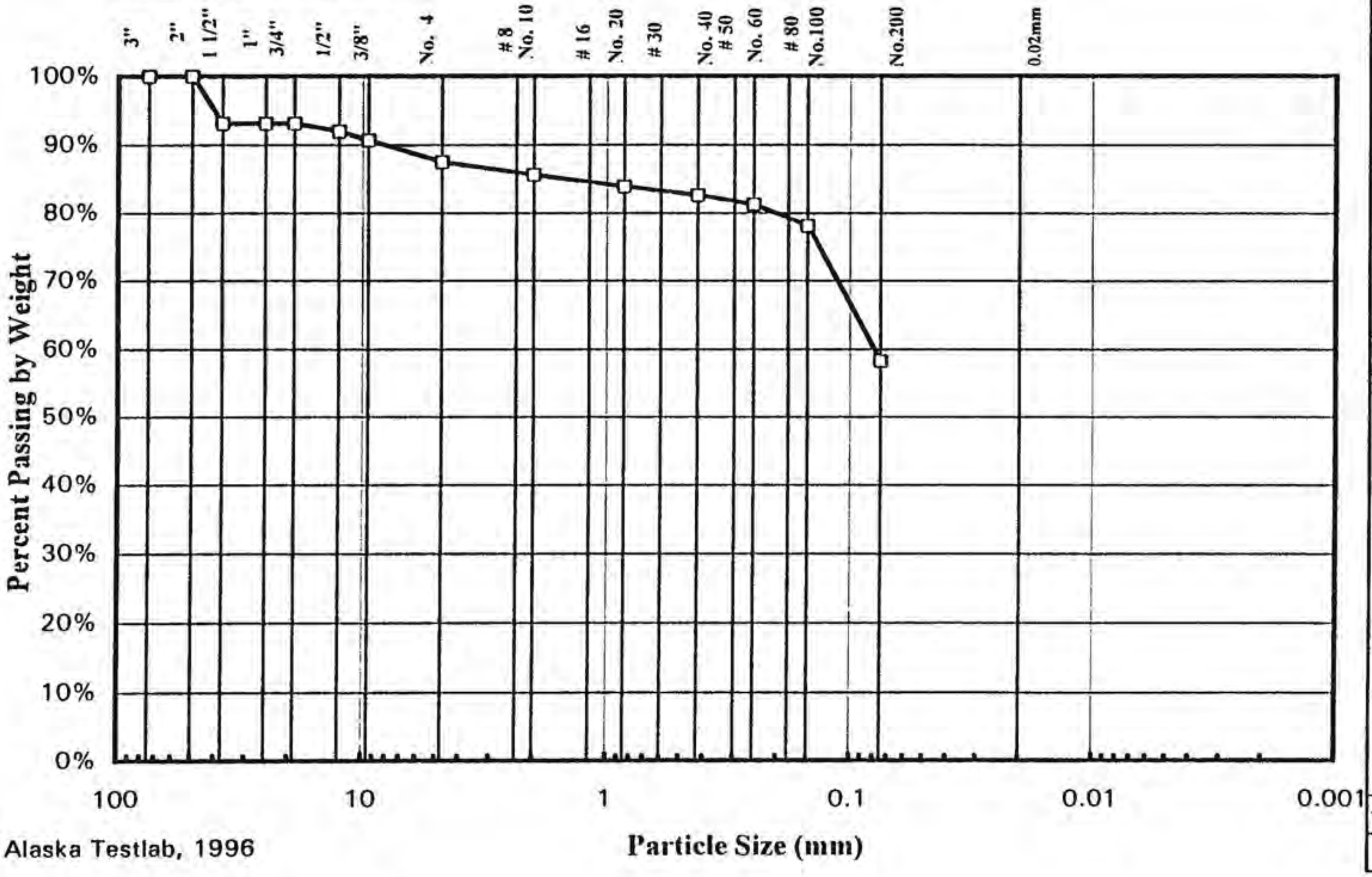
ALASKA TESTLAB
A Division of DOWL, Incorporated
4040 B Street Anchorage, Alaska 99503
(907) 562-2000 FAX (907) 563-3953

Client: Peratrovich Nottingham & Drage
Project: Petersburg Harbor GEO No. 96256.02
Location: TH-3, SA-3 @ 13.0'-14.5'
Submitted by Client

PARTICLE-SIZE DISTRIBUTION

W.O. A27160
Lab No. 300
Received: February 26, 1997

Engineering Classification: Sandy Silty CLAY, CL-ML
Frost Classification: F4



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"	100%	
1 1/2"	93%	
1"	93%	
3/4"	93%	
1/2"	92%	
3/8"	91%	
No. 4	87%	
Total Wt. of Coarse Fraction = 1571.4g		
No. 8		
No. 10	86%	
No. 16		
No. 20	84%	
No. 30		
No. 40	83%	
No. 50		
No. 60	81%	
No. 80		
No.100	78%	
No.200	58%	
Total Wt. of Fine Fraction = 335.7g		
0.02 mm		

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(907) 562-2000 FAX (907) 563-3953

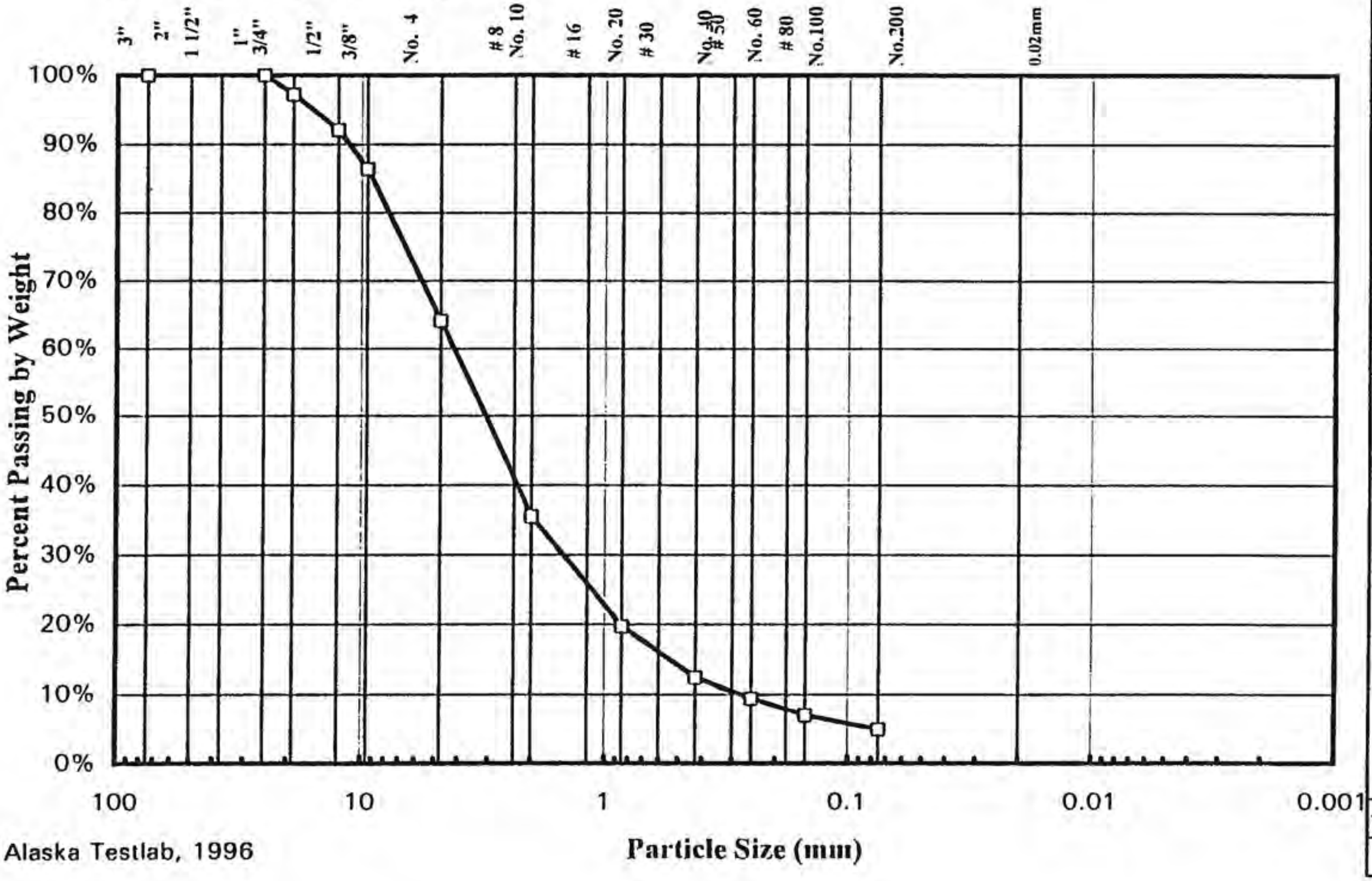
Client: Peratrovich Nottingham & Drage
Project: Petersburg Harbor GEO No. 96256.02

Location: TH-3, SA-6 @ 37.0'-38.5'
Submitted by Client

PARTICLE-SIZE DISTRIBUTION

W.O. A27160
Lab No. 301
Received: February 26, 1997

Engineering Classification: Well Graded SAND with Gravel, SW
Frost Classification: Not Measured



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"	100%	
3/4"	97%	
1/2"	92%	
3/8"	86%	
No. 4	64%	
Total Wt. of Coarse Fraction = 1280.8g		
No. 8		
No. 10	35%	
No. 16		
No. 20	20%	
No. 30		
No. 40	12%	
No. 50		
No. 60	9%	
No. 80		
No.100	7%	
No.200	4.9%	
Total Wt. of Fine Fraction = 340.9g		
0.02 mm		

Howard K. Weston, P.E. Technical Director
David L. Andersen, P.E. Laboratory Supervisor

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(907) 562-2000 FAX (907) 563-3953

Client: Peratrovich Nottingham & Drage
Project: Petersburg Harbor GEO No. 96256.02

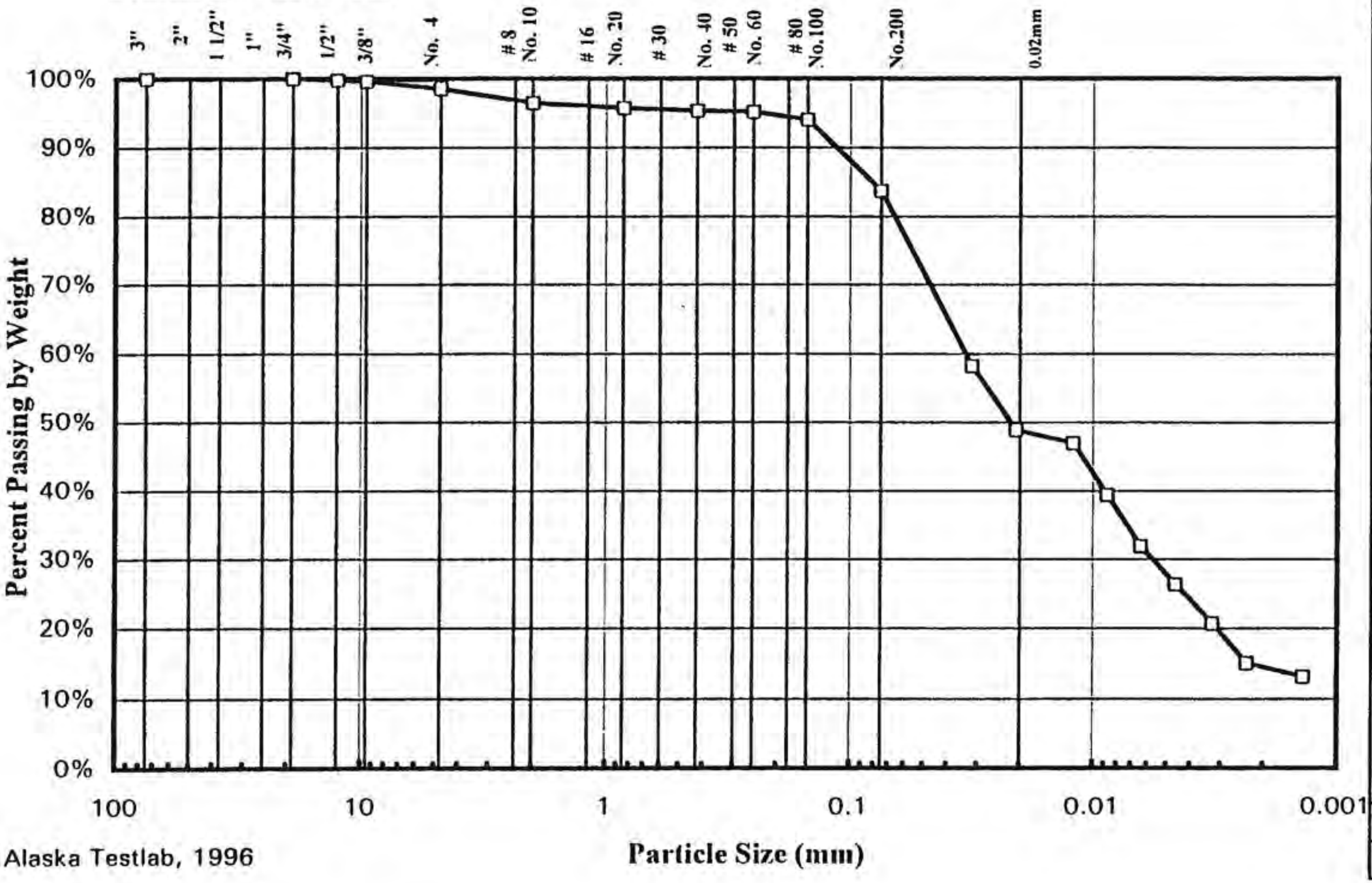
Location: TH-4, SA-1 @ 4.0'-5.5'
Submitted by Client

PARTICLE-SIZE DISTRIBUTION

W.O. A27160
Lab No. 302
Received: February 26, 1997

Engineering Classification: SILT with Sand, ML

Frost Classification: F4



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = -0%		
3"		
2"		
1 1/2"		
1"		
3/4"	100%	
1/2"	100%	
3/8"	100%	
No. 4	99%	
Total Wt. of Coarse Fraction = 1089.3g		
No. 8		
No. 10	96%	
No. 16		
No. 20	96%	
No. 30		
No. 40	95%	
No. 50		
No. 60	95%	
No. 80		
No.100	94%	
No.200	84%	
Total Wt. of Fine Fraction = 0g		
0.02 mm	48.7%	

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(907) 562-2000 FAX (907) 563-3953

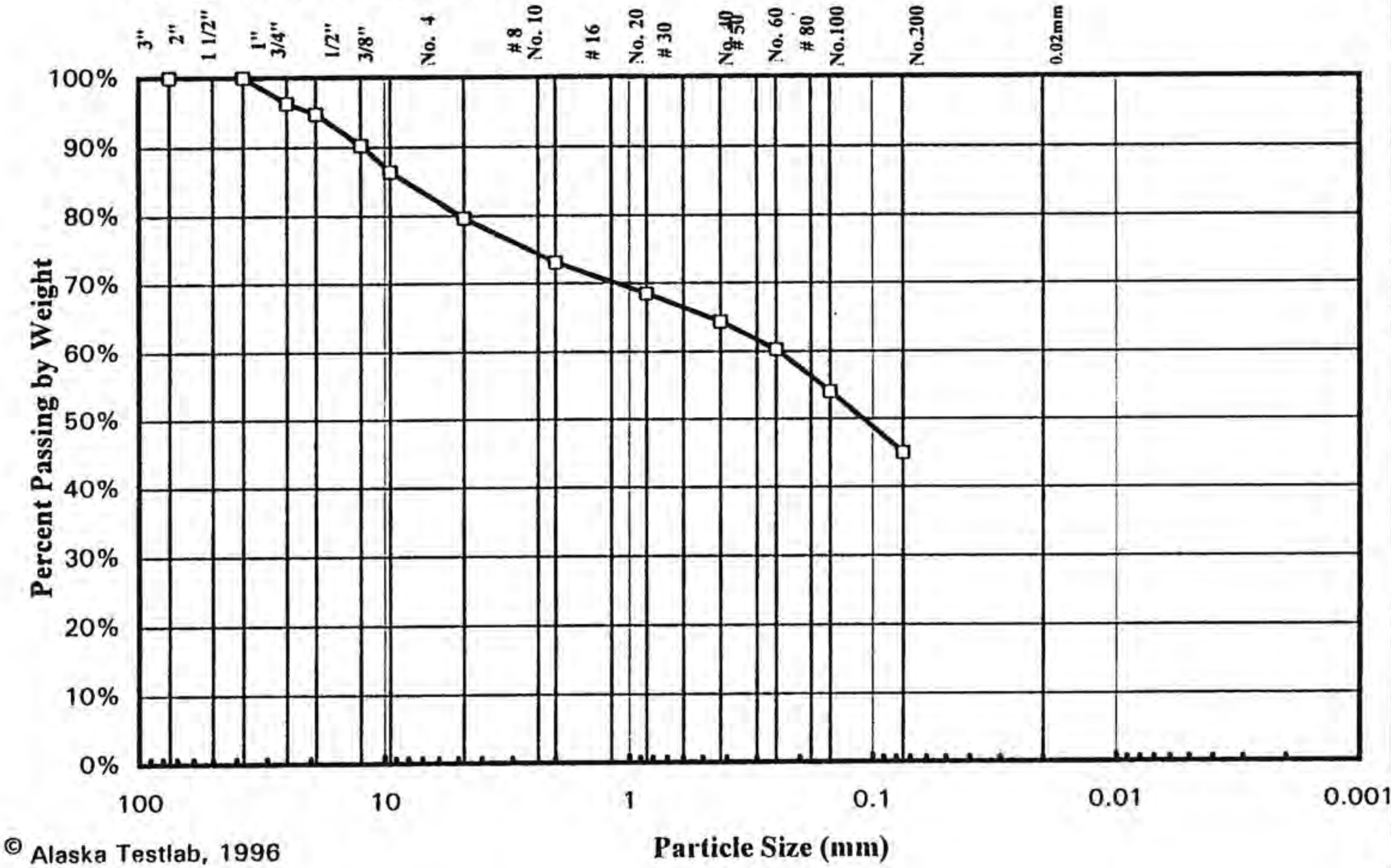
Client: Peratrovich Nottingham & Drage
Project: Petersburg Harbor GEO No. 96256.02

Location: TH-4, SA-3 @ 15.5'-16.5'
Submitted by Client

PARTICLE-SIZE DISTRIBUTION

W.O. A27160
Lab No. 303
Received: February 26, 1997

Engineering Classification: Silty SAND with Gravel, SM ✓
Frost Classification: Not Measured



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"	100%	
1"	96%	
3/4"	95%	
1/2"	90%	
3/8"	86%	
No. 4	80%	
Total Wt. of Coarse Fraction = 1313g		
No. 8		
No. 10	73%	
No. 16		
No. 20	68%	
No. 30		
No. 40	64%	
No. 50		
No. 60	60%	
No. 80		
No.100	54%	
No.200	45%	
Total Wt. of Fine Fraction = 348.1g		
0.02 mm		

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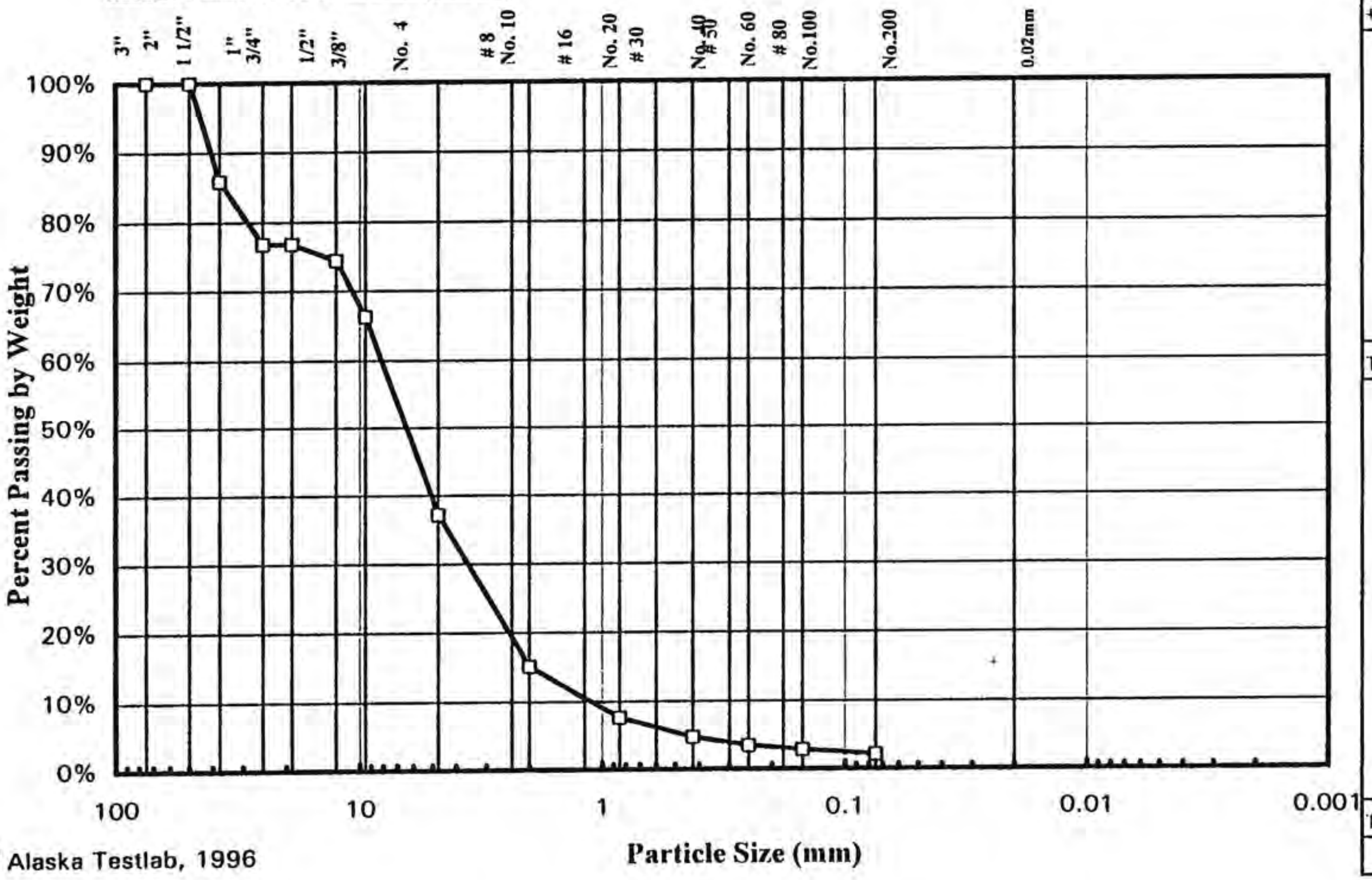
(907) 562-2000 FAX (907) 563-3953

Client: Peratrovich Nottingham & Drage
Project: Petersburg Harbor GEO No. 96256.02
Location: TH-4, SA-9 @ 46.0'-47.5'
Submitted by Client

PARTICLE-SIZE DISTRIBUTION

W.O. A27160
Lab No. 304
Received: February 26, 1997

Engineering Classification: Well Graded GRAVEL with Sand, GW ✓
Frost Classification: NFS (MOA)



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"	100%	
1 1/2"	86%	
1"	77%	
3/4"	77%	
1/2"	74%	
3/8"	66%	
No. 4	37%	
Total Wt. of Coarse Fraction = 774.6g		
No. 8		
No. 10	15%	
No. 16		
No. 20	8%	
No. 30		
No. 40	5%	
No. 50		
No. 60	3%	
No. 80		
No.100	3%	
No.200	2.1%	
Total Wt. of Fine Fraction = 288g		
0.02 mm		

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(907) 562-2000 FAX (907) 563-3953

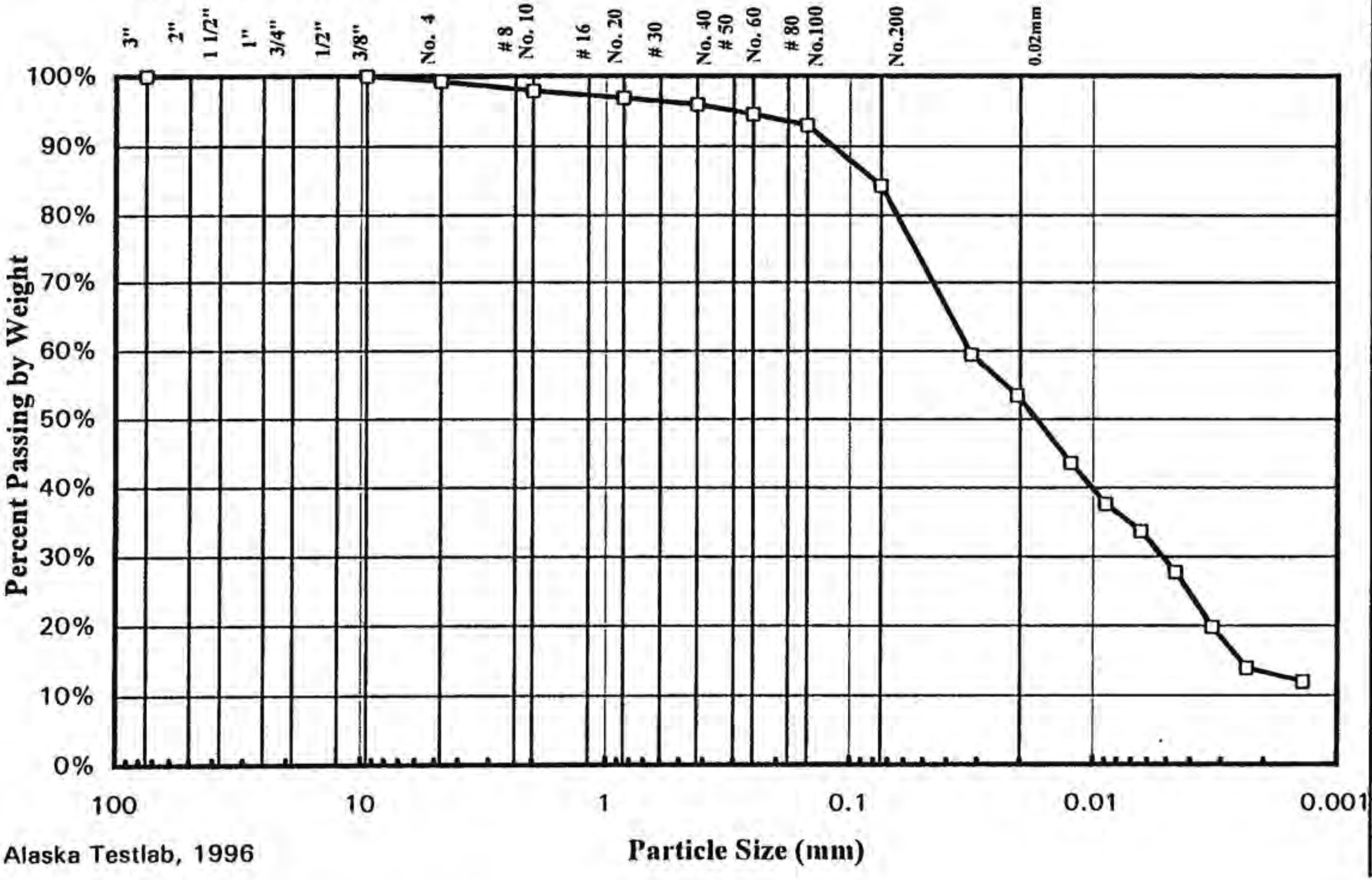
Client: Peratrovich Nottingham & Drage
Project: Petersburg Harbor GEO No. 96256.02

Location: TII-5, SA-1B @ 0.5'-1.5'
Submitted by Client

PARTICLE-SIZE DISTRIBUTION

W.O. A27160
Lab No. 305
Received: February 26, 1997

Engineering Classification: Silty CLAY w/ Sand, CL-ML
Frost Classification: F4



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"		
1/2"		
3/8"	100%	
No. 4	99%	
Total Wt. of Coarse Fraction = 757.3g		
No. 8		
No. 10	98%	
No. 16		
No. 20	97%	
No. 30		
No. 40	96%	
No. 50		
No. 60	95%	
No. 80		
No.100	93%	
No.200	84%	
Total Wt. of Fine Fraction = 0g		
0.02 mm	52.9%	

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Client: Peratrovich Nottingham & Drage
Project: Petersburg Harbor GEO No. 96256.02

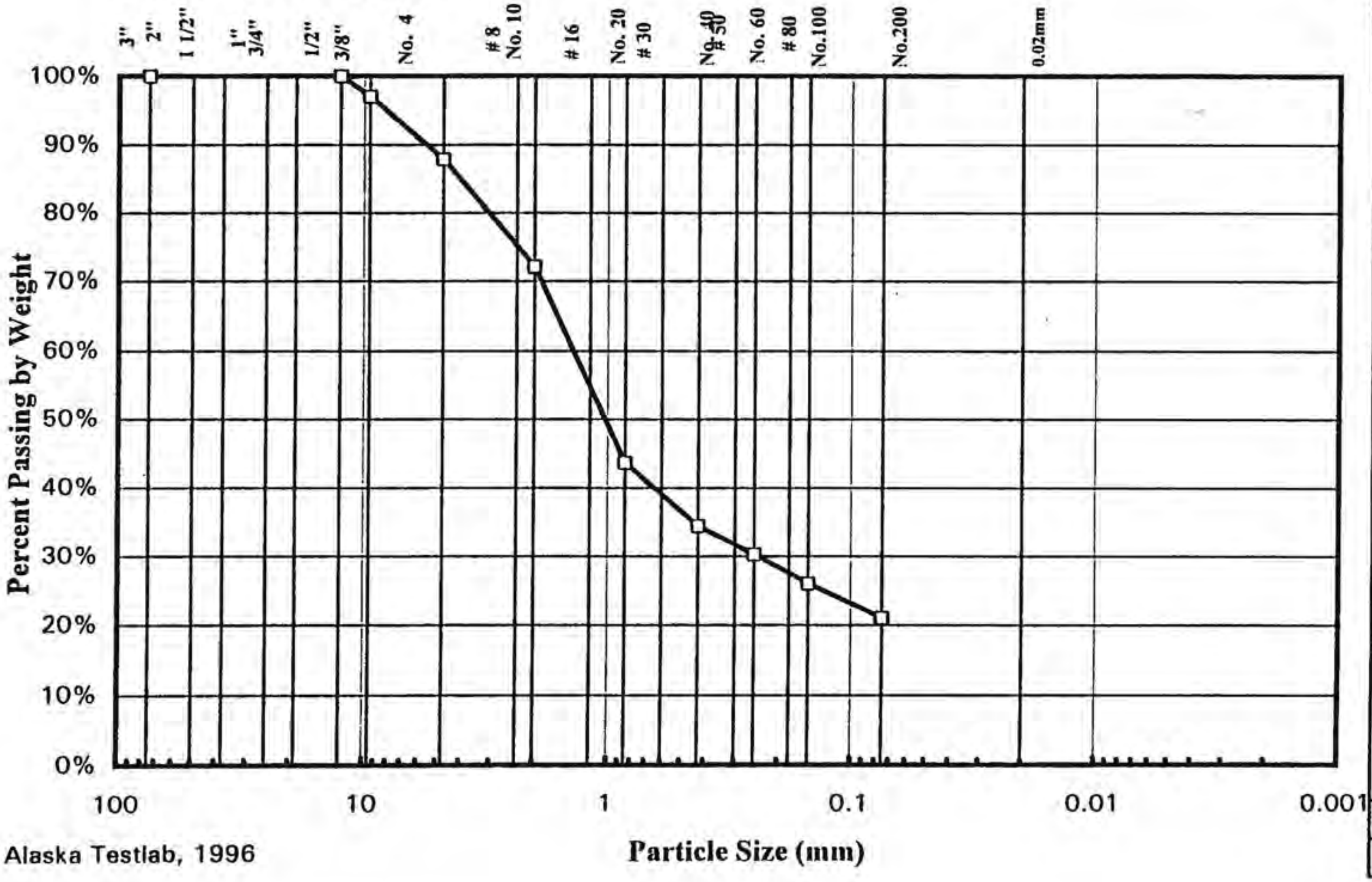
Location: TH-5, SA-6 @ 33.5'-34.5'
Submitted by Client

PARTICLE-SIZE DISTRIBUTION

W.O. A27160
Lab No. 307
Received: February 26, 1997

Engineering Classification: Silty SAND , SM

Frost Classification: Not Measured



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"		
1/2"	100%	
3/8"	97%	
No. 4	88%	
Total Wt. of Coarse Fraction = 992.1g		
No. 8		
No. 10	72%	
No. 16		
No. 20	44%	
No. 30		
No. 40	34%	
No. 50		
No. 60	30%	
No. 80		
No.100	26%	
No.200	21%	
Total Wt. of Fine Fraction = 368.3g		
0.02 mm		

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Client: Peratrovich Nottingham & Drage
Project: Petersburg Harbor GEO No. 96256.02

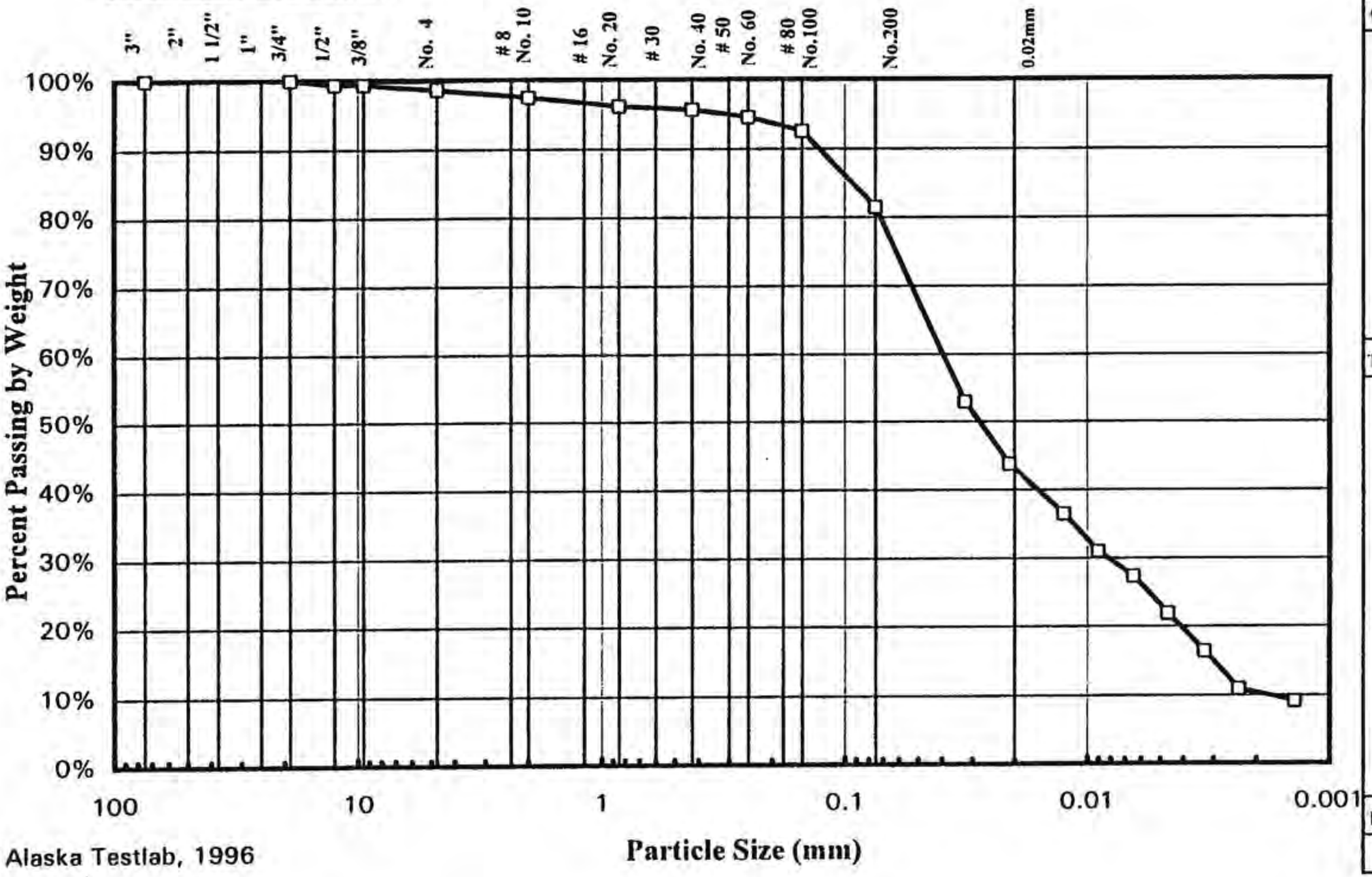
Location: TH-6, SA-1 @ 4.0'-5.0'
Submitted by Client

PARTICLE-SIZE DISTRIBUTION

W.O. A27160
Lab No. 308
Received: February 26, 1997

Engineering Classification: SILT with Sand, ML

Frost Classification: F4



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"	100%	
1/2"	99%	
3/8"	99%	
No. 4	99%	
Total Wt. of Coarse Fraction = 1246.4g		
No. 8		
No. 10	97%	
No. 16		
No. 20	96%	
No. 30		
No. 40	96%	
No. 50		
No. 60	95%	
No. 80		
No.100	93%	
No.200	81%	
Total Wt. of Fine Fraction = 0g		
0.02 mm	43.0%	

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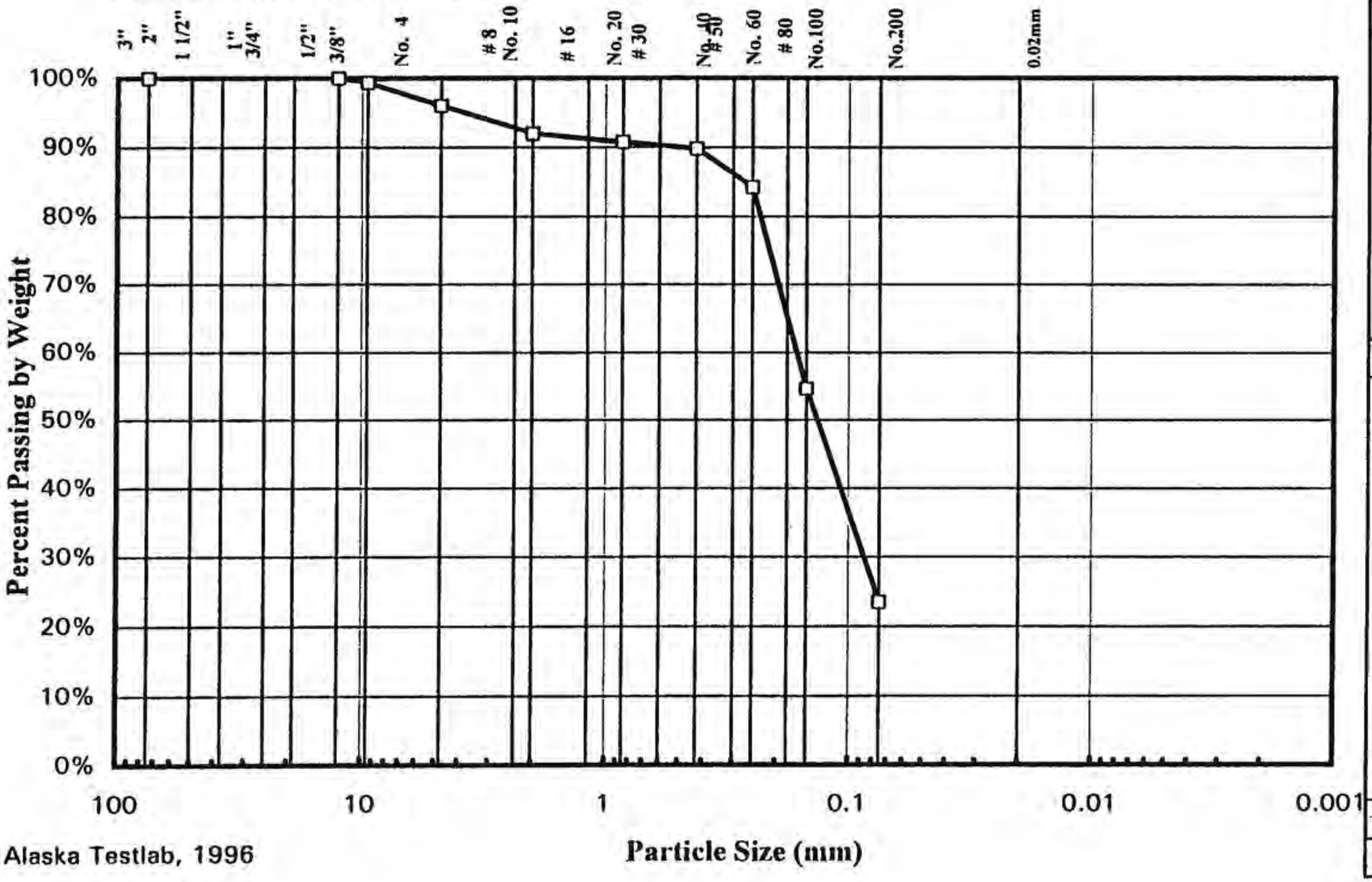
Client: Peratrovich Nottingham & Drage
Project: Petersburg Harbor GEO No. 96256.02

Location: TH-6, SA-4 @ 21.5'-22.5'
Submitted by Client

PARTICLE-SIZE DISTRIBUTION

W.O. A27160
Lab No. 309
Received: February 26, 1997

Engineering Classification: Silty SAND , SM ✓
Frost Classification: Not Measured



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SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"		
1/2"	100%	
3/8"	99%	
No. 4	96%	
Total Wt. of Coarse Fraction = 645.4g		
No. 8		
No. 10	92%	
No. 16		
No. 20	91%	
No. 30		
No. 40	90%	
No. 50		
No. 60	84%	
No. 80		
No.100	55%	
No.200	23%	
Total Wt. of Fine Fraction = 357g		
0.02 mm		

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4040 B Street Anchorage, Alaska 99503
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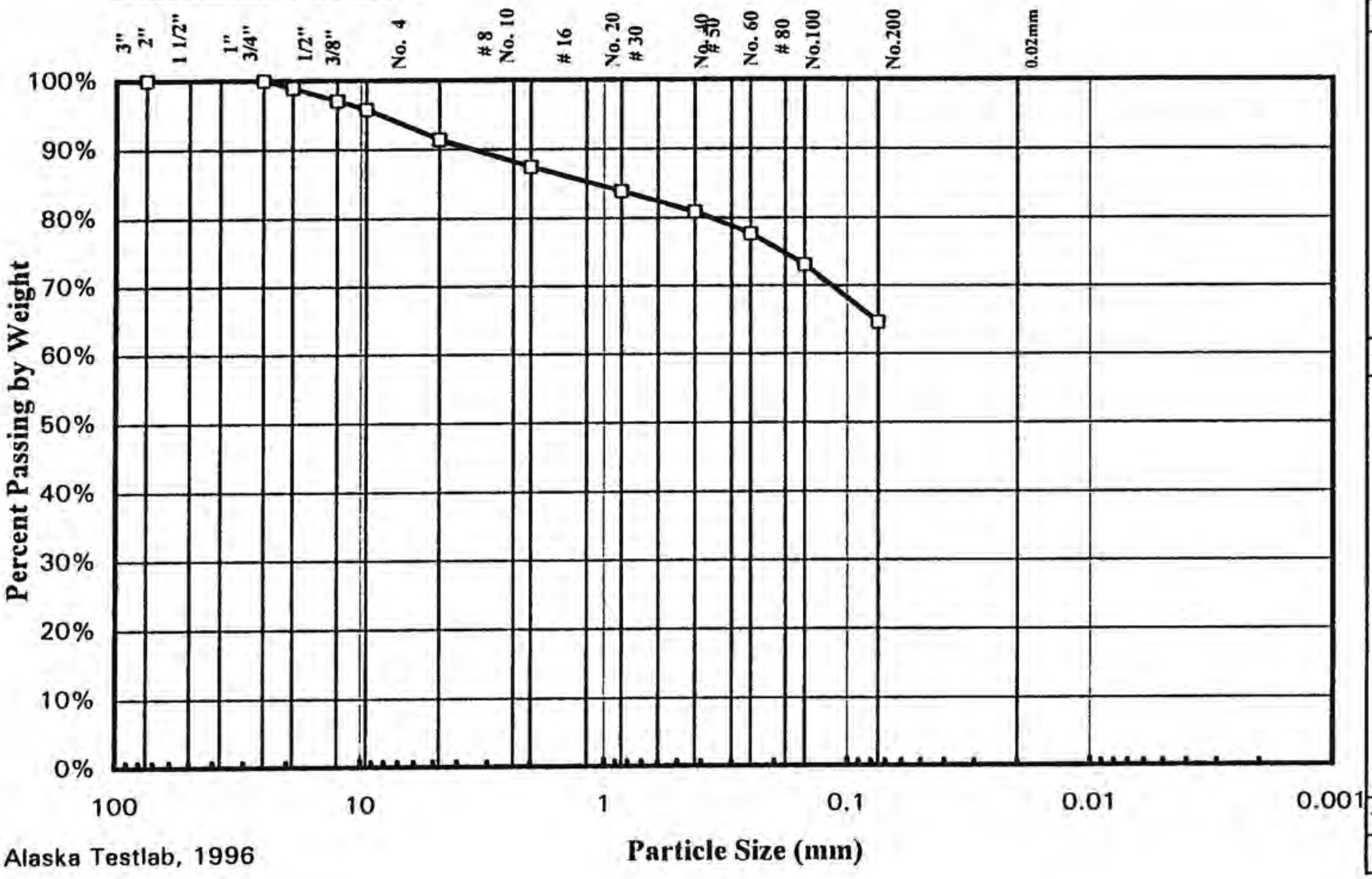
Client: Peratrovich Nottingham & Drage
Project: Petersburg Harbor GEO No. 96256.02

Location: TH-6, SA-6 @32.5'-33.5'
Submitted by Client

PARTICLE-SIZE DISTRIBUTION

W.O. A27160
Lab No. 310
Received: February 26, 1997

Engineering Classification: Sandy silty CLAY, CL-ML
Frost Classification: F4



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"	100%	
3/4"	99%	
1/2"	97%	
3/8"	96%	
No. 4	91%	
Total Wt. of Coarse Fraction = 1241.9g		
No. 8		
No. 10	87%	
No. 16		
No. 20	84%	
No. 30		
No. 40	81%	
No. 50		
No. 60	78%	
No. 80		
No.100	73%	
No.200	65%	
Total Wt. of Fine Fraction = 353.8g		
0.02 mm		

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(907) 562-2000 FAX (907) 563-3953

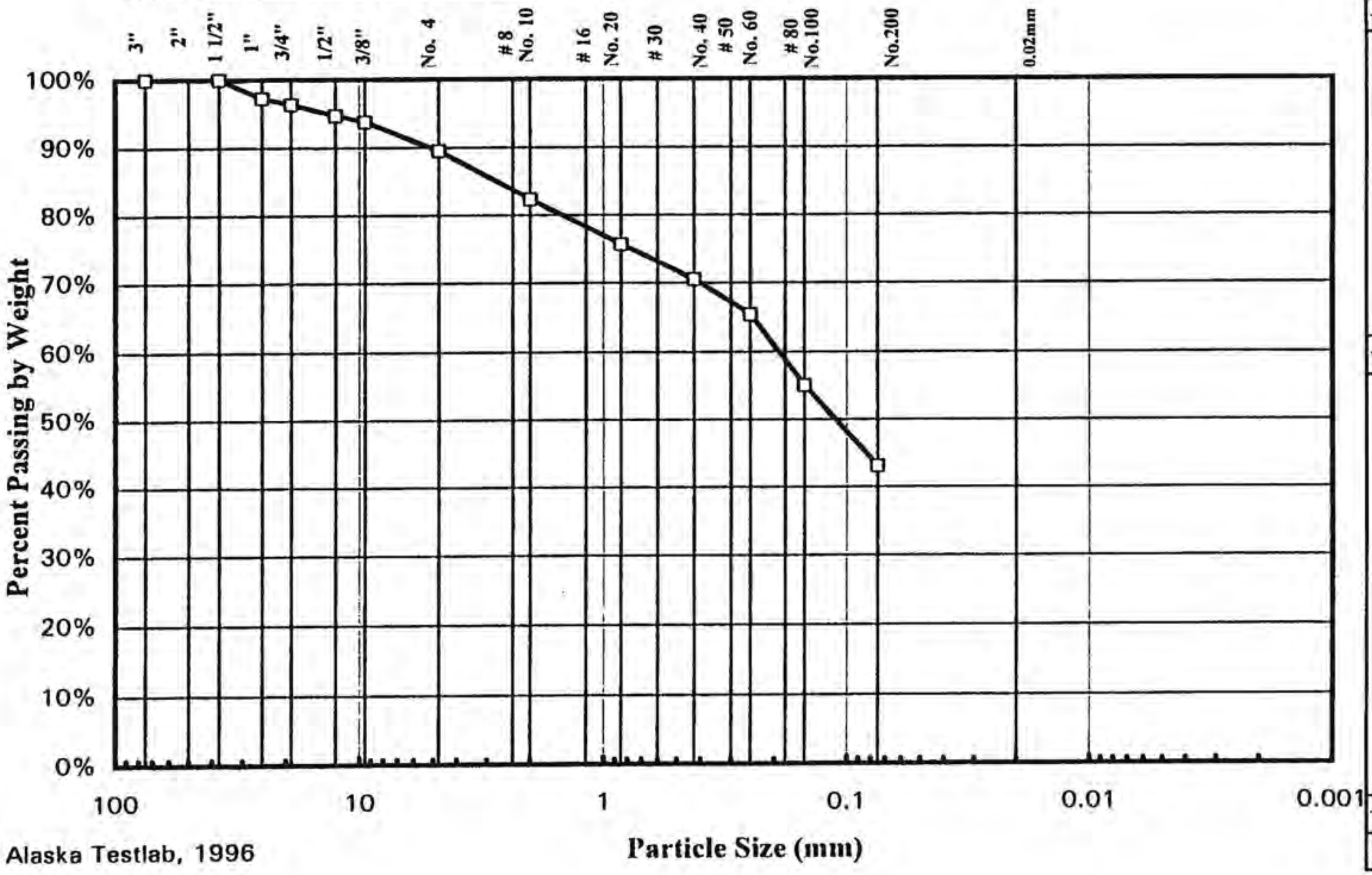
Client: Peratrovich Nottingham & Drage
Project: Petersburg Harbor GEO No. 96256.02

Location: TH-6, SA-7 @ 43.5'-46.0'
Submitted by Client

PARTICLE-SIZE DISTRIBUTION

W.O. A27160
Lab No. 311
Received: February 26, 1997

Engineering Classification: Silty SAND , SM ✓
Frost Classification: Not Measured



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"	100%	
1"	97%	
3/4"	96%	
1/2"	95%	
3/8"	94%	
No. 4	89%	
Total Wt. of Coarse Fraction = 2692.9g		
No. 8		
No. 10	82%	
No. 16		
No. 20	76%	
No. 30		
No. 40	70%	
No. 50		
No. 60	65%	
No. 80		
No.100	55%	
No.200	43%	
Total Wt. of Fine Fraction = 340.7g		
0.02 mm		

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(907) 562-2000 FAX (907) 563-3953

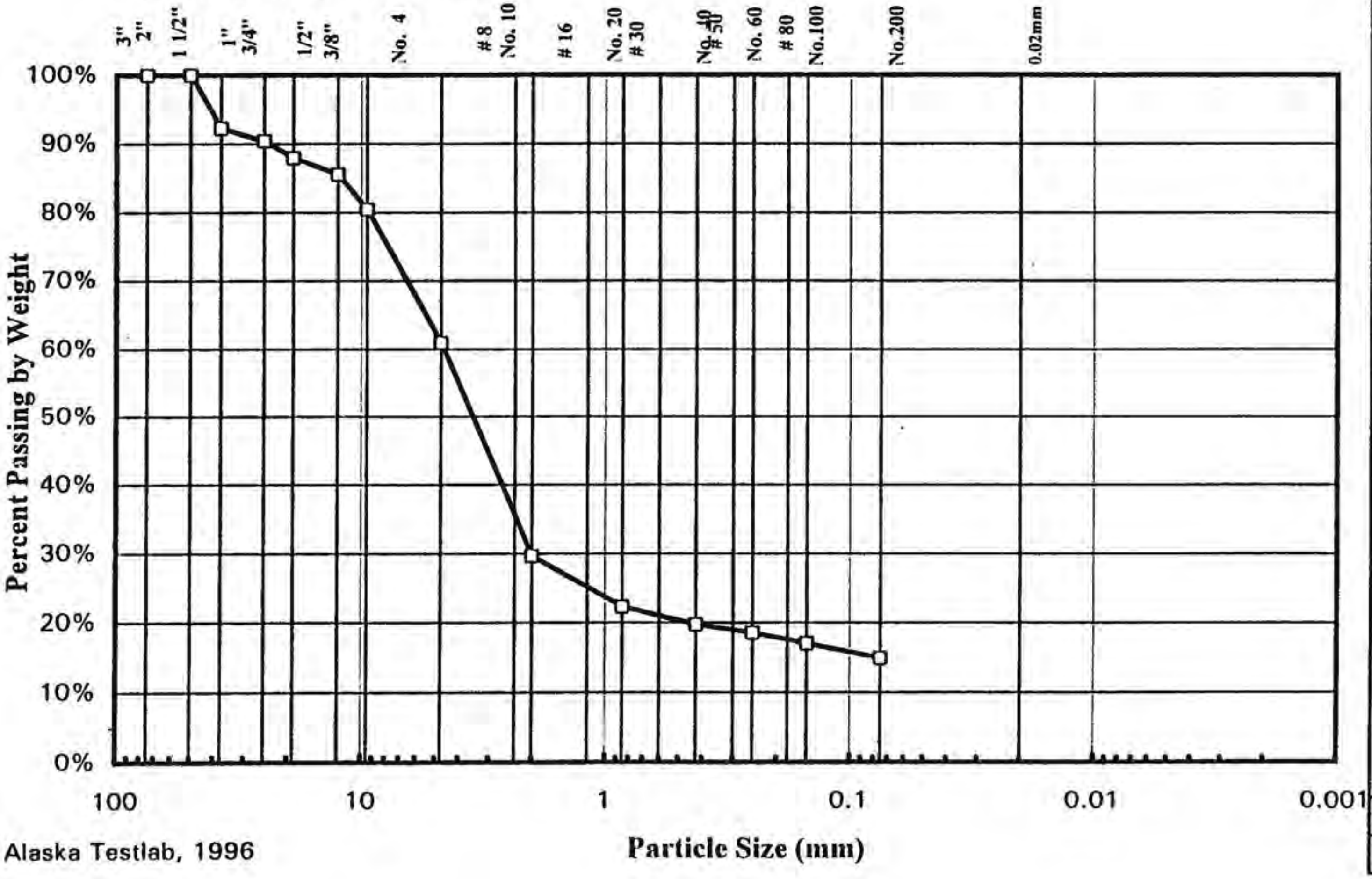
Client: Peratrovich Nottingham & Drage
Project: Petersburg Harbor GEO No. 96256.02

Location: TH-7, SA-4 @ 23.0'-24.0'
Submitted by Client

PARTICLE-SIZE DISTRIBUTION

W.O. A27160
Lab No. 312
Received: February 26, 1997

Engineering Classification: Silty SAND with Gravel, SM
Frost Classification: Not Measured



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"	100%	
1 1/2"	92%	
1"	90%	
3/4"	88%	
1/2"	86%	
3/8"	80%	
No. 4	61%	
Total Wt. of Coarse Fraction = 1799.2g		
No. 8		
No. 10	30%	
No. 16		
No. 20	22%	
No. 30		
No. 40	20%	
No. 50		
No. 60	19%	
No. 80		
No.100	17%	
No.200	15%	
Total Wt. of Fine Fraction = 308.7g		
0.02 mm		

Howard K. Weston, P.E. Technical Director
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4040 B Street Anchorage, Alaska 99503
(907) 562-2000 FAX (907) 563-3953

Client: Peratrovich Nottingham & Drage

Project: Petersburg Harbor GEO No. 96256.02

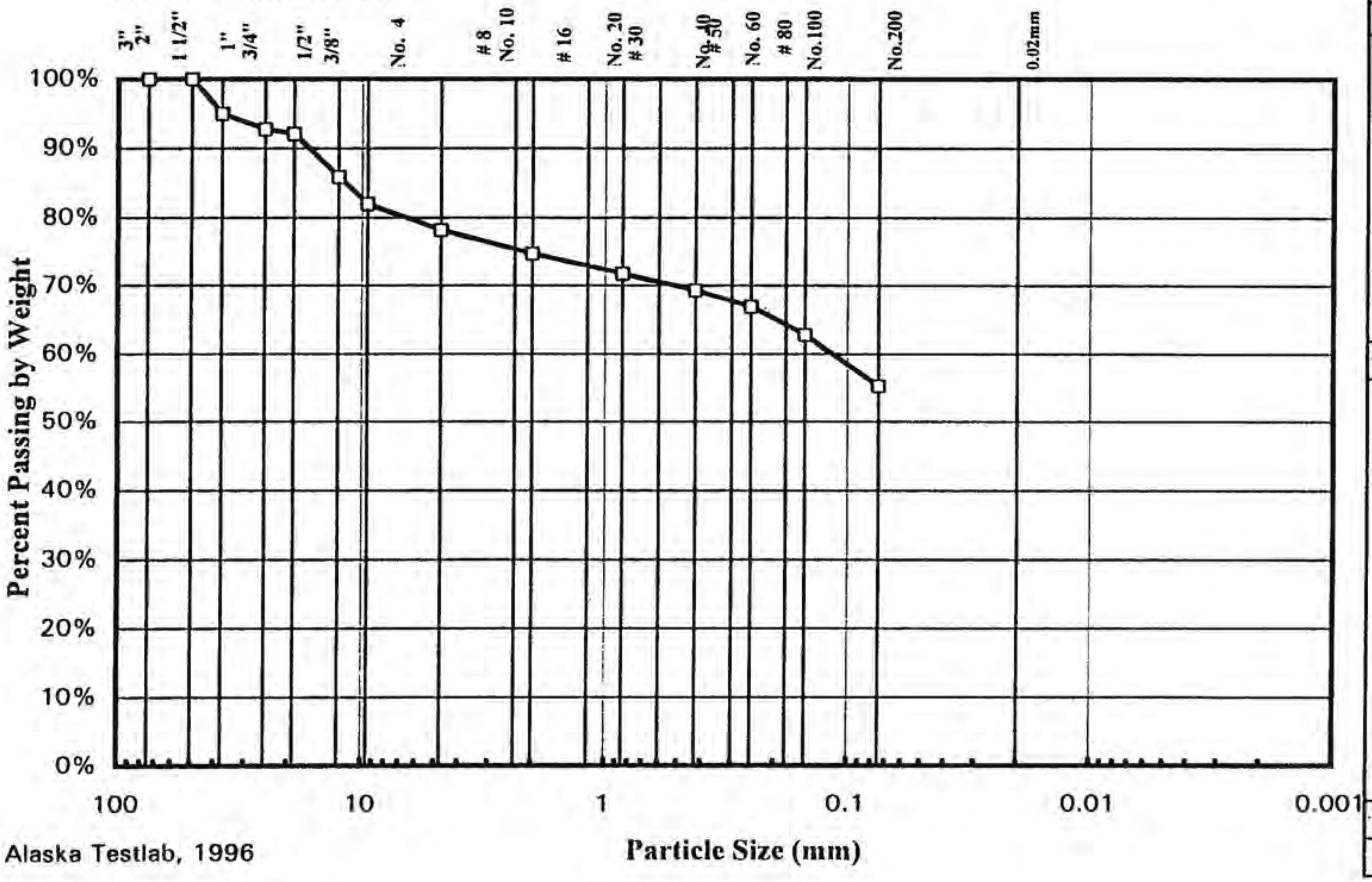
Location: TH-7, SA-6 @ 35.5'-36.5'
Submitted by Client

PARTICLE-SIZE DISTRIBUTION

W.O. A27160
Lab No. 313
Received: February 26, 1997

Engineering Classification: Sandy SILT with Gravel, ML

Frost Classification: F4



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"	100%	
1 1/2"	95%	
1"	93%	
3/4"	92%	
1/2"	86%	
3/8"	82%	
No. 4	78%	
Total Wt. of Coarse Fraction = 1689.1g		
No. 8		
No. 10	75%	
No. 16		
No. 20	72%	
No. 30		
No. 40	69%	
No. 50		
No. 60	67%	
No. 80		
No.100	63%	
No.200	55%	
Total Wt. of Fine Fraction = 320.1g		
0.02 mm		

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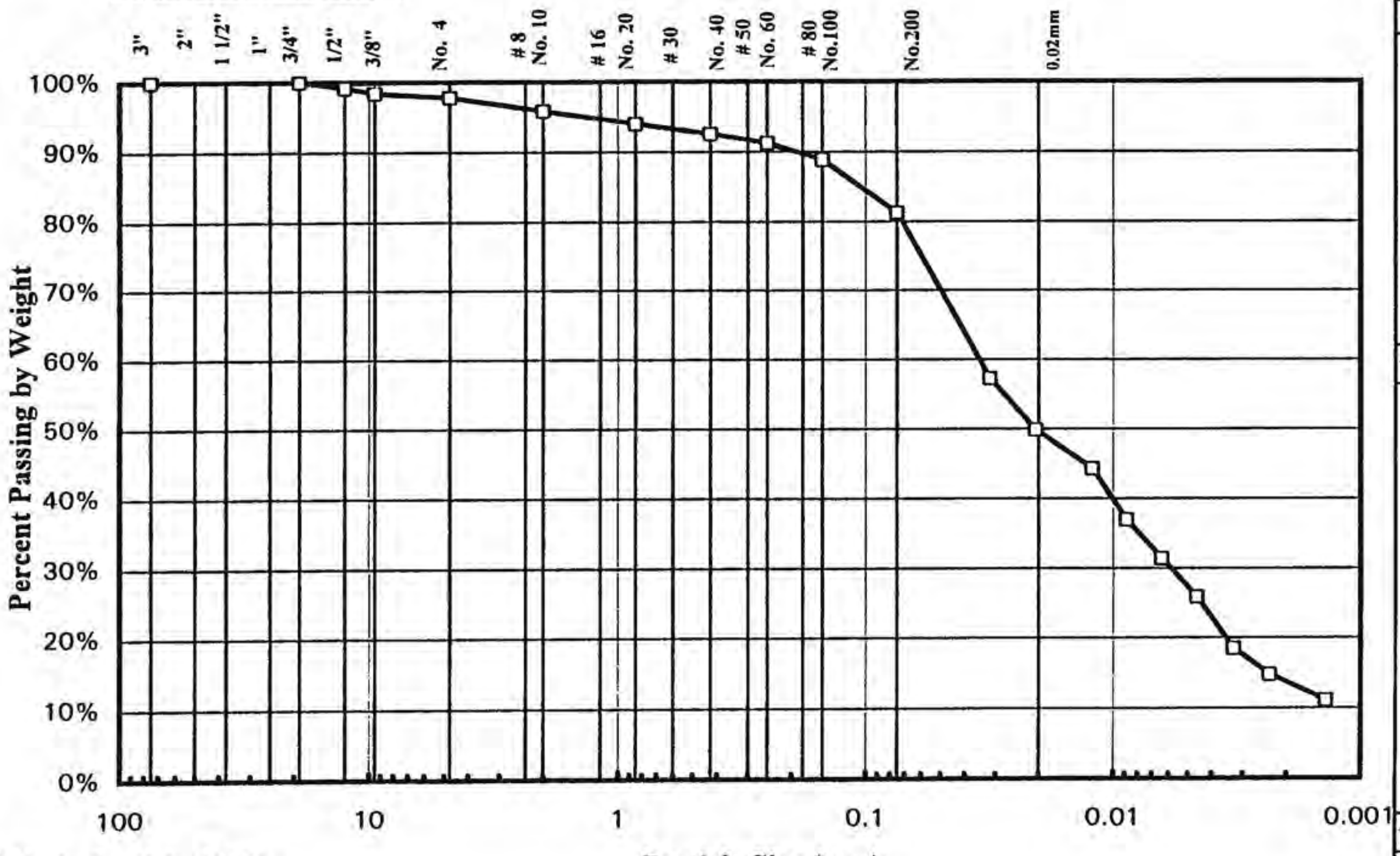
4040 B Street Anchorage, Alaska 99503
(907) 562-2000 FAX (907) 563-3953

Client: Peratrovich Nottingham & Drage
Project: Petersburg Harbor GEO No. 96256.02
Location: TH-8, SA-1 @ 0.5'-1.5'
Submitted by Client

PARTICLE-SIZE DISTRIBUTION

W.O. A27160
Lab No. 314
Received: February 26, 1997

Engineering Classification: Silty CLAY w/ Sand, CL-ML
Frost Classification: F4



Particle Size (mm)

SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"	100%	
1/2"	99%	
3/8"	98%	
No. 4	98%	
Total Wt. of Coarse Fraction = 1246.2g		
No. 8		
No. 10	96%	
No. 16		
No. 20	94%	
No. 30		
No. 40	93%	
No. 50		
No. 60	91%	
No. 80		
No.100	89%	
No.200	81%	
Total Wt. of Fine Fraction = 0g		
0.02 mm	49.5%	

Howard K. Weston, P.E. Technical Director
David L. Andersen, P.E. Laboratory Supervisor

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4040 B Street Anchorage, Alaska 99503
(907) 562-2000 FAX (907) 563-3953

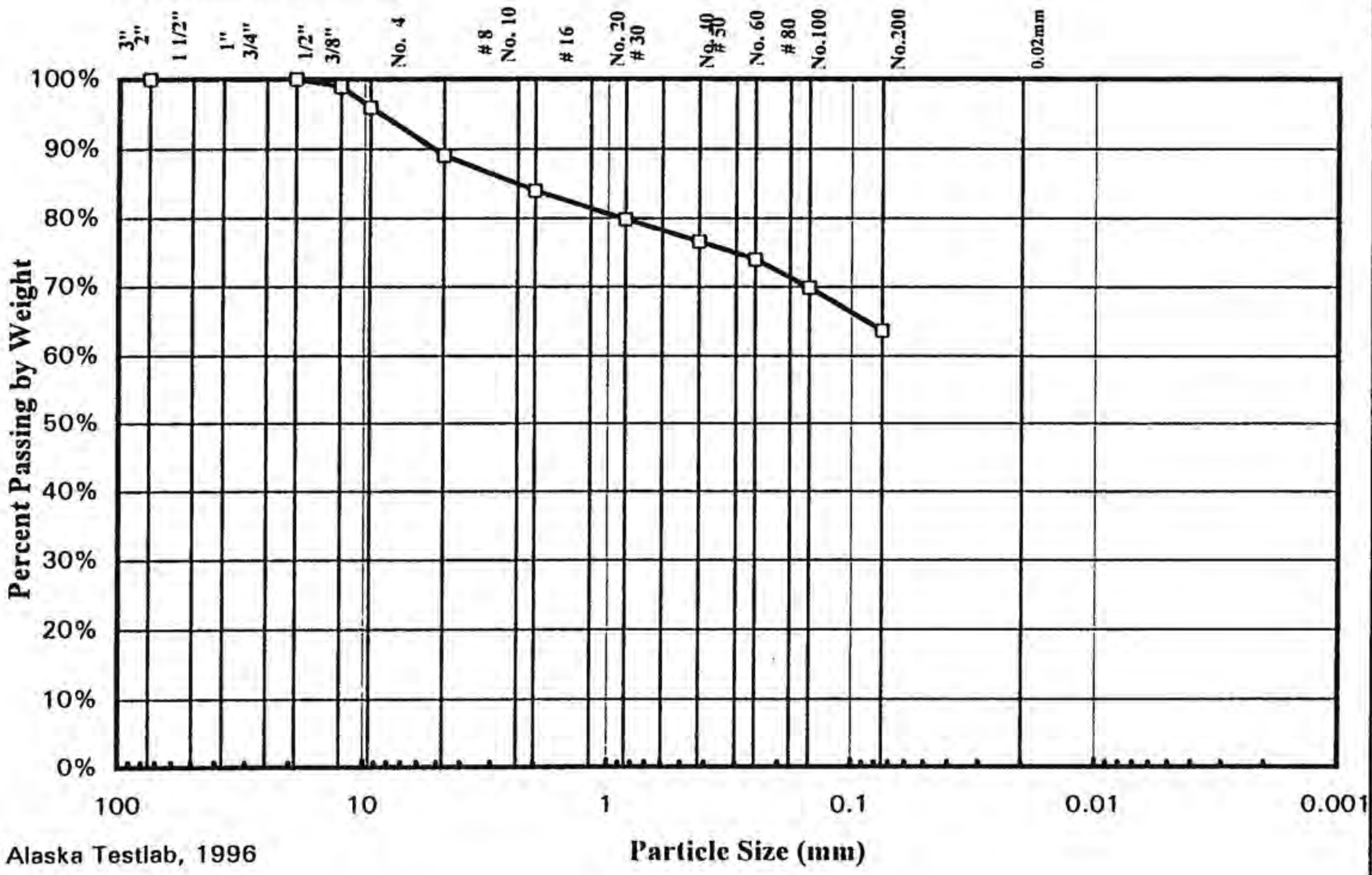
Client: Peratrovich Nottingham & Drage
Project: Petersburg Harbor GEO No. 96256.02

Location: TH-8, SA-5 @ 26.0-'-26.5'
Submitted by Client

PARTICLE-SIZE DISTRIBUTION

W.O. A27160
Lab No. 315
Received: February 26, 1997

Engineering Classification: Sandy Silty CLAY, CL-ML
Frost Classification: F4



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SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"	100%	
1/2"	99%	
3/8"	96%	
No. 4	89%	
Total Wt. of Coarse Fraction = 517.7g		
No. 8		
No. 10	84%	
No. 16		
No. 20	80%	
No. 30		
No. 40	77%	
No. 50		
No. 60	74%	
No. 80		
No.100	70%	
No.200	64%	
Total Wt. of Fine Fraction = 348.5g		
0.02 mm		

Howard K. Weston, P.E. Technical Director
David L. Andersen, P.E. Laboratory Supervisor

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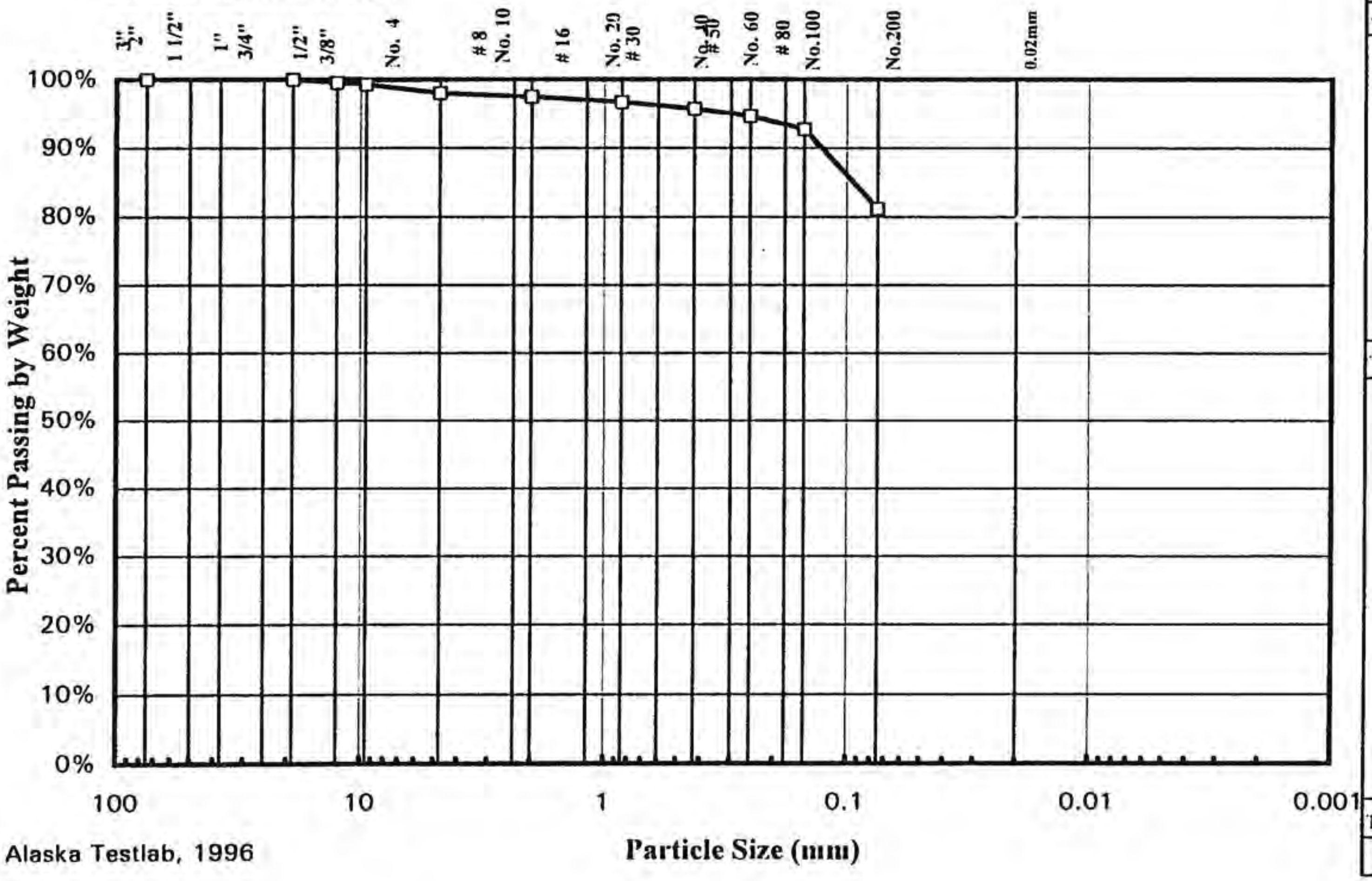
T E S T L A B
A Division of DOWL, Incorporated
4040 B Street Anchorage, Alaska 99503
(907) 562-2000 FAX (907) 563-3953

Client: Peratrovich Nottingham & Drage
Project: Petersburg Harbor GEO No 96256.02
Location: TH-9, SA-4 @ 19.0'-20.5'
Submitted by Client

PARTICLE-SIZE DISTRIBUTION

W.O. A27160
Lab No. 316
Received: February 26, 1997

Engineering Classification: Silty CLAY w/ Sand, CL-ML
Frost Classification: F4



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"		
3/4"	100%	
1/2"	100%	
3/8"	99%	
No. 4	98%	
Total Wt. of Coarse Fraction = 902.1g		
No. 8		
No. 10	97%	
No. 16		
No. 20	97%	
No. 30		
No. 40	96%	
No. 50		
No. 60	95%	
No. 80		
No.100	93%	
No.200	81%	
Total Wt. of Fine Fraction = 350.2g		
0.02 mm		

Howard K. Weston, P.E. Technical Director
David L. Andersen, P.E. Laboratory Supervisor

ALASKA TESTLAB
A Division of DOWL, Incorporated
4040 B Street Anchorage, Alaska 99503
(907) 562-2000 FAX (907) 563-3953

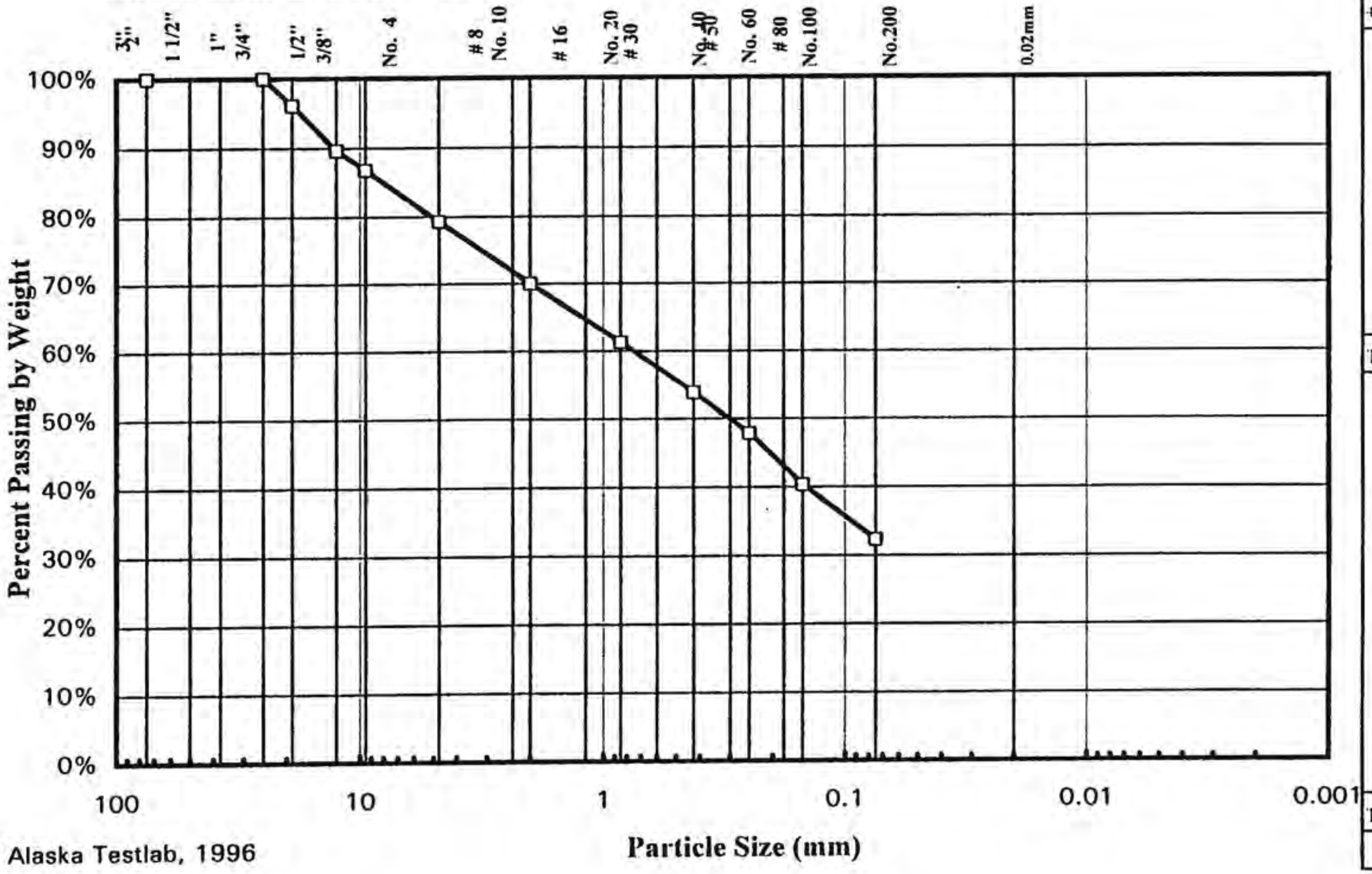
Client: Peratrovich Nottingham & Drage
Project: Petersburg Harbor GEO No. 96256.02

Location: TH-9, SA-7 @ 34.0-35.5'
Submitted by Client

PARTICLE-SIZE DISTRIBUTION

W.O. A27160
Lab No. 317
Received: February 26, 1997

Engineering Classification: Silty SAND with Gravel, SM ✓
Frost Classification: Not Measured



SIZE	PASSING	SPECIFICATION
+3 in Not Included in Test = ~0%		
3"		
2"		
1 1/2"		
1"	100%	
3/4"	96%	
1/2"	90%	
3/8"	87%	
No. 4	79%	
Total Wt. of Coarse Fraction = 1367.7g		
No. 8		
No. 10	70%	
No. 16		
No. 20	61%	
No. 30		
No. 40	54%	
No. 50		
No. 60	48%	
No. 80		
No.100	40%	
No.200	32%	
Total Wt. of Fine Fraction = 332.3g		
0.02 mm		

Howard K. Weston, P.E. Technical Director
David L. Andersen, P.E. Laboratory Supervisor

APPENDIX D

ARTICLE

"IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT"

IMPORTANT INFORMATION
ABOUT YOUR
GEOTECHNICAL ENGINEERING REPORT

More construction problems are caused by site subsurface conditions than any other factor. As troublesome as subsurface problems can be, their frequency and extent have been lessened considerably in recent years, due in large measure to programs and publications of ASFE/ The Association of Engineering Firms Practicing in the Geosciences.

The following suggestions and observations are offered to help you reduce the geotechnical-related delays, cost-overruns and other costly headaches that can occur during a construction project.

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

A geotechnical engineering report is based on a subsurface exploration plan designed to incorporate a unique set of project-specific factors. These typically include: the general nature of the structure involved, its size and configuration; the location of the structure on the site and its orientation; physical concomitants such as access roads, parking lots, and underground utilities, and the level of additional risk which the client assumed by virtue of limitations imposed upon the exploratory program. To help avoid costly problems, consult the geotechnical engineer to determine how any factors which change subsequent to the date of the report may affect its recommendations.

Unless your consulting geotechnical engineer indicates otherwise, *your geotechnical engineering report should not be used:*

- When the nature of the proposed structure is changed, for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one;
- when the size or configuration of the proposed structure is altered;
- when the location or orientation of the proposed structure is modified;
- when there is a change of ownership, or
- for application to an adjacent site.

Geotechnical engineers cannot accept responsibility for problems which may develop if they are not consulted after factors considered in their report's development have changed.

MOST GEOTECHNICAL "FINDINGS" ARE PROFESSIONAL ESTIMATES

Site exploration identifies actual subsurface conditions only at those points where samples are taken, when they are taken. Data derived through sampling and subsequent laboratory testing are extrapolated by geotechnical engineers who then render an opinion about overall subsurface conditions, their likely reaction to proposed construction activity, and appropriate foundation design. Even under optimal circumstances actual conditions may differ from those inferred to exist, because no geotechnical engineer, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than a report indicates. Actual conditions in areas not sampled may differ from predictions. *Nothing can be done to prevent the unanticipated, but steps can be taken to help minimize their impact.* For this reason, *most experienced owners retain their geotechnical consultants through the construction stage*, to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

SUBSURFACE CONDITIONS CAN CHANGE

Subsurface conditions may be modified by constantly-changing natural forces. Because a geotechnical engineering report is based on conditions which existed at the time of subsurface exploration, *construction decisions should not be based on a geotechnical engineering report whose adequacy may have been affected by time.* Speak with the geotechnical consultant to learn if additional tests are advisable before construction starts.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical report. The geotechnical engineer should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND PERSONS

Geotechnical engineers' reports are prepared to meet the specific needs of specific individuals. A report prepared for a consulting civil engineer may not be adequate for a construction contractor, or even some other consulting civil engineer. Unless indicated otherwise, this report was prepared expressly for the client involved and expressly for purposes indicated by the client. Use by any other persons for any purpose, or by the client for a different purpose, may result in problems. *No individual other than the client should apply this report for its intended purpose without first conferring with the geotechnical engineer. No person should apply this report for any purpose other than that originally contemplated without first conferring with the geotechnical engineer.*

A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a geotechnical engineering report. To help avoid these problems, the geotechnical engineer should be retained to work with other appropriate design professionals to explain relevant geotechnical findings and to review the adequacy of their plans and specifications relative to geotechnical issues.

BORING LOGS SHOULD NOT BE SEPARATED FROM THE ENGINEERING REPORT

Final boring logs are developed by geotechnical engineers based upon their interpretation of field logs (assembled by site personnel) and laboratory evaluation of field samples. Only final boring logs customarily are included in geotechnical engineering reports. *These logs should not under any circumstances be redrawn* for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process. Although photographic reproduction eliminates this problem, it does nothing to minimize the possibility of contractors misinterpreting the logs during bid preparation. When this occurs, delays, disputes and unanticipated costs are the all-too-frequent result.

To minimize the likelihood of boring log misinterpretation, *give contractors ready access to the complete geotechnical engineering report* prepared or authorized for their use. Those who do not provide such access may proceed under the *mistaken* impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes which aggravate them to disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY

Because geotechnical engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against geotechnical consultants. To help prevent this problem, geotechnical engineers have developed model clauses for use in written transmittals. These are *not* exculpatory clauses designed to foist geotechnical engineers' liabilities onto someone else. Rather, they are definitive clauses which identify where geotechnical engineers' responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your geotechnical engineering report, and you are encouraged to read them closely. Your geotechnical engineer will be pleased to give full and frank answers to your questions.

OTHER STEPS YOU CAN TAKE TO REDUCE RISK

Your consulting geotechnical engineer will be pleased to discuss other techniques which can be employed to mitigate risk. In addition, ASFE has developed a variety of materials which may be beneficial. Contact ASFE for a complimentary copy of its publications directory.

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Petersburg Navigation Improvements

Appendix B: Hydraulics and Hydrology

Petersburg, Alaska

September 2018

US Army Corps of Engineers
Alaska District

Table of Contents

List of Figures

List of Tables

1.0 INTRODUCTION

1.1 Appendix Purpose

This appendix describes the hydraulic design of navigation improvements for the South Harbor at Petersburg by increasing the depth

- for the approach to the Crane Dock,
- between floats C and D,
- for small vessels along the main south harbor float, and

removal of a mound of sediment that feeds sedimentation into the middle Harbor (Figure 4).

It provides the background for determining the Federal interest in dredging and operation and maintenance of the South Harbor in Petersburg Alaska.

1.2 Description of Project Area

Petersburg is located on the northwest end of Mitkof Island, where the Wrangell Narrows meet Frederick Sound. It lies midway between Juneau and Ketchikan, about 120 miles from either community (Figure 1- Figure 3).

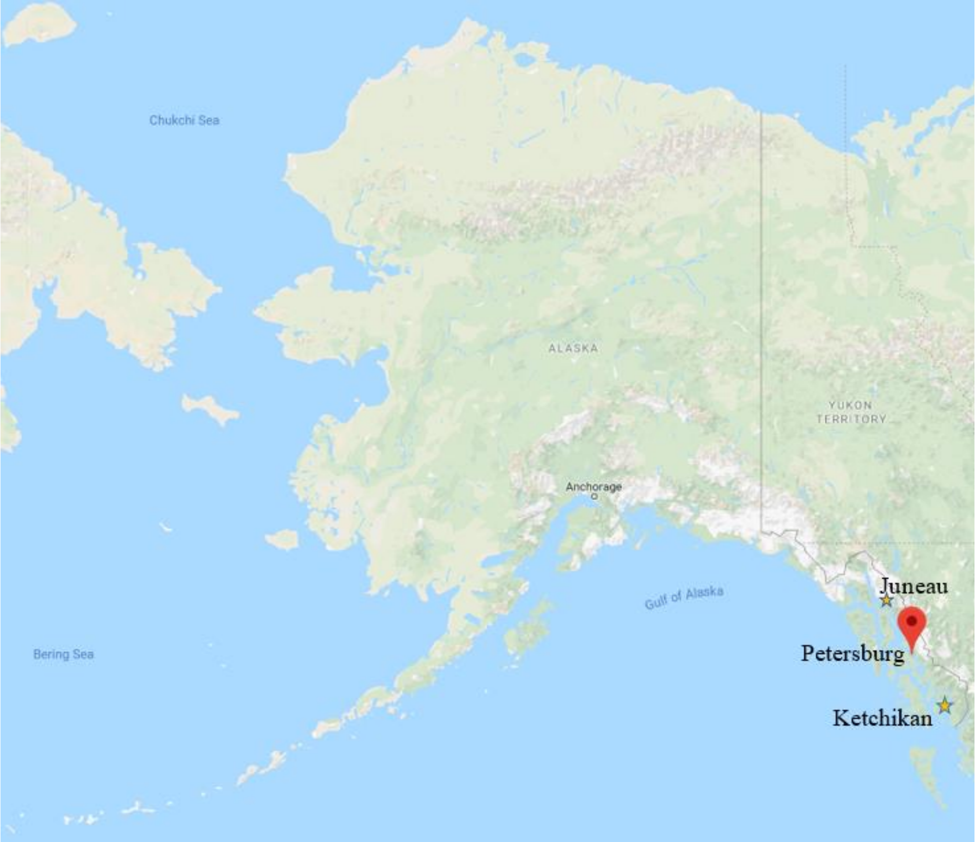


FIGURE 1 STATE OF ALASKA LOCATION MAP WITH LOCATION OF PETERSBURG.

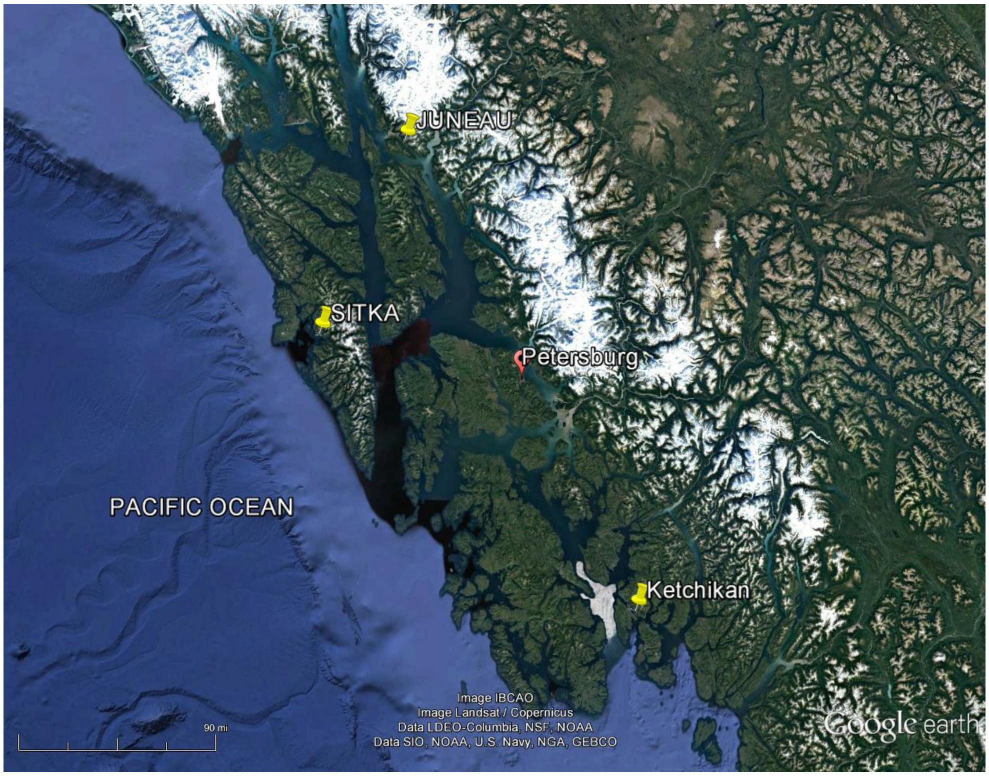


FIGURE 2. PETERSBURG'S LOCATION IN RELATION TO JUNEAU AND KETCHIKAN.

FIGURE 3 PETERSBURG'S LOCATION

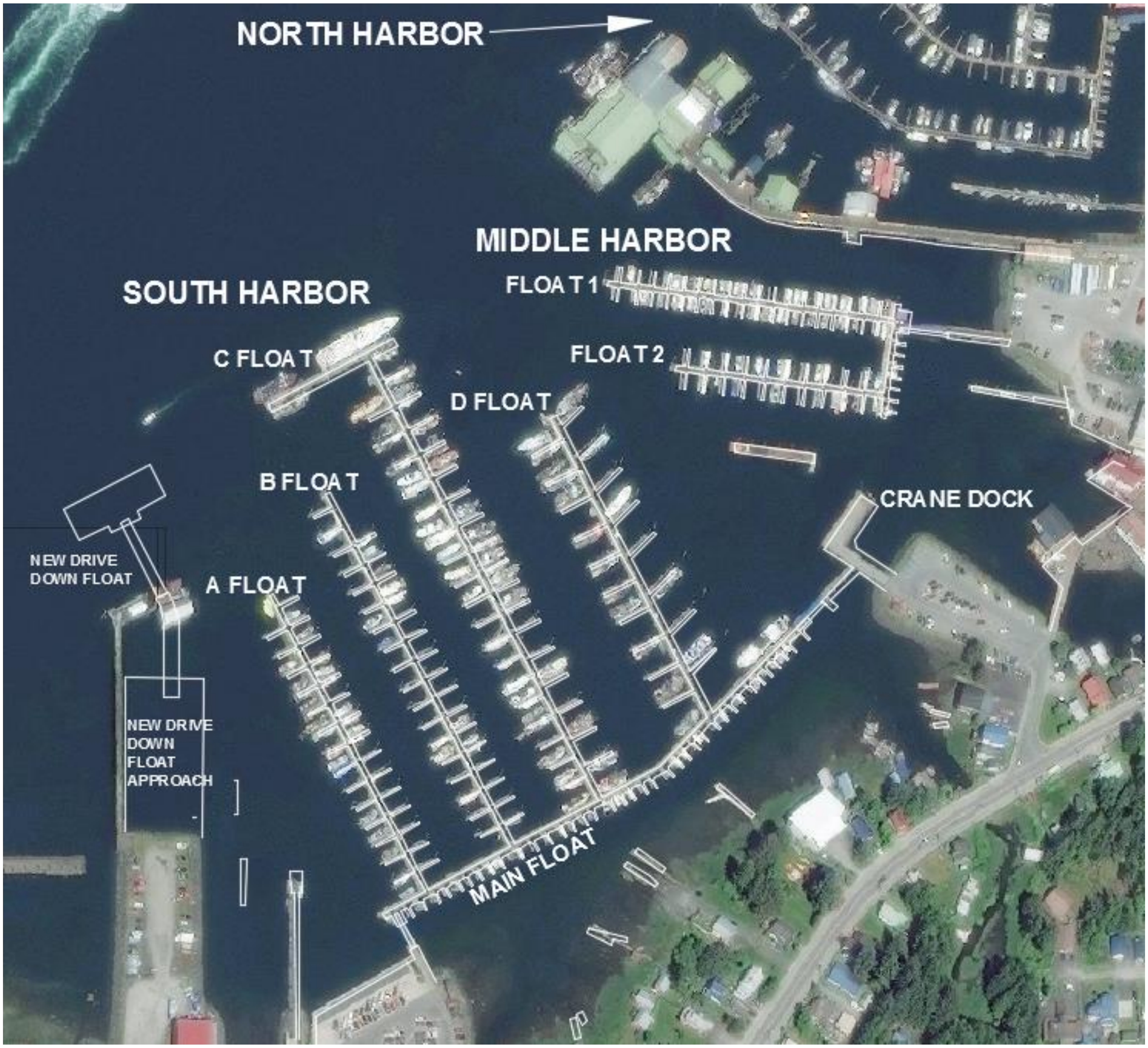


FIGURE 4 LOCATION OF SOUTH HARBOR, MAIN DOCK, CRANE DOCK, AND C&D FLOATS

2.0 CLIMATOLOGY, METEOROLOGY, HYDROLOGY

2.1 Temperature and Precipitation

Petersburg falls within the southeast maritime climate zone, characterized by cool summers, mild winters and heavy rain throughout the year. Summer temperatures range from 57-63° F. Winter temperatures range from 36 to 49° F. Average annual precipitation is 109 inches, and average annual snowfall is 77 inches (TABLE 1).

Table 1 MONTHLY CLIMATE SUMMARY PETERSBURG, ALASKA

PERIOD OF RECORD: 1981-2010, PROVIDED BY THE NATIONAL CLIMATE DATA CENTER

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	36.2	38.3	42.4	49.5	56.5	61.9	64.0	63.2	57.0	48.9	40.4	36.3	49.6
Average Min. Temperature (F)	26.0	27.1	29.6	34.1	40.4	46.3	49.2	48.2	44.0	38.1	30.9	27.2	36.8
Average Total Precipitation (in.)	11.48	7.36	8.45	6.04	5.92	4.94	5.21	7.20	13.65	15.71	12.22	11.05	109.23
Average Total SnowFall (in.)	21.9	16.1	16.9	0.7	0.0	0.0	0.0	0.0	0.0	0.6	9.1	11.4	76.7

2.2 Ice Conditions

Petersburg is ice free year round.

2.3 Tides

Petersburg is in an area of semi-diurnal tides with two high waters and two low waters each lunar day. The tidal parameters in Table 2 were determined using National Oceanic and Atmospheric Administration published data for Turn Point (approximately 1 mile southwest of Petersburg) published June 2009 for the tidal epoch 1983-2001. There was no reported highest observed water level and no lowest observed water level.

Table 2 Tidal Parameters – Petersburg

Parameter	**Elevation (ft)**
Highest Predicted Tide	19.69
Mean Higher High Water (MHHW)	16.07
Mean Sea Level (MSL) *	8.34
Mean Tide Level (MTL) **	8.34
Mean Lower Low Water (MLLW)	0.00
Lowest Predicted Tide	-4.15

*MSL The arithmetic mean of hourly heights observed over the National Tidal Datum Epoch. Shorter series are specified in the name; e.g. monthly mean sea level and yearly mean sea level.
**MTL The arithmetic mean of mean high water and mean low water.

2.5 Water Level

The effect of an increase in water level needs to be evaluated when designing a navigation project. Water level increase is typically a result of wave set up, storm surge, inverted barometer effects, and tide. Relative sea level rise is a longer term change in water level and its effects on a project is an additional factor that needs to be considered in design of navigation improvements.

Wave Setup

Wave setup is the water level rise at the coast caused by breaking waves. The features of this project extend beyond the area of breaking waves so wave set up was not considered in the calculations for the Petersburg Navigation Improvement project.

Storm Surge

Storm surge is an increase in water elevation caused by a combination of relatively low atmospheric pressure and wind driven transport of seawater over relatively shallow and large unobstructed waters. Friction at the air-sea interface is increased when the air is colder than the water, which causes more wind-driven transport. Storm induced surge can produce short term increases in water level, which can rise to an elevation considerably above tidal levels. Petersburg experiences low pressure events that could contribute to storm surge, but the water is too deep to stack up and cause a significant surge. A rise in the water elevation due to surge has not been a problem reported at Petersburg, so no storm surge was used in the calculations for the project.

Inverted Barometer

The inverted barometer is the response of the sea surface to changes in atmospheric pressure. A high pressure system decreases sea level, and conversely, low atmospheric pressure results in sea level rise. Generally, a 1 millibar change in pressure results in a 1 cm change in the water surface. To compensate for a lowered water level due to a high pressure system the lowest astronomic tide was used when determining the dredge depth.

Tide

The mean higher high tide of 16.07 feet was used for the high water elevation.

Sea Level Rise

The Corps of Engineers requires that planning studies and engineering designs over the project life cycle, for both existing and proposed projects consider alternatives that are formulated and evaluated for the entire range of possible future rates of sea-level change (SLC), represented by three scenarios of “low,” “intermediate,” and “high” sea-level change. The SLC “low” rate is the historic SLC. The “intermediate” and “high” rates are computed using the following:

Estimate the “intermediate” rate of local mean sea-level change using the modified National Research Council’s (NRC) Curve I and the NRC equations. Add those to the local historic rate of vertical land movement.

Estimate the “high” rate of local mean sea-level change using the modified NRC Curve III and NRC equations. Add those to the local rate of vertical land movement. This “high” rate exceeds the upper bounds of the Intergovernmental Panel on Climate Change (IPCC) estimates from both 2001 and 2007 to accommodate potential rapid loss of ice from Antarctica and Greenland.

NRC Equations

The 1987 NRC described these three scenarios using the following equation:

$$E(t) = 0.0012t + bt^2$$

in which t represents years, starting in 1986, b is a constant, and $E(t)$ is the eustatic sea-level change, in meters, as a function of t. The NRC committee recommended “projections be updated approximately every decade to incorporate additional data.” At the time the NRC report was prepared, the estimate of global mean sea-level change was approximately 1.2 mm/year. Using the current estimate of 1.7 mm/year for GMSL change, as presented by the IPCC (IPCC 2007), results in this equation being modified to be:

$$E(t) = 0.0017t + bt^2$$

The three scenarios proposed by the NRC result in global eustatic sea-level rise values, by the year 2100, of 0.5 meters, 1.0 meters, and 1.5 meters. Adjusting the equation to include the historic GMSL change rate of 1.7 mm/year and the start date of 1992 (which corresponds to the midpoint of the current National Tidal Datum Epoch of 1983-2001), results in updated values for the variable b being equal to 2.71E-5 for modified NRC Curve I, 7.00E-5 for modified NRC Curve II, and 1.13E-4 for modified NRC Curve III. The three GMSL rise scenarios are depicted in Figure 5.

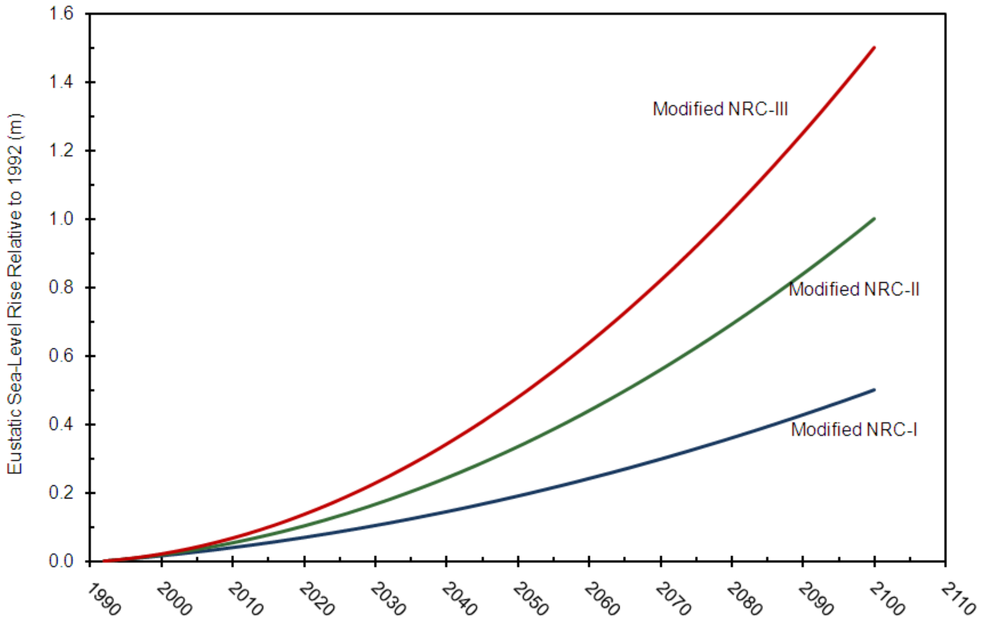


FIGURE 5 SCENARIOS FOR GMSL RISE (BASED ON UPDATES TO NRC 1987 EQUATION).

Manipulating the equation to account for the fact that it was developed for eustatic sea level rise starting in 1992, while projects will actually be constructed at some date after 1992, results in the following equation:

$$E(t2) - E(t1) = 0.0017(t_2 - t_1) + b(t_2^2 - t_1^2)$$

where t_1 is the time between the project's construction date and 1992 and t_2 is the time between a future date at which one wants an estimate for sea-level change and 1992 (or $t_2 = t_1 +$ number of years after construction) . For the three scenarios proposed by the NRC, b is equal to 2.71E-5 for Curve 1, 7.00E-5 for Curve 2, and 1.13E-4 for curve 3.

There is no sea level trend data for Petersburg. Guidance in Appendix C of Engineering Circular (EC) 1165-2-212 recommends that in the absence of site specific data, the next closest long term gage be used. NOAA has sea level trends published for Juneau, Sitka, and Ketchikan, Alaska, which are the closest stations to Petersburg (Figure 2). The sea level trend for Juneau is -0.51 inches/year, Sitka is -0.092, and Ketchikan is -0.013 inches/year.

For this study a static rate of sea level change was used. For an assumed construction start in 2019 and a fifty year project life, a project at Petersburg could see sea level fall by as much as 2.12 feet (-2.12 feet sea level rise) or rise much as 1.90 feet (Table 3-Table 5). Any fall in sea level will be managed with maintenance dredging to ensure design depth.

TABLE 3 SEA LEVEL RISE PREDICTION FOR JUNEAU FOR A 50 YEAR PROJECT LIFE.

Sea Level Change	Low	Intermediate	High
	-2.12 feet	-1.66 feet	-0.19 feet

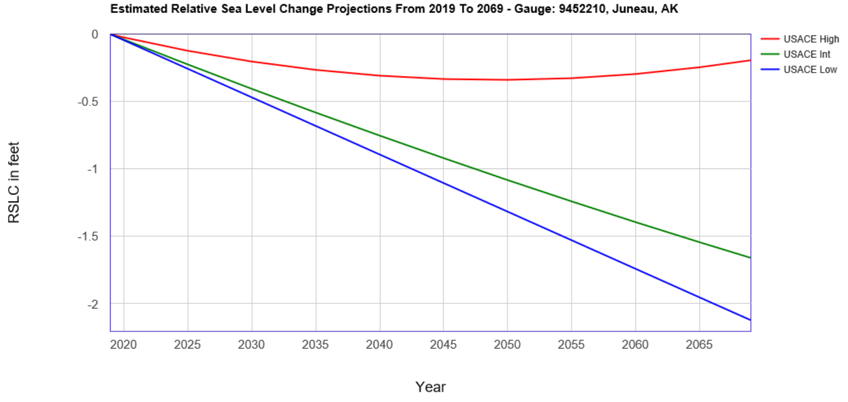


TABLE 4 SEA LEVEL RISE PREDICTION FOR SITKA FOR A 50 YEAR PROJECT LIFE.

Sea Level Change	Low	Intermediate	High
	-0.34 feet	0.13 feet	1.59 feet

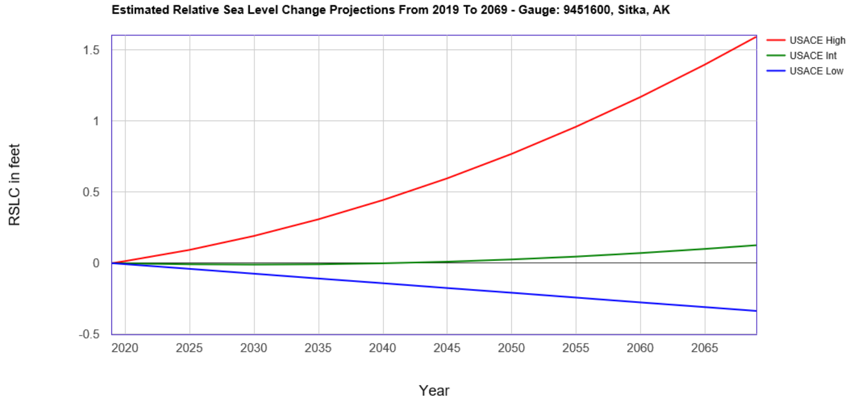
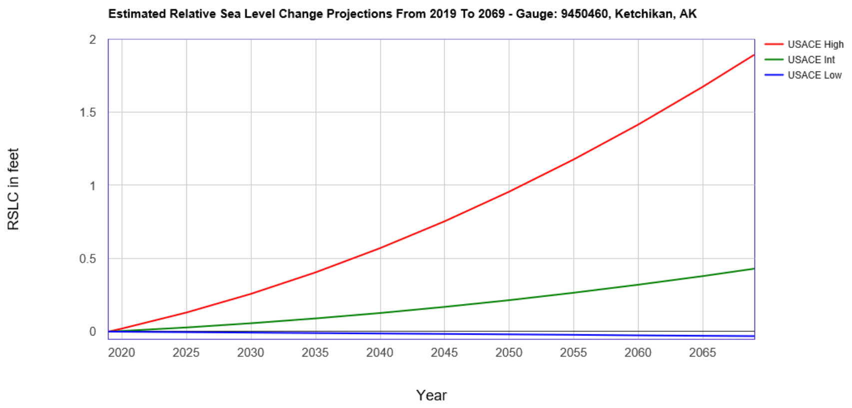


TABLE 5 SEA LEVEL RISE PREDICTION FOR KETCHIKAN FOR A 50 YEAR PROJECT LIFE.

Sea Level Change	Low	Intermediate	High
	-0.03 feet	0.43 feet	1.90 feet

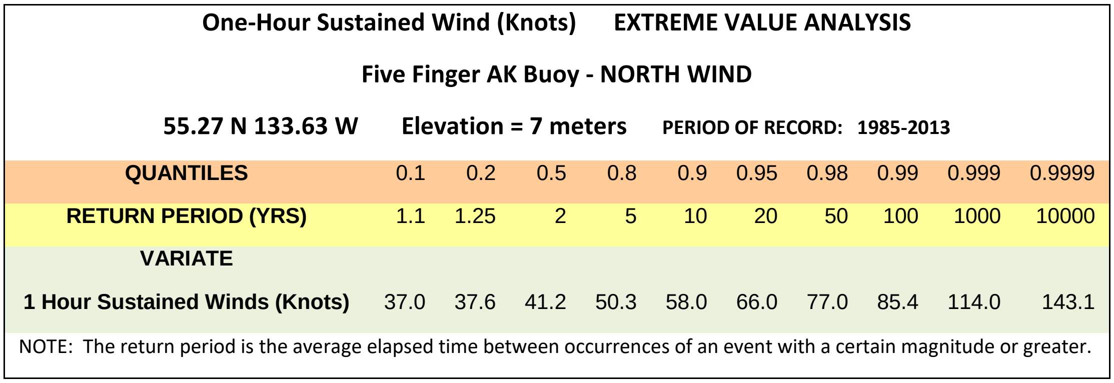

Estimated Relative Sea Level Change Projections From 2019 To 2069 - Gauge: 9450460, Ketchikan, AK
RSLC in feet
2
1.5
1
0.5
0
2020
2025
2030
2035
2040
2045
2050
2055
2060
2065
Year
USACE High
USACE Int
USACE Low

2.6 Wind

The wind speeds presented in Table 6 and Table 7 were developed by Air Force Combat Climatology Center using historical wind speeds from the Five Finger Coastal-Marine Automated Network (C-MAN) at the Five Finger lighthouse (Figure 6). The Five Fingers data represents unobstructed wind speeds.

FIGURE 6 LOCATION OF C-MAN STATION USED FOR WIND DATA

TABLE 6 NORTH WIND SPEED EXTREMAL ANALYSIS



One-Hour Sustained Wind (Knots) EXTREME VALUE ANALYSIS

Five Finger AK Buoy - NORTH WIND

55.27 N 133.63 W Elevation = 7 meters PERIOD OF RECORD: 1985-2013

QUANTILES	0.1	0.2	0.5	0.8	0.9	0.95	0.98	0.99	0.999	0.9999
RETURN PERIOD (YRS)	1.1	1.25	2	5	10	20	50	100	1000	10000
VARIATE										
1 Hour Sustained Winds (Knots)	37.0	37.6	41.2	50.3	58.0	66.0	77.0	85.4	114.0	143.1

NOTE: The return period is the average elapsed time between occurrences of an event with a certain magnitude or greater.

TABLE 7 SOUTH WIND SPEED EXTREMAL ANALYSIS

One-Hour Sustained Wind (Knots) EXTREME VALUE ANALYSIS

Five Finger AK Buoy - SOUTH WIND

55.27 N 133.63 W Elevation = 7 meters PERIOD OF RECORD: 1985-2013

QUANTILES	0.1	0.2	0.5	0.8	0.9	0.95	0.98	0.99	0.999	0.9999
RETURN PERIOD (YRS)	1.1	1.25	2	5	10	20	50	100	1000	10000
VARIATE										
1 Hour Sustained Winds (Knots)	39.8	40.1	42.9	50.8	57.7	65.1	75.2	83.1	110.0	137.5

NOTE: The return period is the average elapsed time between occurrences of an event with a certain magnitude or greater.

2.7 Rivers and Creeks in the Project Vicinity

Hammer Slough feeds into the area to be dredged. This slough appears to be the main supply of sediment that settles in the harbors. The frequency of infilling for this project is assumed to be similar to the USACE dredging in the north harbor (Figure 7) which was dredged in 1971, and 42 years later in 2013 maintenance dredging removed approximately 27,000 cubic yards of material.

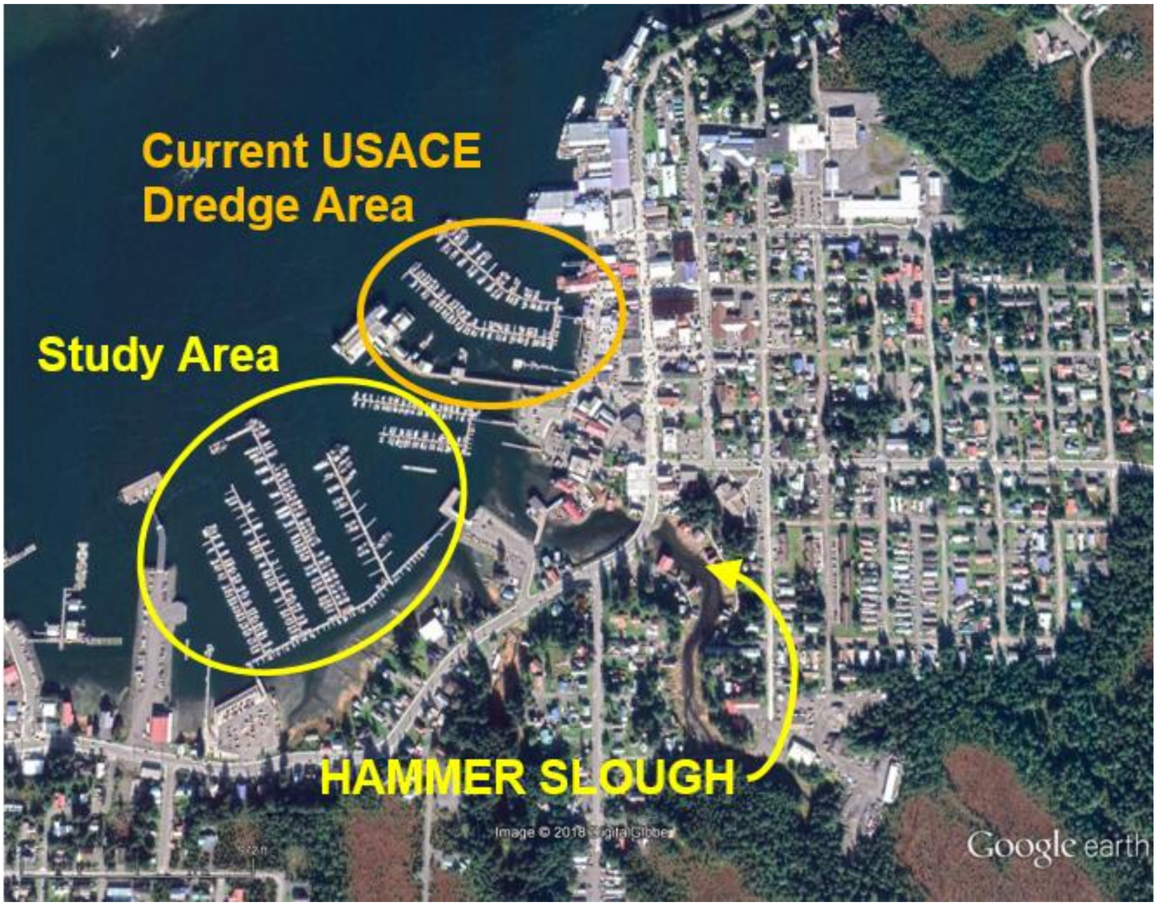


FIGURE 7 LOCATION OF HAMMER SLOUGH, CURRENT USACE DREDGE AREA, AND STUDY AREA

3.0 DESIGN CRITERIA

3.1 Design Vessel

The economic analysis generated the design vessel for this study. The design vessel is a hybrid of the National Geographic *Sea Lion* (length and beam) and a Seiner with a 12 foot draft. The characteristics of the design vessel is shown in Table 8.

TABLE 8 DESIGN SHIP CHARACTERISTICS

Vessel Length [ft]	**Design Beam [ft]**	**Design Draft [ft]**
164	33	12

3.2 Dredge Depth

Moving vessels must maintain clearance between their hulls and channel bottom; accordingly, various navigational design parameters are analyzed. Design parameters such as squat, safety clearance, vertical motion due to waves, and water density effects are added to determine the minimum required under-keel clearance (Figure 8).

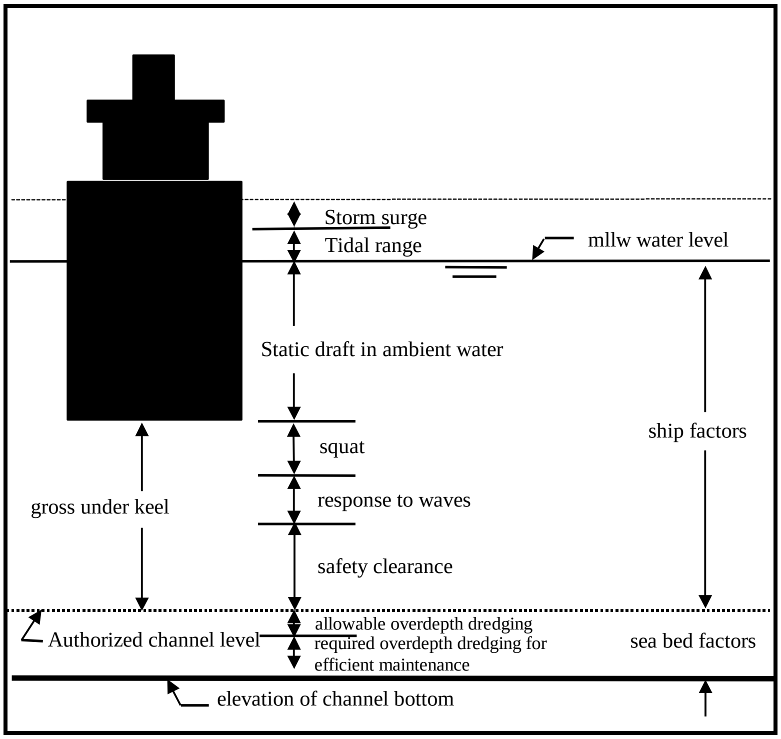


FIGURE 8 UNDER-KEEL CLEARANCE PARAMETERS

The maneuvering channel depth to the crane dock was determined using the criteria listed in Table 9. The lowest astronomical tide is -4.15 feet MLLW which results in a depth of -19.25 feet MLLW which is usable 100% of the time.

Within the fairway area between floats C and D the squat and pitch, roll, and heave requirement is not necessary so required harbor depth reduces to -18 feet

TABLE 9 MANEUVERING CHANNEL CRITERIA	
Vessel Draft [ft]	12.0
Pitch, Roll, Heave [ft]	0.6
Squat [ft]	0.5
Tide Allowance [ft]	4.15
Safety Clearance	2.0
Total depth required [ft]	19.25

The dredge depth landward of the main float would reduce to -10 feet MLLW due to the reduced vessel draft of the smaller boats (approximately 3.5 feet). The local sponsor requested that a fourth dredge area be dredged to -9 feet MLLW at the back of the Middle Harbor in order to trap the sediment accumulated from the Hammer Slough discharge (Figure 9). The estimated dredge volume for each area is presented in Table 10.

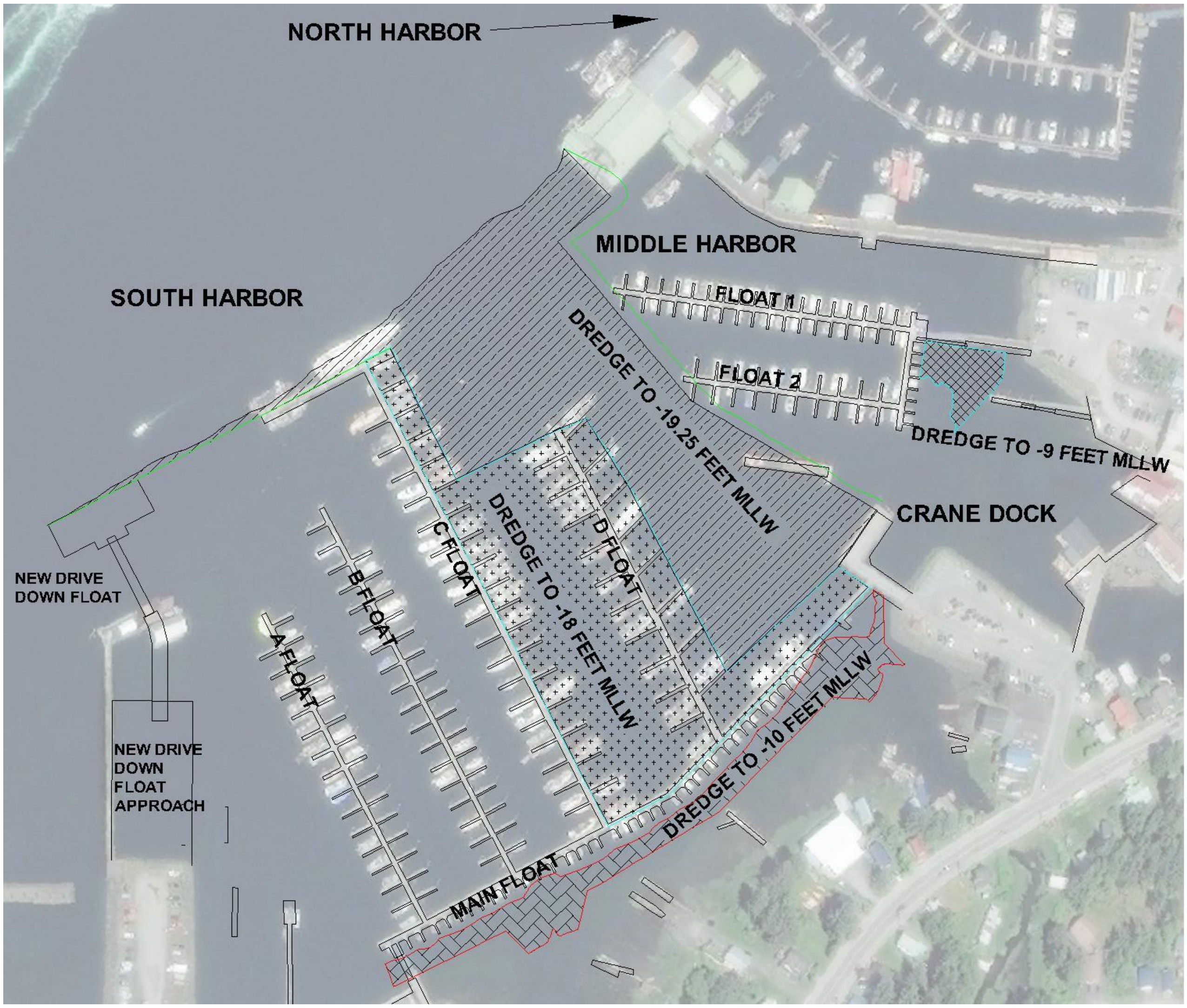


FIGURE 9 DREDGE AREAS

TABLE 10 DREDGE VOLUMES AND AREAS

Dredge Area	Dredge Depth [ft]	Dredge Volume [cy]	Dredge Area [sf]	One Foot Overdepth Allowance [cy]	Total Dredge Volume [cy]
Maneuvering Channel	-19.25	33,750	322,074	11,930	45,680
Between C and D Floats	-18	5,820	237,369	8,800	14,620
Landward of Main Float	-10	17,370	62,390	2,320	19,690
Behind Floats 1 and 2	-9	2,370	10,191	380	2,750
Total		59,310		23,410	82,740

4.0 DREDGE DISPOSAL OPTIONS

Dredge disposal options evaluated include

- open water disposal or,
- contained disposal at Scow Bay.

4.1 Open Water Disposal

A determination on open water disposal will be made upon completion of the Section 404 (b) (1) evaluation in accordance with the Guidelines of the Clean Water Act to evaluate discharge of dredged material into waters of the United States. The Guidelines outline measures to avoid, minimize, and compensate for impacts. The areas being evaluated are Fredrick Sound approximately 2 miles from Petersburg and Thomas Bay located approximately 20 miles from Petersburg (Figure 10). It is assumed for this study that one of these sites will be allowed for disposal.

FIGURE 10 LOCATION OF PETERSBURG, FREDRICK SOUND, AND THOMAS BAY POTENTIAL DISPOSAL SITES

4.2 Contained Disposal

The contained disposal at Scow Bay would be combined with construction of a deeper water boat launch ramp. The launch ramp would need protection from waves from the south. Options considered for vessel protection during launching and landing include:

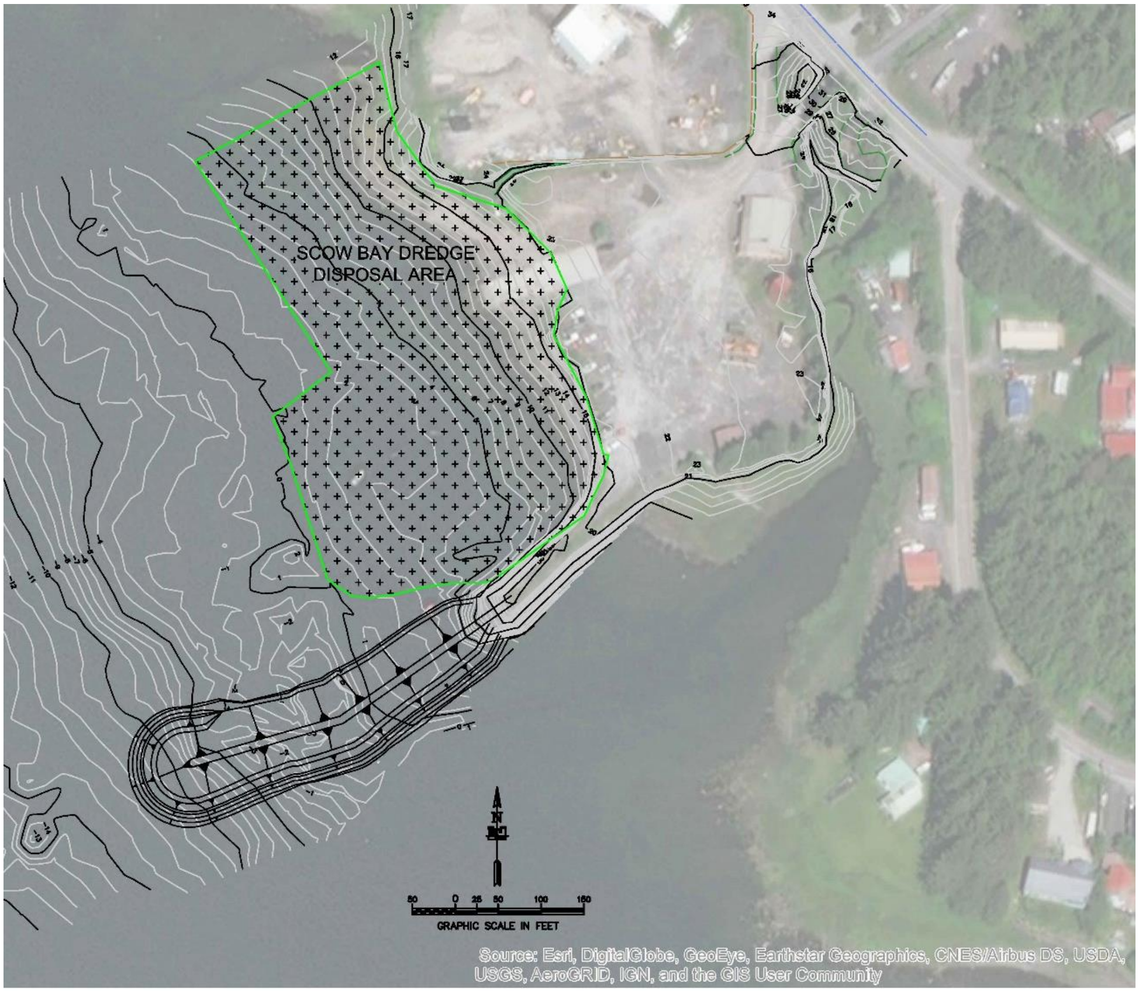
- Floating Breakwater
- Rubble mound breakwater

Floating Breakwater

A floating breakwater consists of a floating structure that can provide wave protection for short period waves with heights up to 4 feet. A floating breakwater is anchored with chain or piles. Because the design wave at Scow Bay is greater than 4 feet, a floating breakwater was dropped from further consideration.

Rubble Mound Breakwater

A rubble mound breakwater is already present at Scow Bay to protect a boat launch ramp. This rubble mound would be extended to protect the contained disposal area and a new boat launch ramp that would be constructed (Figure 11). The use of a rubble mound breakwater to provide wave protection is a proven concept. Rubble mound breakwaters have been successfully used in southeast Alaska.



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

FIGURE 11 PLAN VIEW OF DREDGE DISPOSAL AREA AND PROTECTIVE BREAKWATER

5.0 BREAKWATER DESIGN PARAMETERS

5.1 WAVE ANALYSIS

5.1.1 Wave Climate

The wave climate at a proposed dredge disposal area at Scow Bay was evaluated to determine the effort required to develop this area for disposal. The area is subject to short period wind generated waves from the south. Currently there is a single breakwater at Scow Bay that protects a small launch ramp from south waves. There is no protection for waves from the north or west.

5.1.2 Fetch

The coastline at Scow Bay is oriented generally north to south. The fetch was calculated using the average length of nine radial lines at 3 degree spacing, extending from Scow Bay area to the shoreline (Figure 12). The average fetch was determined to be 3.1 miles.

FIGURE 12 FETCHES USED IN DESIGN

5.1.3 Wave Prediction

The 72.6 year return interval wind from the south (derived from Table 7) was used to determine the design storm wave corresponding to a 50 year design life with a 50% probability of being equaled or exceeded (Figure 13). Methods described in the Coastal Engineering Manual (CEM) were used to predict wave height based on a fetch distance of 3.1 miles and a wind speed of 78.8 knots.

The significant wave from the south is 6.2 feet and the average height of the highest 1/10 of waves (H_{10}) is 7.9 feet. The design wave from the north was not calculated due to the short fetch distance.

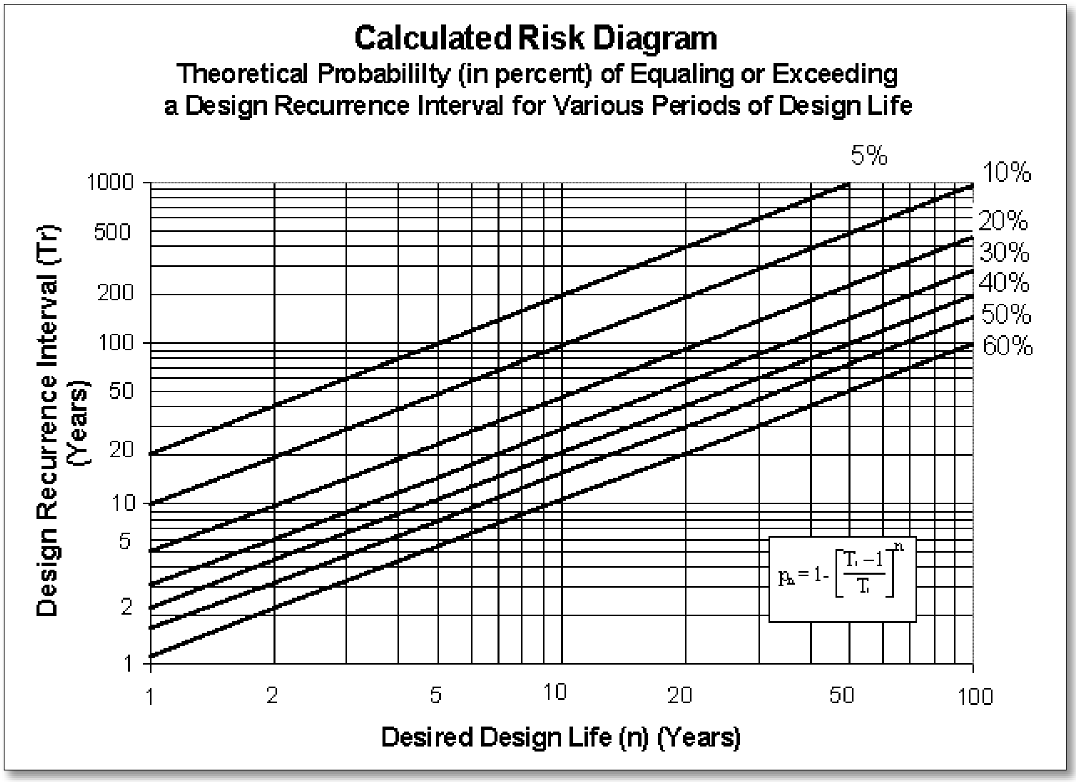


FIGURE 13 CALCULATED RISK DIAGRAM

5.2 Rubble Mound Design

5.2.1 Armor Stone

Using Hudson's equation for a wave of 7.9 feet from the south and a K_d of 3.2 results in an average armor stone size of 4270 pounds and a two layer thickness of 6.5 feet.

5.2.3 Crest Height

The crest height was set at 25 feet using equation VI-5-13 in the Coastal Engineering Manual and an exceedance level of 10% to determine run-up. The mean higher high water level of 16 feet was used as the still water level. Storm surge was not included in the calculations since storm surge in not typically an issue at Petersburg. The crest width was set at 9.5 feet based on armor stone size. A typical breakwater cross section is shown in Figure 14.

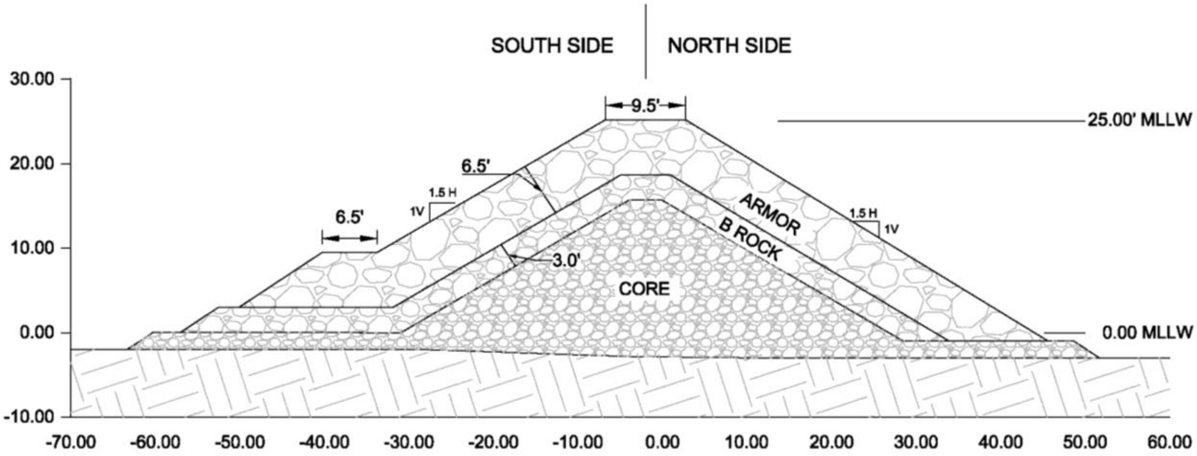


FIGURE 14 TYPICAL CROSS SECTION

6.0 MAINTENANCE

The main source of sediment in the North, Middle, and South harbors appears to be sediment from Hammer Slough. Bathymetric survey of the area indicates that the Slough flow is channelized and directed towards Middle and North Harbor. The frequency of infilling and need to dredge for this project is assumed to be similar or less than the infilling in the North Harbor. USACE dredged the North Harbor in 1971 and, 42 years later, in 2013 maintenance dredging removed approximately 27,000 cubic yards of material.

The assumption that the maintenance dredging requirement would be similar to the North Harbor was checked by comparing the current bathymetric survey to a 1983 project layout sheet from the State of Alaska Department of Transportation that shows the bathymetry in South Harbor. The comparison indicates that South Harbor has had 20,000 cubic yards of sedimentation in 34 years. This compares well with the North Harbor dredging requirement.

7.0 CONSTRUCTION CONSIDERATIONS

Prior to preparing plans and specifications, a survey of the dredge areas and Scow Bay should be performed to verify project quantities. In addition to survey work, soil borings should be obtained to confirm that the material is suitable for its selected disposal method. The nature of the obstructions identified during the 2017 survey of the South Harbor should be identified to aid in planning for proper disposal of the obstructions.

The dredging is anticipated to take one year to complete. Dredging activities will need to be closely coordinated with the Petersburg harbormaster in order to efficiently dredge in an active harbor. It is assumed that the dredge window will be similar to the window for the North Harbor dredging which stipulated that no in-water work will be performed between 15 March and 15 June in order to avoid the peak herring spawn and juvenile salmon out-migration and rearing activities, and when Steller sea lion and humpback whale feeding and abundance is expected to be greatest in the project area.

In order to attract a number of bidders, it is recommended that the project be advertised early in the year to maximize the number of contractors to bid on this project.

8.0 REFERENCES

American Society of Civil Engineers Task Committee on Maninas. 2012. *Planning and Design Guidelines for Small Craft Harbors, Revised Edition.* New York: American Society of Civil Engineers.

ASCE Task Committee on Marinas 2020. 2012. *Planning and Design for Small Craft Harbors: Third Edition.* ASCE.

U.S Army Corps of Engineers. 1984. "EM 1110-2-1615 Hydraulic Design of Small Boat Harbors."

U.S. Army Corps of Engineers. 2008. "Coastal Engineering Manual."

U.S. Army Corps of Engineers. 1984. "Shore Protection Manual."

Petersburg Navigation Improvements

Appendix C: Economics

Petersburg, Alaska

September 2018

US Army Corps
of Engineers
Alaska District

CONTENTS

FIGURES

TABLES

1. OVERVIEW

Figure 1. Petersburg, Alaska and Municipal Harbors, Courtesy: Wild Iris Photography

1.1 Executive Summary

The economic analysis presented in this appendix evaluates a final array of four alternatives for improving navigation in Petersburg, Alaska. The alternatives include non-structural reorganization of the Petersburg harbor system, dredging South Harbor only, dredging South Harbor and developing a haul-out facility at Scow Bay, and dredging South Harbor and developing a new harbor at Scow Bay. The U.S. Army Corps of Engineers (USACE) evaluated a range of benefit scenarios based on the expected portion of commercial fishing and subsistence vessels impacted by depth constraints during low-tide cycles.

Based on the preliminary National Economic Development (NED) analysis, the recommended plan is Alternative 3, South Harbor Dredging Only, with a benefit–cost ratio (BCR) of 2.77 and average annual net benefits of approximately $698,000. Under all benefit scenarios considered, the recommended plan is economically justified with a BCR ranging from 1.24 to 4.53, and net annual benefits of $95,000 to $1.4 million. Results of the NED analysis are summarized in Table 1 and Table 2 below.

Table 1. Summary of Costs and Benefits by Alternative

Alternative	**Present Value Benefits**[1]	**Average Annual Benefits**	**Present Value Costs**	**Average Annual Costs**	**Net Annual Benefits**	**Benefit-Cost Ratio**
1	N/A	N/A	N/A	N/A	N/A	N/A
2	$35,645,000	$1,320,000	$62,453,000	$2,313,000	–$993,000	0.57
3	$29,478,000	$1,092,000	$10,631,000	$394,000	$698,000	2.77
4	$74,540,000	$2,761,000	$51,366,000	$1,903,000	$858,000[2]	1.45
5	$79,598,000	$2,948,000	$51,366,000	$1,903,000	–$546,000	0.84

Notes:

1. This table shows benefits for the "most likely" benefit scenario considered, which was estimated through Monte Carlo simulations. The BCR for Alternative 3 ranges from 1.2 to 4.5 based on the portion of vessels affected during low-tide cycles.
2. Alternative 4 meets the study objectives and provides additional opportunities for development of marine infrastructure in Scow Bay, resulting in higher net benefits than Alternative 3. In addition to producing the benefits estimated for Alternative 3, this alternative would result in additional transportation cost savings to vessels currently using haul-out facilities at other harbors in the region.

Table 2. Sensitivity Analysis for Recommended Plan (Alternative 3)

Scenario[1]	**Present Value Benefits**	**Average Annual Benefits**	**Present Value Costs**	**Average Annual Costs**	**Net Annual Benefits**	**Benefit-Cost Ratio**
Low	$13,9205,000	$489,000	$10,631,000	$394,000	$95,000	1.24
Mid	$24,831,000	$920,000	$10,631,000	$394,000	$526,000	2.34
Most Likely	$29,478,000	$1,092,000	$10,631,000	$394,000	$698,000	2.77
High	$48,078,000	$1,782,000	$10,631,000	$394,000	$1,388,000	4.53

Notes:

1. Scenarios are based on the assumed portion of vessels impacted during low-tide cycles (low = 25%, mid = 50%, high = 100%). The most likely scenario is based on Monte Carlo simulations. Given that most vessels run multiple gear types and essentially fish year round, it is likely that a larger portion of vessels would be affected during each low-tide cycle and would benefit from the proposed navigation improvements.

1.2 Introduction

The purpose of this economic analysis is to evaluate whether the proposed navigation improvements at Petersburg, Alaska, are economically justified. This analysis is conducted from a National Economic Development (NED) perspective where NED benefits are defined as the change in value of goods and services that accrue to the Nation as a whole as a result of constructing the project. National Economic Development costs are defined as the total economic costs of constructing and maintaining the project. The average annual economic benefits of the project are compared to the average annual economic costs to provide an estimated benefit–cost ratio. A project with a benefit–cost ratio greater than 1.0 is considered economically justified. Guidance is contained in USACE Engineering Regulation (ER) 1105-2-100, specifically in the appendices on economic and social considerations, the USACE Civil Works program, and the USACE Continuing Authorities Program, as well as recent Economic Guidance Memoranda (EGMs) issued by Headquarters USACE.

1.3 Project Location and Description

Petersburg is located on the northwest end of Mitkof Island, where the Wrangell Narrows meet Frederick Sound. It lies midway between Juneau and Ketchikan, about 120 miles from either community (Figure 2 and Figure 3).

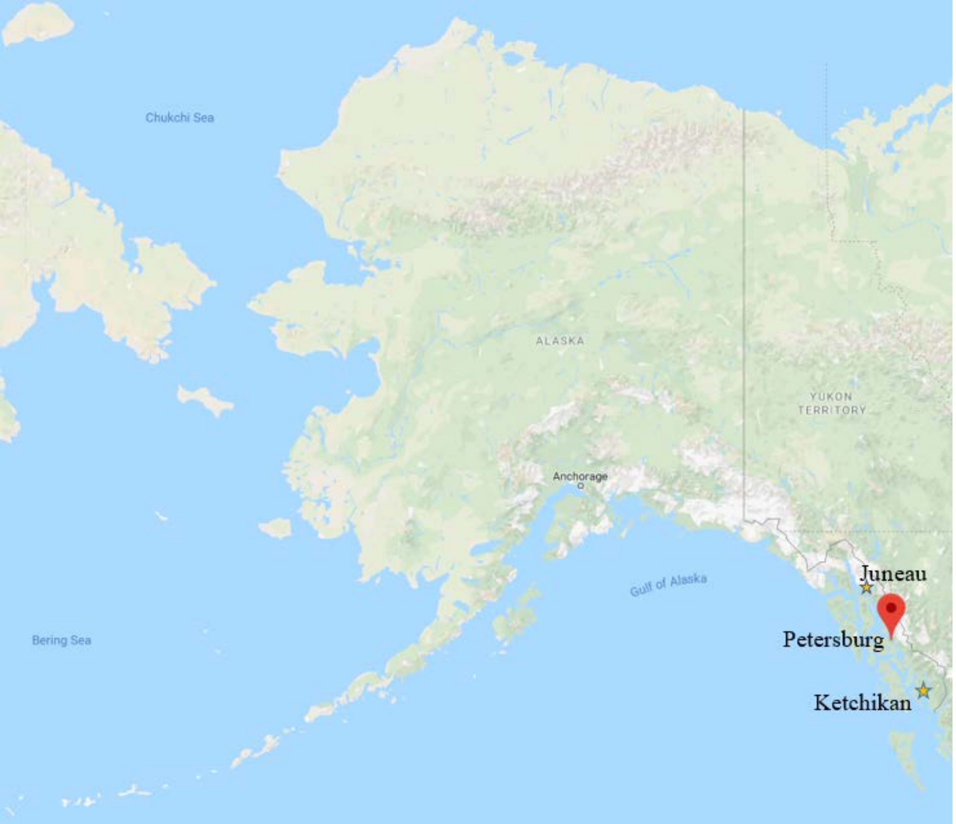


Figure 2. Location of Petersburg in Alaska

Figure 3. Petersburg's location in relation to Juneau and Ketchikan

Petersburg was founded over 100 years ago by Norwegian fishermen and is one of Alaska's major commercial fishing communities. In 2013, the City of Petersburg was dissolved and the Petersburg Borough was formed. The borough encompasses about 3,800 square miles of land and water. The majority of this land is federally owned and managed as the Tongass National Forest. The majority of borough residents live on Mitkof Island, which is not connected to any mainland road system. All people and goods move via ferry, container barge, airplane, or boat.

The formation of the borough has brought new community development, fiscal, and partnership responsibilities. These include expanding public services to new residents, considering and planning for future use of large areas of undeveloped or underdeveloped lands, and the acquisition of additional facilities including harbor facilities that support the area's fishing industry.

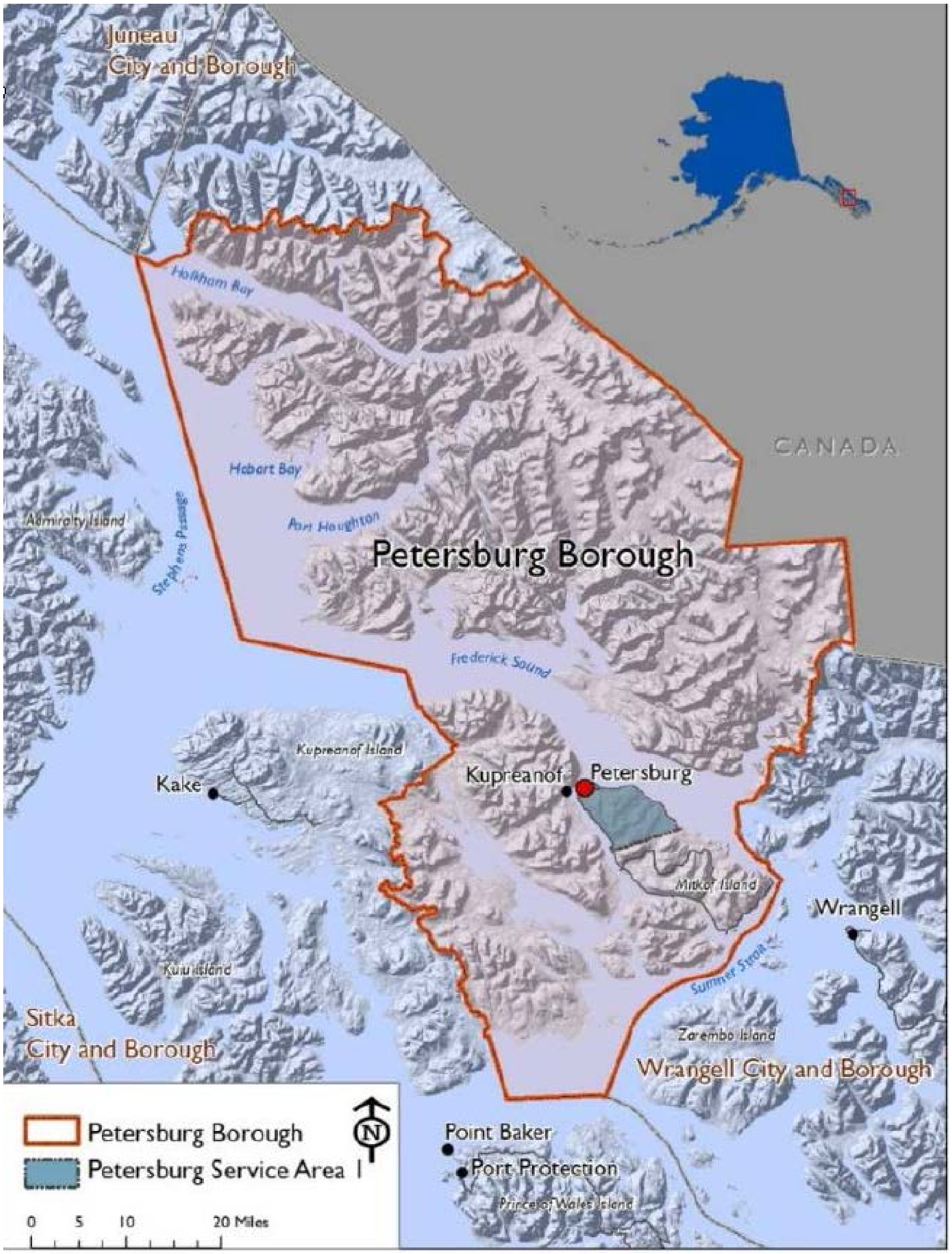


Figure 4. Petersburg Borough

1.4 Problems and Opportunities

The primary problem identified in this analysis is transportation inefficiency related to ocean-going vessels' ability to navigate the Petersburg harbor system; tidal ranges vary widely, and these vessels are unable to access public use facilities. Lack of sufficient depths result in vessels anchoring offshore, occupying other than assigned moorage areas, and remaining docked until sufficient depth exists to safely navigate the harbor system and access fishing grounds.

Insufficient depths and existing marine infrastructure within the Petersburg harbor system cause transportation inefficiencies and limit access for commercial fishing and subsistence activities, creating economic inefficiencies for the region and Nation.

The following opportunities have been identified:

- Improve access for commercial and subsistence vessels
- Reduce life and human safety risks
- Increase regional economic activities
- Increase regional employment opportunities
- Reduce damage to catch and dead-loss, which is caused by delays and contamination.

Catch and dead-loss refer to fish, crab, or other species caught by commercial fishermen that may die in transit to the processing facility due to increased wait times and inability to access the facility during low tidal stages. Contamination refers to catch sitting in the cargo hold for extended periods of time in stagnant water, which can affect the quality of the product.

2. MARINE RESOURCES

2.1 Introduction

The level of economic activity in Petersburg has been closely linked to the fishing industry since the town’s inception. The Petersburg harbor system primarily supports commercial fishing vessels and operations.[1] Therefore, demand for harbor facilities depends on the viability of fishery resources in the region. This section describes the fisheries in the Petersburg area including historical catch and values, fisheries management institutions and practices, and expectations for the future.

Fisheries management in the State of Alaska is divided into four large geographic regions: Southeast, Central, Westward, and Alaska-Yukon-Kuskokwim (Figure 5).

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[1] Over 90 percent of vessels using Petersburg Harbor facilities are commercial vessels.

Figure 5. Alaska Commercial Fisheries Management Regions

Petersburg falls within the Southeast Alaska/Yakutat region (Region 1), which consists of Alaska waters between Cape Suckling to the north and Dixon Entrance to the south (Figure 6).

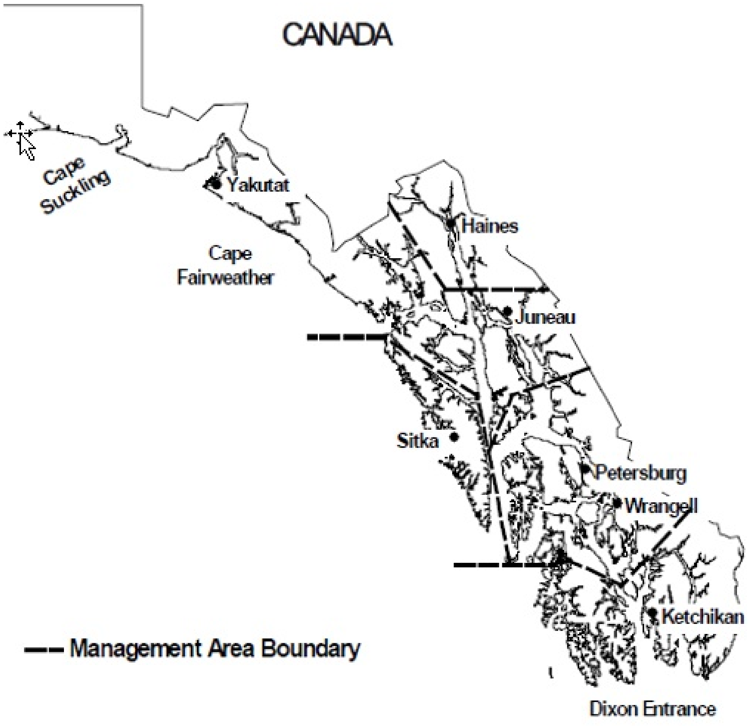

Figure 6. Southeastern Alaska/Yakutat Region (Region I)

2.2 Commercial Fisheries Overview

Commercial use of salmon resources in Southeast Alaska began in the late 1870s. Until the early 1900s, sockeye salmon was the primary species harvested. Pink salmon began to dominate the harvest in the early 1900s and, during the past decade, have made up about 70 percent of the region’s total salmon harvest. The relative order of production from highest to lowest is generally pink, chum, coho, sockeye, and Chinook salmon.

Salmon are commercially harvested in Southeast Alaska with purse seines and drift gillnets; in Yakutat with set gillnets; and in both areas with hand and power troll gear. Herring are harvested in winter bait, sac roe, spawn-on-kelp, and bait pound fisheries. Miscellaneous shellfish (sea cucumber, sea urchins, and geoduck clams) are harvested in dive fisheries in the region. The Alaska Department of Fish and Game (ADF&G) has management jurisdiction over all groundfish resources within state waters in Region I. The State also has management authority for Demersal Shelf Rockfish, ling cod, and black and blue rock fish in both state and federal waters. There are several commercially important shellfish species in Southeast Alaska. They include golden and red king crab, Dungeness crab, Tanner crab, and pandalid shrimp.

2.3 Historical Catch and Value

Petersburg is a small town but a major port. In 2016, the National Marine Fisheries Service estimated approximately 41 million pounds of seafood were landed in Petersburg with an ex-vessel value of $37 million. This makes Petersburg the 21st largest port by volume for total commercial fishery landings in the Nation.[2] These figures are down slightly from 2015 when 69.6 million pounds were landed with an ex-vessel value of $39.3 million. Over the last decade, the record harvest occurred in 2013 when over 122 million pounds of seafood were landed in Petersburg with an ex-vessel value of $73 million. This made Petersburg the 12th largest port by value and 17th largest by volume in the Nation for that year. Harvest data and ex-vessel values are shown in Table 3.

Table 3. Total Commercial Fish Landings and Value for Petersburg, Alaska, 2007-2016

Year	Rank (by Value)	Millions of Pounds	Millions of Dollars	Millions of Dollars, Inflation-Adjusted
2007	16	75.4	$41.7	$50.4
2008	26	34.7	$26.8	$31.0
2009	22	55.4	$30.7	$35.0
2010	24	49.9	$36.3	$40.1

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[2] National Marine Fisheries Service, Total Landings by Port, 2016. https://www.st.nmfs.noaa.gov/commercial-fisheries/commercial-landings/other-specialized-programs/total-commercial-fishery-landings-at-an-individual-u-s-port-for-all-years-after-1980/index

2011	14	101.1	$68.8	$74.8
2012	20	52.0	$50.0	$53.1
2013	12	122.6	$73.0	$75.2
2014	24	64.7	$50.9	$51.6
2015	26	69.6	$39.3	$39.7
2016	29	41.0	$37.0	$37.2

Source: National Marine Fisheries Service

2.4 Commercial Fisheries Outlook

The fishing industry in Petersburg and Southeast Alaska is considered strong and is expected to continue to support demand for moorage and other harbor facilities in Petersburg. Fishery activities will continue to fluctuate as resource abundance varies, regulations change, or technological breakthroughs are made. Overall, the biological stock is healthy, and the presence of multiple land-based processing plants in Petersburg offers opportunities for commercial fishermen to timely deliver and process catch for shipping while the harvest is fresh. In short, Petersburg has been and will continue to be a fishing town.

3. SOCIOECONOMICS

3.1 Demographic Profiles

Petersburg is located on the northwest end of Mitkof Island, where the Wrangell Narrows meet Frederick Sound in Southeast Alaska. Table 4 provides population data for the United States, Alaska, and Petersburg Borough over the last 20 years for which data is available.

Table 4. Population Comparisons: United States, Alaska, Petersburg Borough

Area	**% Change 2000–2016**	**2016**	**2010**	**2000**
United States	14.8%	323,127,513	308,745,105	281,421,906
Alaska	18.3%	741,894	710,231	626,932
Petersburg Borough	–0.9%	3,196	2,948	3,224

Source: 2000 Census, 2010 Census, 2016 Population Estimate; Census Bureau

An estimated 3,196 residents lived in the Petersburg Borough in 2016. This represents a population increase of 8.4 percent since 2010 and a decrease of 0.9 percent since 2000. It should be noted that Petersburg has many transient workers during the fish processing season who are not counted by the U.S. Census, so these population estimates can be considered conservative.

Based on 2016 census estimates, 74.8 percent of Petersburg residents are white; 10.4 percent are Hispanic or Latino; 7.5 percent are American Indian or Alaska Native; and 4.4 percent of residents are Asian. In the state of Alaska, 65.6 percent of residents are white; 6.7 percent are Hispanic or Latino; 14.1 percent are American Indian or Alaska Native; and 6 percent are Asian. Table 5 displays racial demographics for the Petersburg Borough, state, and Nation.

Table 5. Population by Race

	Petersburg Borough	**Alaska**	**United States**
Total	3,196	736,855	318,558,162
White alone	74.8%	65.6%	73.3%
Black or African American alone	2.3%	3.3%	12.6%
American Indian and Alaska Native alone	7.5%	14.1%	0.8%
Asian alone	4.4%	6.0%	5.2%
Native Hawaiian and Other Pacific Islander alone	0.6%	1.2%	0.2%
Two or more races	8.3%	8.5%	3.1%
Hispanic or Latino	10.4%	6.7%	17.3%
White alone, not Hispanic or Latino	67.0%	62.0%	62.0%

Source: 2012–2016 American Community Survey 5-Year Estimates, Census Bureau

3.2 Employment & Income

In 2016, approximately 79 percent of the Petersburg Borough population was 16 years old and older. Of that population, 69.2 percent was in the labor force. The unemployment rate for the borough was 9.1 percent, above both the State of Alaska rate of 7.8 percent and the United States rate of 7.4 percent.[3] Table 6 lists occupational data for the study area.

Table 6. Civilian Labor Force by Occupation

	Petersburg Borough	**Alaska**	**United States**
Civilian employed population 16 years old and older	1,632	357,098	148,001,326
OCCUPATION			
Management, business, science, and arts occupations	471 / 28.9%	132,669 / 37.2%	54,751,318 / 37.0%
Service occupations	199 / 12.2%	62,844 / 17.6%	26,765,182 / 18.1%
Sales and office occupations	268 / 16.4%	79,782 / 22.3%	35,282,759 / 23.8%

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[3] U.S. Census Bureau, 2012-2016 American Community Survey 5-Year Estimates

Farming, fishing, and forestry occupations	242 / 14.8%	3,668 / 1.0%	1,062,331 / 0.7%
Construction, extraction, maintenance, and repair occupations	182 / 11.2%	37,664 / 10.5%	12,440,120 / 8.2%
Production, transportation, and material moving occupations	270 / 16.5%	40,471 / 11.3%	18,542,291 / 12.2%

Source: 2012–2016 American Community Survey 5-Year Estimates, Census Bureau

In 2016, the median household income in Petersburg was $63,940, below the State of Alaska median income of $74,444 and above the National median income of $55,322. The mean household income was $82,803. Table 7 shows the number of households in Petersburg Borough, Alaska, and the United States and the percentage of each by their respective incomes.

Table 7. Family Income Comparisons

	Petersburg Borough	Alaska	United States
Total Households	1,237	250,235	117,716,237
Less than $10,000	5.0%	3.7%	7.0%
$10,000 to $14,999	6.1%	3.4%	5.1%
$15,000 to $24,999	10.1%	7.1%	10.2%
$25,000 to $34,999	7.9%	7.0%	9.9%
$35,000 to $49,999	7.8%	11.4%	13.2%
$50,000 to $74,999	21.3%	17.9%	17.8%
$75,000 to $99,999	11.9%	14.8%	12.3%
$100,000 to $149,999	15.6%	19.2%	13.5%
$150,000 to $199,999	9.8%	8.8%	5.4%
$200,000 or more	4.5%	6.8%	5.7%

Source: 2012–2016 American Community Survey 5-Year Estimates, Census Bureau

4. ECONOMIC ANALYSIS

4.1 Purpose and Scope

The purpose of this economic analysis is to evaluate alternatives to reduce transportation inefficiencies within the Petersburg harbor system. The alternatives considered would reduce delays caused by waiting for favorable tides to enter and exit the harbor as well as improve opportunities to participate in subsistence activities.

4.2 General Methodology

The basic methodology utilized in the economic analysis and compilation of this report consisted of three steps. First, the USACE reviewed published information about the history, present status, future prospects for harbor operations and vessel traffic management at Petersburg. Next, local port officials, harbor users, and maritime specialists operating in Petersburg were interviewed to gain a better understanding of the navigation problems and potential benefits that could result from a navigation improvements project. Finally, selection and description of NED benefits and related construction and life cycle costs were made for the proposed improvement alternatives that appear cost effective and achievable.

This report assesses NED benefits of the alternatives identified in the Project Alternatives section and follows the methodology for small boat harbor navigation analysis described in the Planning Guidance Notebook[4] and other relevant Corps of Engineers regulations and policy guidance. Benefits equal the difference between Without- and With-Project costs associated with transportation delays, enhanced access for subsistence activities, and utilization of unemployed or underemployed labor resources during project construction.

All costs were calculated using Fiscal Year (FY) 2018 (October 2017) price levels and then converted to Average Annual Equivalent (AAEQ) values using the FY 2018 Federal discount rate of 2.750 percent, assuming a 50-year period of analysis. Costs and benefits for each alternative were then compared to determine economic justification. The plan that reasonably maximizes net benefits (benefits less cost) is the NED plan.

4.3 Existing Conditions

The following sections describe current conditions at Petersburg.

4.3.1 Tidal Range

Petersburg is in an area of semi-diurnal tides with two high waters and two low waters each lunar day. The tidal parameters in Table 8 were determined using National Oceanic and Atmospheric Administration published data for Turn Point (approximately 1 mile southwest of Petersburg) published June 2009 for the tidal epoch 1983-2001. There was no reported highest observed water level or lowest observed water level.

Table 8. Petersburg Tidal Parameters

Parameter	Elevation (feet)
Highest Predicted Tide	19.69
Mean Higher High Water (MHHW)	16.07
Mean Sea Level (MSL) *	8.34
Mean Tide Level (MTL) **	8.34
Mean Lower Low Water (MLLW)	0.00
Lowest Predicted Tide	–4.15

*****MSL – The arithmetic mean of hourly heights observed over the National Tidal Datum Epoch. Shorter series are specified in the name; e.g., monthly mean sea level and yearly mean sea level.
******MTL – The arithmetic mean of mean high water and mean low water.

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[4] https://planning.erdc.dren.mil/toolbox/library/ERs/entire.pdf

4.3.2 Marine Facilities

As one of Alaska’s major commercial fishing communities, there are multiple marine facilities around Petersburg that provide general moorage and other services to the fishing fleet. The majority of Petersburg Borough residents live on Mitkof Island and most of the commercial fish landings take place in Petersburg. This analysis focuses on facilities in Petersburg Harbor and Scow Bay where insufficient depths and marine infrastructure result in transportation inefficiencies for the commercial and subsistence vessels using these facilities. Existing marine facilities within the Petersburg harbor system have been constructed and reconstructed over a period of many years, with facilities ranging in age from nearly new to over 30 years old. Aside from USACE dredging in North Harbor that originally occurred in 1971 and again in 2013, marine infrastructure improvements described in this section were performed by the Petersburg Borough Port and Harbor Department (or at their direction). For more information on the waterfront facilities on Mitkof Island, please see the Borough’s Waterfront Master Plan.[5] Much of the information presented in this section is summarized from that plan.

Petersburg is accessed by air and water. It is on the mainline state ferry route and has ferry terminals on the north and south ends of Mitkof Island (Figure 6). The State-owned James A. Johnson Airport has a runway for scheduled jet service and small plane charter services. Lloyd R. Roundtree Seaplane Base (on the Wrangell Narrows) allows for float plane services.

Harbor facilities include a petroleum wharf, barge terminals, three boat harbors (i.e. the “Petersburg harbor system”) with moorage for approximately 700 boats, a boat launch, and a boat haul-out. Freight arrives by barge, ferry, or cargo plane. Remote areas of the borough are served by small state-owned boat docks at Papke's Landing in the Wrangell Narrows, on Kupreanof Island at the City of Kupreanof, and in Hobart Bay. Boat launch ramps are located on the south end of Mitkof Island at Banana Point, Blaquerie Point, and Woodpecker Cove. The State-owned Mitkof Highway carries traffic north and south and is paved or chip-sealed for 28 miles between the South Mitkof Ferry Terminal and the airport.

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[5] Petersburg Borough Waterfront Master Plan, 2016.

Figure 7. Mitkof Island

4.3.2.1 Petersburg Harbor System

The Petersburg harbor system comprise three contiguous areas along the downtown waterfront: the North Harbor between Icicle Seafoods and Ocean Beauty Seafoods, the Middle Harbor located south of Ocean Beauty Seafoods, and the South Harbor that extends between Middle Harbor and the drive-down dock (Figure 7).

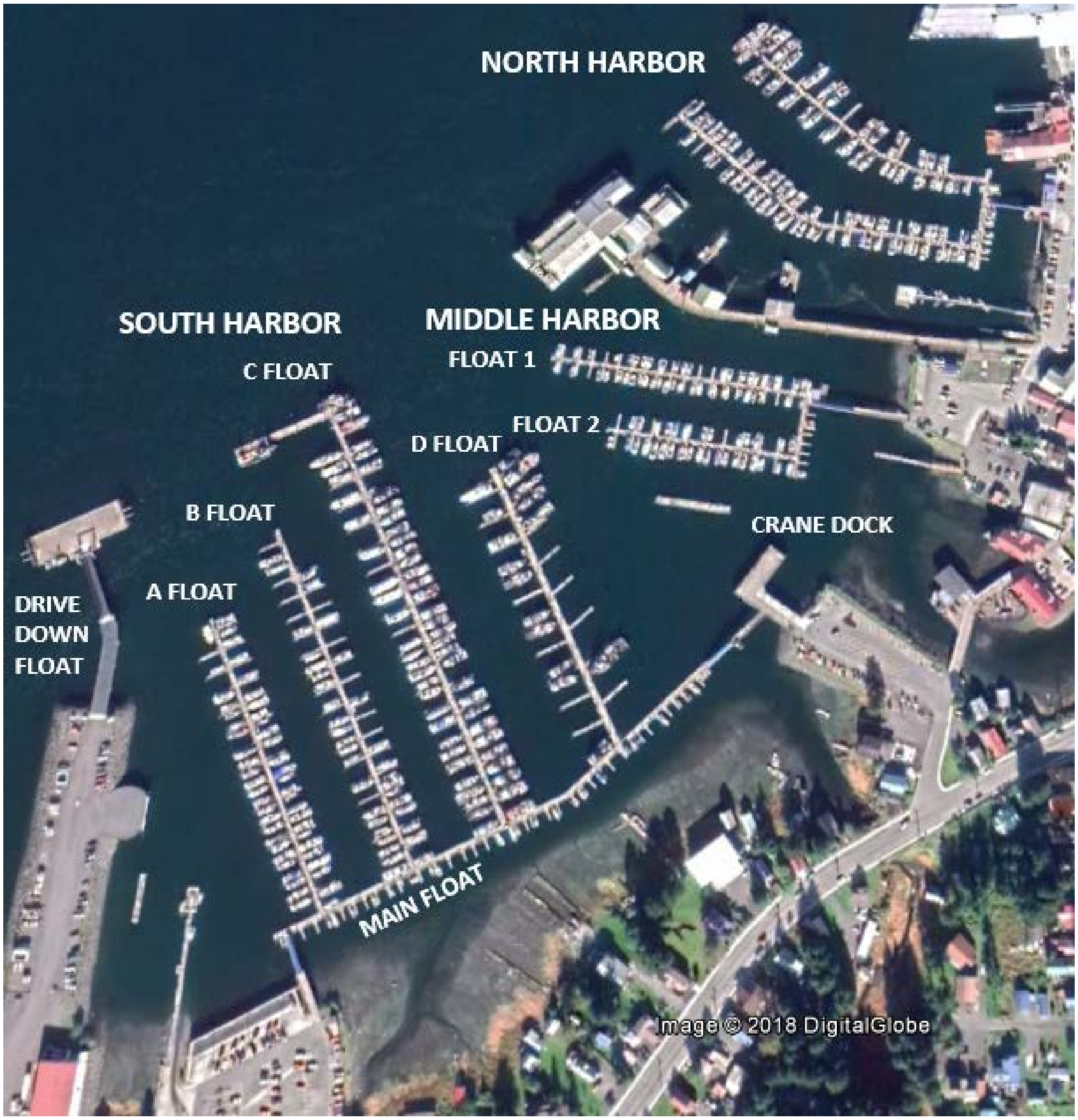

Figure 8. Petersburg Harbor System

Petersburg's harbors were primarily developed to serve the regional commercial fishing industry. In addition to the floating docks, it is home to three major fish processors and two small processors, a U.S. Coast Guard (USCG) mooring station, a seaplane base, a fuel dock, and various public and private marine services. The harbor is also home to a substantial recreational fishing fleet that generally uses slips during the summer season and hauls out during the off-season. In recent years, tourism, yachts, and mini-cruise ship calls have contributed to Petersburg harbors' activity.

North Harbor

Petersburg North Harbor is bounded to the north by the Icicle Seafoods processing plant and to the south by the Ocean Beauty Seafoods processing plant and pier (Figure 8). Trident Seafoods also operates a small processing plant within North Harbor. The North Harbor has two main floats with a connecting float that joins them. These floats support approximately 120 berths ranging in length from 18 to 75 feet. Several longer mooring positions are used for transient vessels along the outside margin of the end floats.

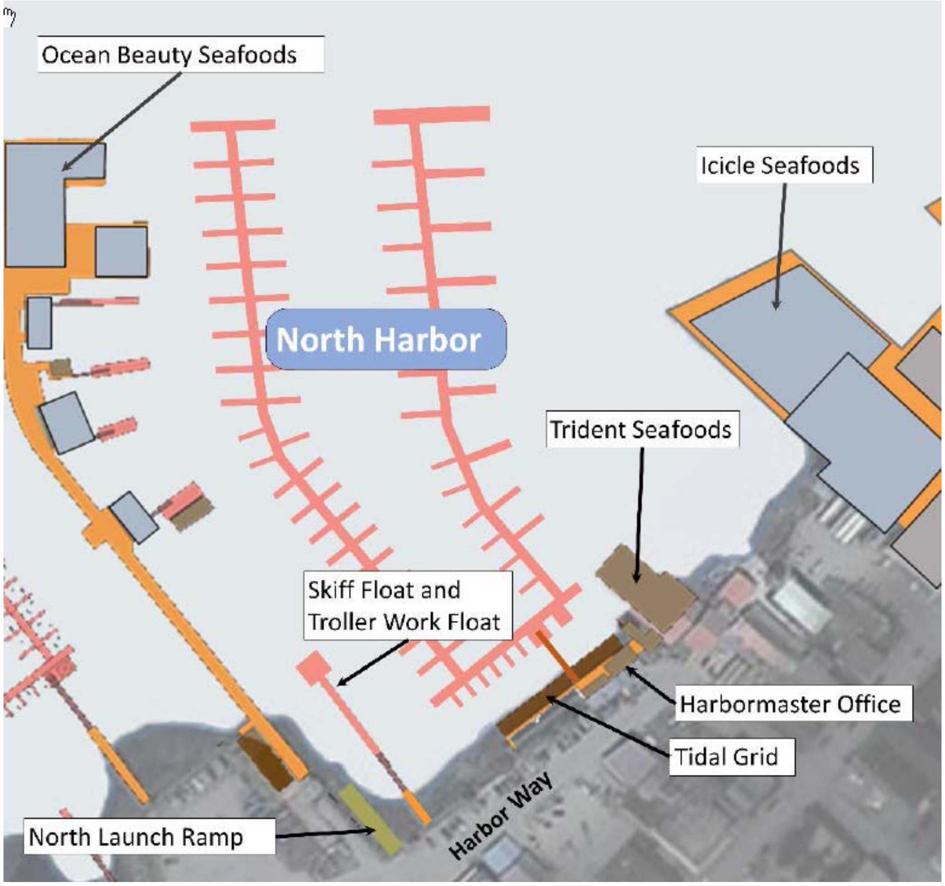

Figure 9. North Harbor

In addition to the processing plants and berths, the North Harbor has a 136-foot skiff float for Borough residents arriving by small vessels from Kupreanof Island and other surrounding communities. It also has a tidal grid of staked timbers for maintenance of commercial vessels up to 42 feet in length. The tidal grid is approximately 200 feet long and is primarily used for cleaning boat hulls below waterline. The North Harbor launch ramp, a timer ramp at the south side of the North Harbor, requires periodic maintenance. It is too short to launch boats at low tide, and there is no adjacent dedicated trailer parking.

The last major renovation of North Harbor before 2013 was performed in 1965 when more than 1,700 linear feet (LF) of log float was removed and replaced with more than 17,000 square feet of polystyrene floats. In 2013, the existing headwalk float, both mainwalk floats, all stall (“finger”) floats, and the transient float were removed, along with all existing timber pile. Also demolished was an existing steel gangway, 215 LF of existing timber deck, and 37 LF of existing catwalk adjacent to the harbor office, as well as four existing boat grid sleepers and their associated support piles. The entire slip area in North Harbor was dredged and a new approach dock, gangway, and float system was installed in a layout that increased the average north dock berth length.

Middle Harbor

Middle Harbor is bounded to the north by the Ocean Beauty Seafoods processing plant and to the south by the Petersburg Harbor crane dock (Figure 9). The Middle Harbor has two mainwalks joined by a connecting float. These floats support approximately 137 berths ranging in length from 18 to 32 feet. In addition to the processing plant and berths, Middle Harbor has a 150-foot work float for maintenance of nets and gear. An 84-foot privately owned boarding float is under lease to the ADF&G. At the south end of Middle Harbor, the Petersburg Harbor Department maintains a 120-foot public crane dock for fishing boat gear change. Hammer Slough, a tidal drainage through the center of Petersburg, empties into the harbor between the ADF&G float and the crane dock.

The last major renovation of Middle Harbor before 2005 took place around 1975 when the skiff float in the adjacent North Harbor was extended to relieve grounding issues at low tides. The area around the exiting floats in Middle Harbor was also dredged to improve accessibility. In 2005, the exiting headwalk float, both mainwalk floats, and all stall (“finger”) floats were removed, along with all existing pile. Also demolished were an existing gangway, a portion of the existing timber approach dock, and associated support piles. A new gangway and float system was installed in a layout similar to that which had been demolished.

In 2012, the bulkhead at the landward end of the existing timber approach trestle suffered a partial failure. The Harbor Department executed field-expedient repairs to the bulkhead to prevent continued loss of backfill. In 2015, the Harbor Department replaced a section of the mainwalk float due to damage incurred by a vessel strike. The remaining existing element of construction of immediate concern is the timber approach trestle, which will need to be either upgraded or replaced at some point.

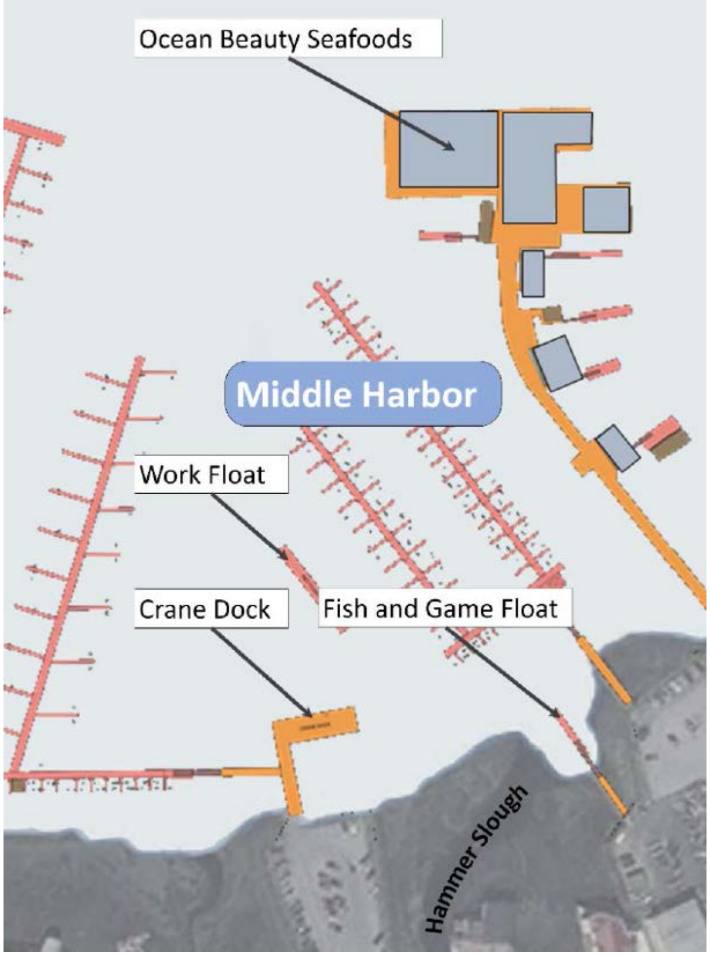

Figure 10. Middle Harbor

South Harbor

South Harbor is bounded to the north by the crane dock and to the south by the drive-down dock (Figure 10). South Harbor includes Floats A, B, C, and D with a connecting float joining them. These floats support 242 berths ranging in length from 40 to 100 feet. Several longer mooring positions for transient vessels and small cruise ships are available on the Pier C end float. On the land side of the South Harbor connecting float, 74 berths (20-foot fingers) have been constructed for skiffs and small boats on the order of the 18 feet in length.

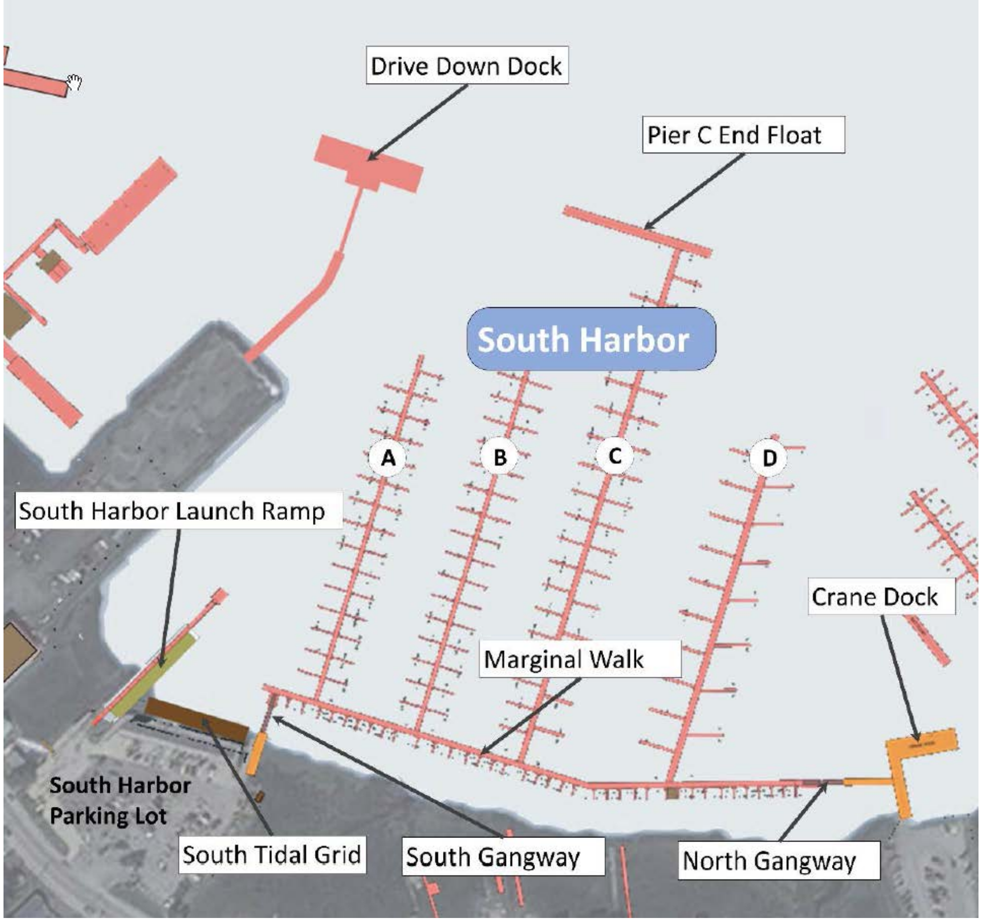

Figure 11. South Harbor

The South Harbor connecting float has two access gangways, one extending from the crane dock and one that connects to the South Harbor parking lot. Both gangways are elevated to allow small boats that berth along the back of the connecting float for egress at high tide. At the south end of the harbor, the Harbor Department maintains a single-lane concrete launch ramp and boarding float. This ramp is usable in all but the most extreme tidal conditions. There is limited trailer parking adjacent to this ramp. South Harbor also has a 195-foot steel tidal grid located parallel to the parking lot that is designed to take larger vessels up to 100 feet in length.

South Harbor improvements constructed in 1984 include the current 12-foot x 84-foot access ramp approach and a 7.5-foot x 65-foot steel access ramp, mainwalk Float A and Float D, extension of mainwalk Float B and Float C with additional finger floats, 200 feet of new vessel repair grid, and upland harbor improvements. In 1999, mainwalk Floats A, B, and C were replaced and additional finger floats added along each extension. The existing transient float was also installed at the end of mainwalk Float C. In 2000, approximately 850 LF of existing timber approach trestle and a timber dock, and approximately 400 LF of an existing fuel dock approach trestle, were demolished. Dredging occurred over an area of roughly six acres at dredge depths ranging from less than 7 feet to more than 10 feet of material, and a new approach dock was constructed for the fuel dock trestle. The western (channel side) half of Floats A, B, and C were reconstructed with new steel piles and timbers in 2003. In 2003, a new end float was added to the existing south launch to provide space for recreational and subsistence boaters to clean fish and load gear.

Many of the older existing vessel finger floats have begun to lose freeboard, and some are experiencing significant rotational twist along their longitudinal axis. It is anticipated that replacement of these finger floats may be necessary in the near term. Remaining areas of concern include existing finger floats, mainwalk Float D, and the bearing of the existing gangway onto the existing gangway landing float. On the landside of the South Harbor connecting float, the small berths are currently restricted by sedimentation and will require dredging to remain operational throughout the full tidal range. This dredging is also necessary to prevent the connecting float from grounding at low tides and damaging the connections to the main floats. At 65 feet in length, the north and south access ramps are too short to allow them to effectively operate for the normal Petersburg Harbor tidal range.

4.3.2.2 Scow Bay

Scow Bay is an industrial district and small residential neighborhood approximately 2.5 miles south of Petersburg’s downtown along the Mitkof Highway (Figure 11). It is not located within a census designated urban area and is considered a rural area (along with the entire Petersburg Borough).

The Scow Bay site was originally owned by the State of Alaska and used as an amphibious aircraft facility to serve the local population. The facility was abandoned once the State constructed a gravel airstrip in 1969 allowing wheeled planes to land in Petersburg. Currently, a portion of the site is used to store State of Alaska road maintenance equipment, but the remaining marine capital assets exceeded their life expectance many years ago and no effort was made to maintain or repurpose these assets once the facility was deemed redundant.

The existing site is constrained in many ways. The existing haul-out ramp (former seaplane ramp) has a slope that is too shallow for launch and recovery by conventional boat trailers, though it is occasionally used in this capacity by local residents. Particularly, residents from nearby island communities utilize the ramp to gain access to the road system in Petersburg for employment opportunities as well as goods and services.

The site is used occasionally to transport commercial and recreational vessels of about 30 to 40 feet in length out of the water using a commercially-operated submersible hydraulic trailer for winter storage at a yard across the highway. One vessel at a time can be accommodated on the existing site for maintenance activities. The site is exposed to wind and wave action, which limits the days when it is safe to transport vessels on the ramp. The ramp is also too short for use throughout the tidal cycle (at low tide, the bottom of the ramp is dry) so the window of opportunity for haul-outs is relatively small. Further, the site does not have infrastructure to address current federal environmental regulations restricting discharge of heavy metals, fuel, runoff, etc. into marine waters. This poses a risk to continued use of the site even at these limited levels.

In short, vessels utilizing the Scow Bay facilities are making due with transportation infrastructure that is beyond its useful life, being used in ways never envisioned by its designers, doesn't meet environmental standards, provides no safety improvements, and is in disrepair.

Figure 12. Scow Bay

4.3.3 Summary

Existing marine facilities within the Petersburg harbor system have been constructed and reconstructed over a period of many years, with facilities ranging in age from nearly new to over 30 years old.[6] While it is expected that the Petersburg Borough will continue to maintain existing marine facilities, insufficient depths within the harbor system will continue to result in transportation inefficiencies and limit access for commercial fishing and subsistence activities, creating economic inefficiencies for the region and Nation. The following section describes the expected future conditions in Petersburg in the absence of Federal investment in navigation improvements.

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[6] Petersburg Borough Waterfront Master Plan, 2016.

4.4 Without-Project Conditions

4.4.1 Assumptions

Several assumptions were made when conducting the future Without-Project economic analysis. Chief among them is that the existing fishery will continue to support the fleet. This is a critical assumption supported by the fact that fisheries in Alaska are regulated to assure future viability of resources. It is also assumed that the Petersburg harbor system will continue to be a cornerstone of the Petersburg Borough economy. However, absent Federal investment in navigation improvements, insufficient depths and existing marine infrastructure within the harbor system are expected to continue to cause transportation inefficiencies and limit access for commercial fishing and subsistence activities. Finally, it is assumed that a haul-out facility and/or harbor will not be developed in Scow Bay without Federal investment, so vessels will continue to utilize other facilities in the region, resulting in greater distance traveled and time spent to reach such facilities. The expected future levels of these inefficiencies and foregone harvesting opportunities, including their associated future Without-Project costs, are discussed in this section.

It is important to note that approximately 93 percent of vessels using Petersburg harbor facilities are commercial fishing vessels.[7] South Harbor is used primarily by commercial boaters, while most of the shoreline slips in the inland mooring area are used by subsistence and recreational boaters. Depth constraints are expected to affect all commercial fishing vessels moored on Float D (38 vessels) and the north half of Float C (36 vessels), as well as 74 subsistence vessels moored on the main float shown in Figure 12. Based on the makeup of the existing fleet and the fleet expected to use South Harbor over the period of analysis, the design vessel for this study is a hybrid of the National Geographic Sea Lion (length and beam) and a commercial fishing vessel with a 12-foot draft.

Harbor users stated an approximate tide of –1 foot Mean Lower Low Water (MLLW) was the limit of safe navigation within these portions of South Harbor.[8] Tides lower than –1 foot MLLW are assumed to cause delays for vessels moored in these areas while entering and exiting South Harbor. While all 74 commercial fishing vessels and 74 subsistence vessels would be affected if entering or exiting the harbor during low-tide events, not all vessels use the harbor daily due to the different types of fisheries accessed from Petersburg. For example, seiners typically make two round trips per week to access fishing grounds during the summer salmon fishing season, which is the season when the harbor is typically most affected by low tides.[9] Therefore, a range of scenarios was evaluated based on the percent of commercial and subsistence vessels expected to be impacted by depth constraints during low-tide cycles. The most conservative scenario assumes 25 percent of vessels would be affected during each low-tide event, which would likely result in an underestimation of potential benefits. Given that most vessels run multiple gear types and essentially fish year round, it is likely that a larger portion of vessels would be affected

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[7] Petersburg harbormaster.

[8] Based on discussions with Petersburg harbormaster and local fishermen.

[9] According to the Petersburg harbormaster, these vessels typically depart South Harbor on a Wednesday, fish Thursday, return Friday, then depart again Saturday, fish Sunday, and return Monday.

during each low-tide cycle and would therefore benefit from the proposed navigation improvements.

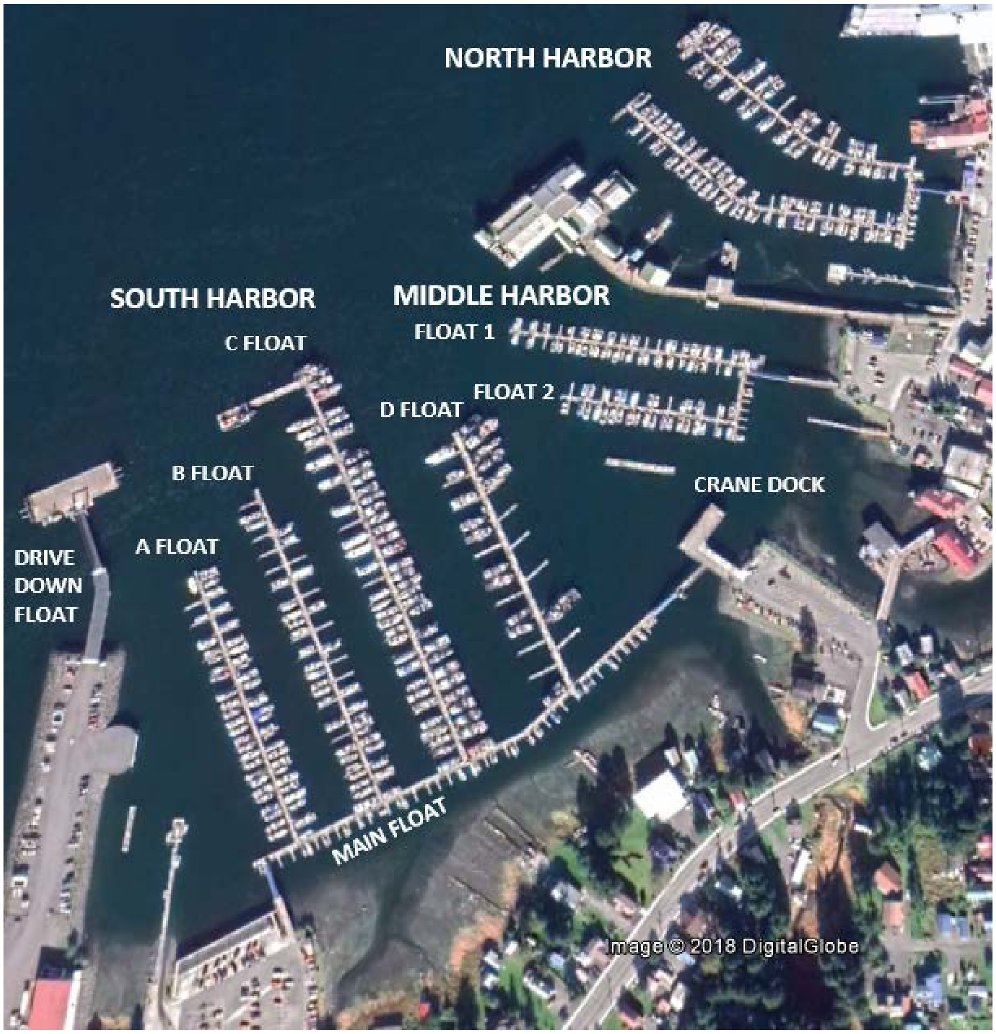

Figure 13. Petersburg Harbor System

Based on focus group interviews with harbor users, depths during lower or minus tides causing vessel delays occur approximately five times during the summer salmon fishing season and impact access to South Harbor for an average of four days at a time. Delays per commercial fishing vessel average five hours. Delays experienced by subsistence vessels range from about two to six hours depending on where vessels can exit the harbor. Delays are about two hours for vessels that can exit at the south end near the drive-down dock, whereas delays for vessels that can exit at the north end of South Harbor near Float D are more similar to the four to six hour delays experienced by the larger vessels on Floats C and D.[10] This analysis conservatively assumes an average delay of two hours for subsistence vessels. This analysis also conservatively assumes vessels would experience delays on half of the days during a low-tide cycle, resulting in

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[10] Conversation with City of Petersburg Community and Economic Development Director on 21 June 2016.

approximately 50 delay hours per commercial vessel and 20 delay hours per subsistence vessel each summer.[11,12] Although vessel delays related to low tides primarily occur during the summer months, which coincides with the commercial salmon fishing season, additional benefits may be realized by reducing delays that occur throughout the rest of the year.

In addition to the delays described above, Petersburg-based vessels must travel to other ports in the region to use haul-out facilities to access vessel work yards and storage yards. While some vessels use existing haul-out facilities at Scow Bay, these facilities have outlasted their useful life and do not meet the needs of the fleet. The closest community to Petersburg is approximately 40 miles away and travel time by boat is approximately four hours each way; however, this yard cannot accommodate all Petersburg vessels plus their own fleet so some Petersburg-based vessels travel further to access such facilities (approximately 120 miles or about 16 hours by water each way). Given the capacity of nearby ports, it is estimated that about 200 Petersburg vessels could be accommodated at the closer distance and the remainder would have to travel further.

Based on data from the State of Alaska Commercial Entry Commission, this analysis assumes 410 vessels would benefit from haul-out facilities at Scow Bay. Petersburg Harbors have approximately 561 slips.[13] Of these, 77 are used by vessels larger than 57 feet that would exceed the capacity of the proposed haul-out facilities at Scow Bay.[14] An additional 74 slips are for vessels under 20 feet that would likely use existing recreational ramps in Petersburg. The remaining 410 vessels are expected to benefit from improved haul-out facilities in Scow Bay, as further described in the next section.

4.4.2 Commercial Fishing

Due to the depth constraints and delays described above, commercial fishing captains and crew members incur additional vessel operating costs (VOCs) and an Opportunity Cost of Time (OCT) while waiting for sufficient depths to safely enter, exit, and maneuver within the harbor system. Moreover, vessels that currently utilize haul-out facilities outside of Petersburg incur additional transportation costs that could be alleviated if haul-out facilities were located in Petersburg.

Vessel Operating Costs

Vessel operating costs for the Petersburg fleet are used to calculate Future-Without Project delay costs and, subsequently, benefits resulting from navigation improvements. Previous Alaska District small boat harbor studies provide the basis for the methodology and assumptions used to develop these estimates. This approach has been used in several Alaska District feasibility

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[11] Delay length per commercial vessel = 5 times per summer x 2 days per occurrence x 5 hours per delay = 50 hours.
[12] Delay length per subsistence vessel = 5 times per summer x 2 days per occurrence x 2 hours per delay = 20 hours.
[13] Petersburg harbormaster.
[14] Alaska Commercial Fisheries Entry Commission Vessel Database, Homeport Petersburg, Alaska, accessed October 9, 2017. http://www.cfec.state.ak.us/plook/#vessels

studies including Craig, Whittier, Valdez, Homer, and Port Lions. The basic framework used in those studies is applicable to Petersburg with changes to input data as appropriate.

Vessel operating costs are based on fixed and variable costs associated with operation. Most fixed costs are calculated as a percentage of vessel investment cost but may also include fees associated with fishing licenses and the cost of fuel, repairs and maintenance, and hourly wages paid to crew members as applicable. It is important to note that in the case of commercial fishing vessels, the captain and crew are paid through crew shares, which vary based on the skill of the crew, the fishery, and the gross harvest value. Crew members earn a share of the harvest value after the cost of fuel, food, and other operating costs are covered. Charter fishing workers are paid hourly so wages are a variable cost. Fixed costs are induced upon the owner of the vessel regardless of productive use. Variable costs occur while the vessel is in operation, including the costs for vessel repair and maintenance, the cost of fuel and lubricating oil, and other such costs. As such, this analysis assumes that fixed expenses for any given vessel operating out of Petersburg will be unchanged with improved navigations, whereas variable expenses for Petersburg vessel operators could change as a result of navigation improvements.

Based on the assumptions described above regarding the portion of the commercial fleet experiencing delays in South Harbor, potential benefits associated with reducing VOCs have a present value of approximately $11.1 million, equating to average annual savings of $410,000 over the period of analysis (74 vessels affected x 50 hours delayed per vessel x $110.73 VOC per hour = $410,000 annual potential savings). Input data including the expected number of vessels that would be delayed, average delay length, and average vessel operating costs per vessel are summarized in Table 9.

Table 9. Potential Vessel Operating Cost Savings: South Harbor Commercial Fishing Vessels

Variable Description	**South Harbor Vessels**
Vessels Affected	74
Average Delay per Vessel	50
Average VOC per hour	$110.73
Potential Annual VOC Savings	$410,000
Total Potential VOC Savings	**$11,061,000**

In addition to these potential savings, opportunities exist for vessels that currently utilize haul-out facilities and moorage at other harbors in the region, but could call at Petersburg if facilities were built in Scow Bay. As noted in the previous assumptions section, 410 vessels are expected to benefit from haul-out facilities at Scow Bay. Given the capacity of nearby ports, 200 Petersburg vessels could be accommodated at the closest port while the remaining 210 vessels would be travel to the next closest port (Table 10).

Table 10. Travel Times to Nearby Ports

Port Facility	Travel Time, Roundtrip (hours) from Petersburg	Vessels	Time Saved, Roundtrip (hours)
Scow Bay	1		
Wrangell (closest port)	8	200	7
Juneau/Hoonah (next closest ports)	32	210	31

Potential VOC savings were evaluated for five user groups using the equation: Number of Trips x Time Saved per Trip x Hourly Vessel Operating Cost = Annual Savings. The five groups are:

1. Vessels able to travel to Wrangell during the off season (180 vessels)
2. Vessels able to travel to Wrangell during the fishing (20 vessels)
3. Vessels required to travel to Juneau or Hoonah during the off season (189 vessels)
4. Vessels required to travel to Juneau or Hoonah during the fishing season
5. Additional vessels that could use Scow Bay haul-out facilities (Substitute (0.50*Time Saved) for the Time Saved in calculations 1–4.

These additional potential savings have a present value of $1.3 million annually or $35.4 million over the period of analysis. Table 11 summarizes input data and calculations for these potential savings.

Table 11. Potential Vessel Operating Cost Savings: Scow Bay Haul-Out Facility

User Group	Number of Trips (assumes 1 trip per vessel annually)	Time Savings Per Vessel Per Trip (hours)	Vessel Operating Cost (hourly)	Annual VOC potential Savings
1	180	7	$110.73	$140,000
2	20	7	$110.73	$16,000
3	189	31	$110.73	$649,000
4	21	31	$110.73	$72,000
5	205			$438,000
Total				**$1,314,000**

When these additional opportunities are considered, total potential VOC savings have a present value of $46.5 million, equating to average annual savings of $1.7 million. Table 12 shows potential VOC savings by area of use.

Table 12. Total Potential Vessel Operating Cost Savings: Commercial Fishing Vessels

Potential Benefit by Area	Present Value	AAEQ Value	% of Total
South Harbor Only	$11,061,000	$410,000	24%
Scow Bay Only	$35,471,000	$1,314,000	76%
Total	**$46,532,000**	**$1,724,000**	**100%**

Opportunity Cost of Time

Opportunity cost of time is the value of time which could otherwise be spent pursuing additional work or leisure activities. The value of time saved is based on methodology described in ER 1105-2-100. For commercial fishing captains and crew members, OCT rates are calculated based on data from the report *Value of Time Commercial Fishermen in Alaska Could Save with Improved Harbor Facilities*, conducted by the Cornell University Human Dimensions Research Unit for USACE Alaska District, in September 2006. According to that report, 70 percent of Alaska salmon fishers would use that added time to conduct more fishing activity while 30 percent said they would use that time for leisure activity. Table 13 summarizes the wage and leisure rates used.

Table 13. Wage Rates for Opportunity Cost of Time Calculations

Description	Captain	Crew	Total
Wage Rate	$90.45	$72.61	$163.05
Leisure Rate	$30.15	N/A	$30.15

Considering that commercial fishing is the primary industry in Petersburg and local fishermen indicated they would rather spend time fishing if not delayed, this analysis assumes that captains and crews in Petersburg would elect to use these saved hours as work time. According to the Cornell report, the hourly wage rate for salmon fishermen is $90.45 for the captain and $72.61 for crew members, updated to current dollars. Average crew size is assumed to be four members (including the captain) based on fleet composition and types of permits fished.[15] Assuming four crew members per vessel, the hourly OCT per vessel is about $300. Based on delay hours and OCT, the total annual OCT value per vessel is approximately $15,000. With 74 commercial fishing vessels impacted, this equates to a potential OCT savings of $1.1 million annually ($15,000 potential savings per vessel x 74 vessels = $1.1 million potential annual savings). Over the period of analysis, these potential savings have a present value cost of approximately $30.8 million.

As with VOCs, additional opportunities exist for vessels that currently use haul-out facilities and moorage at other harbors in the region but could call at Petersburg if facilities were built in Scow Bay. For this analysis, the same 410 vessels that would experience VOC savings would experience OCT savings. To calculate these OCT savings, USACE assumes that 90 percent of the use of the Scow Bay haul-out facilities would occur during the off-season, so the leisure rate for vessel captains was applied, and 10 percent of the use would occur during the fishing season so the wage rates for captain and crew were used.

These additional potential savings have a present value of $515,000 annually or $13.9 million over the period of analysis. Table 14 summarizes input data and calculations for these potential savings.

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[15] Based on Petersburg harbor office records of slip assignments and fishing permits by vessel.

Table 14. Potential Opportunity Cost of Time Savings: Scow Bay Haul-Out Facility

User Group	Number of Trips (assumes 1 trip per vessel annually)	Time Savings Per Vessel Per Trip (hours)	OCT Rate (hourly)	Annual OCT potential Savings
1	180	7	$30.15	$38,000
2	20	7	$163.05	$23,000
3	189	31	$30.15	$177,000
4	21	31	$163.05	$106,000
5	205			$172,000
Total				**$515,000**

When these additional opportunities are considered, potential OCT savings have a present value of $44.7 million, equating to average annual savings of $1.7 million. Table 15 shows potential OCT savings by area of use.

Table 15. Total Potential Opportunity Cost of Time Savings: Commercial Fishing Vessels

Potential Benefit by Area	Present Value	AAEQ Value	% of Total
South Harbor Only	$30,792,000	$1,141,000	69%
Scow Bay Only	$13,915,000	$515,000	31%
Total	**$44,707,000**	**$1,656,000**	**100%**

4.4.3 Subsistence

Depth constraints during low-tide cycles also cause delays for subsistence users and inhibit access to subsistence resources. Reducing delays and improving access for these users is expected to result in VOC and OCT savings as well as an increase in subsistence harvests. Calculations of VOC and OCT savings follow the same methodology used to estimate savings to commercial fishing vessels described above, with the notable exception that leisure rates (instead of wage rates) are used to estimate OCT savings for subsistence users. Leisure rates are one-third of the wage rates used for commercial fishermen, which are based on wages detailed in the *Value of Time Commercial Fishermen in Alaska Could Save with Improved Harbor Facilities*, conducted by the Cornell University in 2006. Wage and leisure rates were updated to current dollars using the U.S. Bureau of Labor Statistics Employment Cost Index. This analysis assumes an average crew size of two people per subsistence vessel, so the leisure rates for captain and crew are combined to estimate the total hourly OCT per vessel.

The VOC and OCT savings are based on the number of subsistence vessels experiencing delays, the total delay hours per vessels each summer, and the respective hourly VOC or OCT rate. Average annual VOC savings equal the number of affected vessels, multiplied by total delay hours, multiplied by the hourly VOC per vessel (74 vessels x 20 delay hours per vessel x $45.88 hourly rate per vessel = $68,000 potential VOC savings). The same equation is used to estimate OCT savings using the hourly OCT leisure rate. Table 16 summarizes these data and the average annual OCT and VOC savings.

Table 16. Potential Vessel Operating Cost and Opportunity Cost of Time Savings: Subsistence Vessels

Variable Description	Value
Number of Subsistence Vessels Affected	74
Total Delay Hours Per Vessel	20
OCT per vessel (hourly leisure rate)*	$54.35
VOC per vessel (hourly leisure rate)*	$45.88
AAEQ OCT Savings	**$80,000**
AAEQ VOC Savings	**$68,000**

The value of foregone subsistence harvest expected to occur without navigation improvements is based on subsistence data and harvest replacement values from the ADF&G Division of Subsistence. Absent Federal action, it is assumed that subsistence harvests would be 23,890 pounds, which is the per capital subsistence harvest multiplied by the number of participants (161 pounds per person x 74 subsistence vessels x 2 subsistence participants per vessel = 23,890 pounds). With navigation improvements, subsistence harvests are assumed to increase 10–15 percent from what would occur without a project, equating to a net increase of about 3,000 pounds per year on average.

Replacement values used in this analysis are based on studies by ADF&G which estimated a range values of 4.00–$8.00 per pound, a recent USACE feasibility study[16], and Monte Carlo simulations using @Risk, a Microsoft Excel add-in. To address variation and uncertainty in subsistence replacement values, this analysis uses an @Risk triangular distribution with the following parameters: $4.00 (minimum), $8.00 (most likely), and $11.72 (maximum), as shown in Figure 14. This analysis uses the mean value of $7.91 per pound.

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[16] Whittier Navigation Improvements Feasibility Study, 2018.

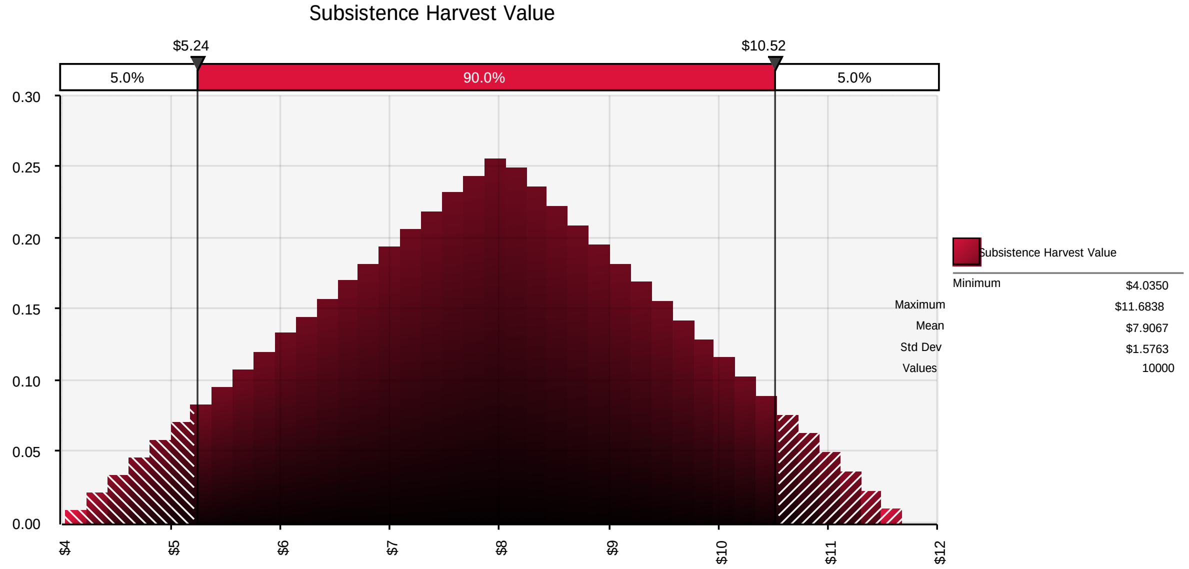

Figure 14. Subsistence harvest value, @Risk simulation results

Based on the mean replacement value of $7.91 per pound and the estimated increase in subsistence harvest, the value of foregone subsistence harvest is $24,000 annually. Table 17 summarizes input data used to estimate the value of the foregone subsistence harvest.

Table 17. Foregone Subsistence Harvest Value

Variable Description	Value
Number of Subsistence Vessels Affected	74
Average Crew Size (includes captain)	2
Total Crew Members, All Vessels	148
Per Capita Annual Subsistence Harvest (pounds)	161.42
Total Annual Subsistence Harvest (pounds)	23,890
Expected Increase in Harvest (%)	12.5
Total Annual Expected Future Harvest (pounds)	26,876
Expected Harvest Increase (pounds)	2,986
Average Price per Pound	$7.91
AAEQ Foregone Subsistence Harvest Value	**$24,000**

In consideration of the analysis presented above, potential benefits associated with reducing delays for subsistence vessels and improving subsistence harvesting opportunities have a present value of $4.6 million, equating to average annual potential benefits of $172,000 over the period of analysis (Table 18).

Table 18. Total Potential Subsistence Benefits

Potential Benefits	Present Value	AAEQ Value	% of Total
Opportunity Cost of Time	$2,172,000	$80,000	46%
Vessel Operating Costs	$1,833,000	$68,000	40%
Foregone Subsistence Harvest	$638,000	$24,000	14%
Total	**$4,643,000**	**$172,000**	

4.4.4 Labor Resource Underutilization

Given socioeconomic and employment characteristics in the Petersburg Borough, an opportunity exists to utilize unemployed or underemployed labor resources during project construction. Corps policy provides guidance on the NED benefit evaluation procedure for unemployed or underemployed labor resources, which are defined as …"*the economic effects of the direct use of otherwise unemployed or underemployed labor resources during project construction or installation*."[17]

This guidance further defines the criteria required for benefit inclusion:

> *"Benefits from use of otherwise unemployed or underemployed labor resources may be recognized as a project benefit if the area has substantial and persistent unemployment at the time the plan is submitted for authorization and for appropriations to begin construction. Substantial and persistent unemployment exists in an area when:*
>
> *(a) The current rate of unemployment, as determined by appropriate annual statistics for the most recent 12 consecutive months, is 6 percent or more and has averaged at least 6 percent for the qualifying time periods specified in subparagraph (b) below and:*
>
> *(b) The annual average rate of unemployment has been at least: (a) 50 percent above the national average for three of the preceding four calendar years, or (b) 75 percent above the national average for two of the preceding three calendar years, or (c) 100 percent above the national average for one of the preceding two calendar years"*.

Given the criteria above, and recent unemployment trends in the Petersburg Borough determined by the U.S. Bureau of Labor Statistics, construction of the proposed navigation improvements qualifies for labor resource benefits (Table 19).

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[17] ER 1105-2-100, Appendix D, Page D-31

Table 19. Unemployment Statistics

Year	**Unemployment Rate by Area**			**% Above National Average for Petersburg Borough**
	United States	**Alaska**	**Petersburg Borough**	
2013	7.4%	7.1%	8.7%	118%
2014	6.2%	6.9%	9.5%	153%
2015	5.3%	6.4%	9.0%	170%
2016	4.9%	6.6%	9.1%	186%
2017	4.4%	7.2%	9.3%	211%
Average	5.6%	6.8%	9.1%	118%

Sources: U.S. Bureau of Labor Statistics; Alaska Department of Labor & Workforce Development

It is expected that currently unemployed labor from the Petersburg Borough would be utilized during project construction. The initial investment would create new jobs, thereby directly reducing unemployment. There would be demands for both labor and construction materials required for the project, and incomes of individuals in associated industries would be increased indirectly due to the interrelationship and interdependence of these industries. These conditions would stimulate the economy and raise the general level of income.

Employment data for the Petersburg Borough indicate there are about 450 workers in construction and transportation occupations who could be employed to construct the project. This analysis assumes average unemployment rates shown in Table 19 are representative of unemployment in these occupations, which results in an unemployed labor pool of 41 construction workers in the Petersburg Borough and 5,344 construction workers in Alaska. These includes workers from the construction, extraction, maintenance and repair occupations and the production, transportation, and material moving occupations shown below.

Table 20. Civilian Labor Force by Occupation

	Petersburg Borough	**Alaska**	**United States**
Civilian employed population 16 years old and older	1,632	357,098	148,001,326
OCCUPATION			
Management, business, science, and arts occupations	471	132,669	54,751,318
Service occupations	199	62,844	26,765,182
Sales and office occupations	268	79,782	35,282,759
Farming, fishing, and forestry occupations	242	3,668	1,062,331
Construction, extraction, maintenance, and repair occupations	182	37,664	12,440,120

Production, transportation, and material moving occupations	270	40,471	18,542,291

Source: 2012–2016 American Community Survey 5-Year Estimates, Census Bureau

The proposed navigation improvements project is expected to employ 10–20 workers during construction. Based on input from Alaska District cost engineers and the USACE Soo Locks feasibility study, direct labor costs are assumed to account for 40 percent of the total construction cost and are allocated between three categories of workers: skilled (40%), semi-skilled (50%), and administrative/supervisory (10%). The portion of locally hired labor for these categories is based on USACE guidance for calculating labor resource benefits.

Given these manpower requirements and the employment statistics presented above, an opportunity exists to utilize unemployed or underemployed labor resources during construction. Absent Federal investment, these potential benefits are considered a foregone opportunity and have a present value of approximately $13.9 million, with average annual values of $515,000. Table 21 through Table 24 display potential labor resource benefits for each proposed alternative.

Table 21. Potential Labor Resource Benefits: Alternative 2

Alternative 2 Labor Resource Benefit Calculations			
1. Estimate On-Site Labor Cost			
Total Project Cost*:	$42,869,231		
Percent Allocated to Labor:	40%		
On Site Labor Cost:	$17,147,692.26		
2. Allocation of On-Site labor Cost			
Labor Classification	On Site Labor Cost	Percent Allocation	Wages
Skilled	$17,147,692	40%	$6,859,077
Semiskilled and Unskilled	$17,147,692	50%	$8,573,846
Administrative and Supervisory	$17,147,692	10%	$1,714,769
TOTAL:			$17,147,692
3. Allocation of Wages to Locally Unemployed or Underemployed Labor			
Labor Classification	Wages	Percent of Locally Hired Labor	Wages Paid to Local Hired Unemployed or Underemployed Labor
Skilled	$6,859,077	43%	$2,949,403.07
Semiskilled and Unskilled	$8,573,846	58%	$4,972,831
Administrative and Supervisory	$1,714,769	35%	$600,169
TOTAL:			$8,522,403
4. Average Annual Labor Resource Benefits			
Average Annual Labor Resource Benefits:			$315,678

** Only remaining costs are applicable. Does not include E&D, S&A, or land costs.*

Table 22. Potential Labor Resource Benefits: Alternative 3

Alternative 3 Labor Resource Benefit Calculations			
1. Estimate On-Site Labor Cost			
Total Project Cost*:	$7,957,558		
Percent Allocated to Labor:	40%		
On Site Labor Cost:	$3,183,023		
2. Allocation of On-Site labor Cost			
Labor Classification	On Site Labor Cost	Percent Allocation	Wages
Skilled	$3,183,023	40%	$1,273,209
Semiskilled and Unskilled	$3,183,023	50%	$1,591,512
Administrative and Supervisory	$3,183,023	10%	$318,302
TOTAL:			$3,183,023
3. Allocation of Wages to Locally Unemployed or Underemployed Labor			
Labor Classification	Wages	Percent of Locally Hired Labor	Wages Paid to Local Hired Unemployed or Underemployed Labor
Skilled	$1,273,209	43%	$547,479.99
Semiskilled and Unskilled	$1,591,512	58%	$923,077
Administrative and Supervisory	$318,302	35%	$111,406
TOTAL:			$1,581,963
4. Average Annual Labor Resource Benefits			
Average Annual Labor Resource Benefits:			$58,597

** Only remaining costs are applicable. Does not include E&D, S&A, or land costs.*

Table 23. Potential Labor Resource Benefits: Alternative 4

Alternative 4 Labor Resource Benefit Calculations			
1. Estimate On-Site Labor Cost			
Total Project Cost*:	$44,522,136		
Percent Allocated to Labor:	40%		
On Site Labor Cost:	$17,808,854		
2. Allocation of On-Site labor Cost			
Labor Classification	On Site Labor Cost	Percent Allocation	Wages
Skilled	$17,808,854	40%	$7,123,542
Semiskilled and Unskilled	$17,808,854	50%	$8,904,427
Administrative and Supervisory	$17,808,854	10%	$1,780,885
TOTAL:			$17,808,854
3. Allocation of Wages to Locally Unemployed or Underemployed Labor			
Labor Classification	Wages	Percent of Locally Hired Labor	Wages Paid to Local Hired Unemployed or Underemployed Labor
Skilled	$7,123,542	43%	$3,063,122.94
Semiskilled and Unskilled	$8,904,427	58%	$5,164,568
Administrative and Supervisory	$1,780,885	35%	$623,310
TOTAL:			$8,851,001
4. Average Annual Labor Resource Benefits			
Average Annual Labor Resource Benefits:			$327,849

** Only remaining costs are applicable. Does not include E&D, S&A, or land costs.*

Table 24. Potential Labor Resource Benefits: Alternative 5

Alternative 5 Labor Resource Benefit Calculations			
1. Estimate On-Site Labor Cost			
Total Project Cost*:			$69,962,486
Percent Allocated to Labor:			40%
On Site Labor Cost:			$27,984,994
2. Allocation of On-Site labor Cost			
Labor Classification	On Site Labor Cost	Percent Allocation	Wages
Skilled	$27,984,994	40%	$11,193,998
Semiskilled and Unskilled	$27,984,994	50%	$13,992,497
Administrative and Supervisory	$27,984,994	10%	$2,798,499
TOTAL:			$27,984,994
3. Allocation of Wages to Locally Unemployed or Underemployed Labor			
Labor Classification	Wages	Percent of Locally Hired Labor	Wages Paid to Local Hired Unemployed or Underemployed Labor
Skilled	$11,193,998	43%	$4,813,419.05
Semiskilled and Unskilled	$13,992,497	58%	$8,115,648
Administrative and Supervisory	$2,798,499	35%	$979,475
TOTAL:			$13,908,542
4. Average Annual Labor Resource Benefits			
Average Annual Labor Resource Benefits:			$515,185

* *Only remaining costs are applicable. Does not include E&D, S&A, or land costs.*

4.4.5 Summary of Future Without-Project Conditions

Absent Federal action to provide navigation improvements at Petersburg, the transportation inefficiencies, forgone harvest opportunities, and underutilization of labor resources described above are expected to continue throughout the period of analysis. These adverse impacts incurred as a result of current and expected future conditions have a present value of approximately $110 million with an average annual value of $4.1 million over the period of analysis (Table 25).

Table 25. Summary of Future Without-Project Conditions

Category	Present Value	AAEQ Value	Percent of Total
Commercial Fishing	**$91,239,000**	**$3,380,000**	**83%**
Opportunity Cost of Time	$44,707,000	$1,656,000	41%
Vessel Operating Costs	$46,532,000	$1,724,000	42%
Subsistence	**$4,643,000**	**$172,000**	**4%**
Opportunity Cost of Time	$2,172,000	$80,000	2%
Vessel Operating Costs	$1,833,000	$68,000	2%
Foregone Subsistence Harvest	$638,000	$24,000	1%
Labor Resource Inefficiencies	**$13,909,000**	**$515,000**	**13%**
Total	**$109,791,000**	**$4,067,000**	**100%**

4.5 With-Project Conditions

The following section describes anticipated conditions at Petersburg assuming that a project has been constructed. The anticipated changes in the operating procedures at the harbor are the basis for the economic analysis.

4.5.1 Assumptions

The NED benefits of small boat harbor projects result from enhanced access to commercial fishing activities and recreational boating and sport fishing opportunities.[18] Project benefits at Petersburg are expected to result from transportation costs savings accruing to commercial and subsistence vessel operators, enhanced access for subsistence activities, and utilization of unemployed or underemployed labor resources during project construction. Commercial fishing and subsistence vessels are expected to experience a time savings With-Project in the form of the reduction in transit time delays, resulting in time savings and reduced vessel operating cost benefits. The proposed navigation improvements are also expected to enhance access for harvesting subsistence resources, which translates to an increase in harvest value based on the replacement cost analysis described in the Without-Project Conditions section.[19] Other costs and practices, such as land side costs, would not change as a result of the project and are assumed to remain constant.

The period of analysis is 50 years, beginning with the base year of 2022, the project effective date, to 2073. The FY 2018 Federal discount rate of 2.750 percent is used to discount benefits and costs.[20] The report uses methodology for small boat harbor navigation analysis described in ER 1105-2-100[21], with specific guidance found in the appendices on economic and social considerations, the USACE Civil Works program, and the USACE Continuing Authorities Program.

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[18] https://planning.erdc.dren.mil/toolbox/library/ERs/entire.pdf

[19] Increase in subsistence activity is based on similar USACE studies involving navigation improvements and access to subsistence resources for Valdez (2011) and Craig, Alaska (2014).

[20] Per EGM 18-01 Federal Interest Rates for Corps of Engineers Projects for Fiscal Year 2018

[21] https://planning.erdc.dren.mil/toolbox/library/ERs/entire.pdf

4.5.2 Project Alternatives

Four alternatives were evaluated along with the future Without-Project Conditions (No Action).

Table 26. Alternative Descriptions

Alternative	Description
1	No Action
2	Non-Structural Reorganization of Petersburg Harbor System
3	South Harbor Dredging Only
4	South Harbor Dredging with Haul-out Area at Scow Bay
5	South Harbor Dredging and New Harbor at Scow Bay

1. No Action. The harbor depth will remain the same, and all vessels in the Petersburg harbor system will remain in their assigned slips. If no action is taken, insufficient depths within the harbor system will continue to cause transportation delays and limit access for commercial fishing and subsistence activities, creating economic inefficiencies to the region and Nation. The study objectives would not be met and no project benefits or opportunities would be realized.

2. Non-Structural Reorganization of Petersburg Harbor System. This non-structural alternative would result in removal of all boats in the harbor system. The float layout and depth in each slip would be evaluated and boats drafting less water would be assigned to shallower slips. Larger vessels with deeper drafts would be moved to slips with deeper depths. This alternative would not address depth in the entrance channel or maneuvering basin, which is a study objective, so some vessel delays would still occur during low tides.

3. South Harbor Dredging Only. Dredging in South Harbor will take place to address vessel delays due to insufficient depth within the harbor system. The assumed project depths are –19.25 feet MLLW in the maneuvering channel, –18 feet MLLW in between Floats C and D, –10 feet MLLW landward of the main float, and –9 feet MLLW behind Floats 1 and 2 (Figure 13). A 1-foot-over-dredge allowance will be added to these depths. Disposal of dredge spoils will be evaluated to determine the least cost alternative in accordance with current guidance. This alternative assumes in-water disposal in either Thomas Bay or Frederick Sound. Optimization of disposal locations will take place in the design and implementation phase after environmental sampling is completed summer 2019. This alternative meets the study objectives of improving access to the Petersburg harbor system and reducing vessel delays due to insufficient depths within the harbor system.

4. South Harbor Dredging with Haul-out Area at Scow Bay. This alternative includes all features of Alternative 3 plus the installation of a vessel haul-out area at Scow Bay. This alternative would provide the infrastructure (a concrete ramp) for hydraulic trailers (provided by private sector) to transport commercial and recreational vessels from the water onto the uplands to access services at adjacent work and storage yards. This alternative meets the study objectives and provides additional opportunities for development of marine infrastructure in Scow Bay. In addition to providing the benefits estimated for Alternative 3, this alternative would result in additional transportation cost savings to vessels that currently utilize haul-out facilities at other harbors in the region.

5. South Harbor Dredging with Haul-out Area and New Harbor at Scow Bay. This alternative includes all features of Alternative 4 plus the installation of a new harbor at Scow Bay to accommodate excess demand for vessels seeking permanent and transient moorage at Petersburg. The existing 400-foot breakwater would be extended out to 800-foot total length to protect the float system and harbor entrance from wave action. Three rows of stalls supporting up to 32-foot, 42-foot, and 60-foot vessels, respectively, would be constructed along with an outer slip area for transient moorage. As with Alternative 4, this alternative also meets the study objectives and provides additional opportunities to vessels that currently utilize haul-out facilities and moorage at other harbors in the region. However, additional benefits beyond those estimated for Alternative 4, such as benefits associated with installing moorage in Scow Bay, were not evaluated in this analysis since they were considered to exceed the scope of this study.

4.5.3 Summary of Future With-Project Conditions

Each alternative provides a varying degree of reduction to the inefficiencies described in the Without-Project Conditions section. All structural alternatives that involve dredging in South Harbor (Alternatives 3, 4, and 5) are expected to provide the same level of benefits in terms of transportation cost savings (measured as time and vessel operating cost savings) and increases in subsistence harvests. For these alternatives, a range of benefit scenarios is considered based on the percent of commercial fishing and subsistence vessels expected to benefit from reduced depth constraints and delays. All potential benefits estimated for each scenario in the Without-Project Conditions section are expected to be realized for Alternatives 3, 4, and 5. It is important to note that the non-structural alternative (Alternative 2) would not address depth constraints in the entrance channel or maneuvering basin, so only a portion of the potential benefits identified in the Without-Project Conditions section would be realized. As such, the “low” benefit scenario is considered most appropriate for Alternative 2.

Alternatives 4 and 5, which involve developing new marine facilities at Scow Bay, are expected to produce additional transportation savings to vessels that currently utilize haul-out facilities at other harbors in the region but would shift to Scow Bay with a project. While these additional benefits are considered in this analysis, any additional benefits that would result from adding moorage at Scow Bay were considered beyond the scope of this study.

4.5.4 Total Project Benefits

Each alternative provides a certain amount of relief from existing and expected future inefficiencies. The differences between the expected level of inefficiencies absent Federal action (Without-Project Conditions) and those that will occur under the various With-Project Conditions are benefits that accrue to the project and form the basis for selecting a recommended plan.

Total annual project benefits were determined at FY18 price levels by calculating the average annual reduction in transportation costs and increase in subsistence harvests. Benefits realized through the use of otherwise unemployed or underemployed labor resources during project construction were also calculated. Benefits are discounted to the FY18 price level using the Federal discount rate of 2.750 percent over a 50-year period of analysis.

Table 27 and Table 28 show the present value and average annual value of benefits for each alternative. Note that these tables summarize benefits for the “most likely” scenario considered, and that numbers may differ slightly from those shown in subsequent tables due to variations in Monte Carlo simulation results. Benefits for the other scenarios are presented in the Risk and Sensitivity section of this appendix.

Table 27. Present Value of Benefits by Alternative

Category:	**Alt 2**	**Alt 3**	**Alt 4**	**Alt 5**
Commercial Fishing	**$31,390,000**	**$31,390,000**	**$68,429,000**	**$68,429,000**
Opportunity Cost of Time	$23,094,000	$23,094,000	$33,530,000	$33,530,000
Vessel Operating Costs	$8,296,000	$8,296,000	$34,899,000	$34,899,000
Subsistence	**$3,482,500**	**$3,482,500**	**$3,482,500**	**$3,482,500**
Opportunity Cost of Time	$1,629,000	$1,629,000	$1,629,000	$1,629,000
Vessel Operating Costs	$1,375,000	$1,375,000	$1,375,000	$1,375,000
Increased Subsistence Harvest	$478,500	$478,500	$478,500	$478,500
Labor Resources	**$8,522,000**	**$1,582,000**	**$8,851,000**	**$13,909,000**
Total	**$43,394,500**	**$36,454,500**	**$80,762,500**	**$85,820,500**
Total, Monte Carlo Simulation	**$35,645,000**	**$35,645,000**	**$29,478,000**	**$74,540,000**

Table 28. Annual Benefits by Alternative

Category:	**Alt 2**	**Alt 3**	**Alt 4**	**Alt 5**
Commercial Fishing	**$1,163,000**	**$1,163,000**	**$2,535,000**	**$2,535,000**
Opportunity Cost of Time	$855,000	$855,000	$1,242,000	$1,242,000
Vessel Operating Costs	$307,000	$307,000	$1,293,000	$1,293,000
Subsistence	**$129,000**	**$129,000**	**$129,000**	**$129,000**
Opportunity Cost of Time	$60,000	$60,000	$60,000	$60,000
Vessel Operating Costs	$51,000	$51,000	$51,000	$51,000
Increased Subsistence Harvest	$18,000	$18,000	$18,000	$18,000
Labor Resources	**$316,000**	**$59,000**	**$328,000**	**$515,000**
Total	**$1,607,000**	**$1,350,000**	**$2,992,000**	**$3,179,000**
Total, Monte Carlo Simulation	**$1,320,000**	**$1,092,000**	**$2,761,000**	**$2,948,000**

4.5.5 Project Costs

USACE Alaska District cost engineers developed Rough Order of Magnitude (ROM) costs the alternatives, including those to construct and maintain facilities. Cost risk contingencies were included to account for uncertain items such as sediment characterization and dredged material disposal methods. Interest during construction assumes a two-year construction window. Initial estimates of operations and maintenance are based on the cost of the 2013 North Harbor dredging effort at Petersburg and the estimated volume of dredged material for South Harbor. Maintenance dredging is assumed to occur in 30 years from project construction. For those alternatives that include a breakwater and/or moorage floats (Alternatives 4 and 5), it is assumed the floats and 15 percent of breakwater armor rock would be replaced in 30 years.

The combination of project first costs, interest during construction, and operations and maintenance costs form the total investment cost, which was used to determine the average annual equivalent cost of each alternative. Project costs were developed without escalation and are in 2018 dollars. Table 29 displays the ROM costs for each alternative.

Table 29. ROM Costs by Alternative

Cost Description	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Lands, Easements, Rights-of-Way, and Relocations (LERR)	N/A	$24,000	$24,000	$24,000
Mobilization & Demobilization	$1,658,000	$1,328,000	$1,784,000	$2,024,000
Remove/Replace Floats	$34,318,000	N/A	N/A	N/A
Breakwater & Slope Protection	N/A	N/A	$585,000	$6,959,000
South Harbor Dredging & Disposal		$4,460,000	$7,663,000	$5,466,000
Haul-Out Ramp	N/A	N/A	$3,134,000	$3,134,000
Navigation Aids	N/A	N/A	N/A	$59,000
Dredge Material Confined Disposal Facility	N/A	N/A	$24,149,000	$24,149,000
Scow Bay Harbor Facilities & Utilities	N/A	N/A	N/A	$19,874,000
Remaining Construction Items	N/A	N/A	N/A	$2,140,000
Preconstruction Engineering and Design (PED)	$2,966,000	$1,400,000	$4,686,000	$7,372,000
Supervision, Inspection, and Overhead (SIOH)	$3,928,000	$746,000	$2,497,000	$3,928,000
Project First Cost	**$42,869,000**	**$7,958,000**	**$44,522,000**	**$69,962,000**
Interest During Construction	$587,000	$109,000	$1,230,000	$1,933,000
Operations, Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R)	$18,997,000	$2,565,000	$5,614,000	$22,436,000
Total Investment	**$62,453,000**	**$10,632,000**	**$51,366,000**	**$94,331,000**

Average annual costs were developed by combining the initial construction costs with the annual Operations and Maintenance costs for each potential alternative using the FY18 Federal discount rate of 2.750 percent along with a period of analysis of 50 years.

Table 30. Average Annual Cost Summary by Alternative

Cost Description	Alt 2	Alt 3	Alt 4	Alt 5
AAEQ Investment	$1,610,000	$299,000	$1,695,000	$2,663,000
AAEQ OMRR&R	$704,000	$95,000	$208,000	$831,000
Total AAEQ Cost	**$2,314,000**	**$394,000**	**$1,903,000**	**$3,494,000**

4.5.6 Net Benefits and Benefit Cost Ratio

Net benefits and the benefit cost ratio 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. Table 31 summarizes project costs, benefits, and the benefit cost ratio by alternative. The plan that reasonably maximizes net benefits is Alternative 3, the South Harbor Dredging Only alternative.

Table 31. Summary of Costs and Benefits by Alternative

Alternative	Present Value Benefits[1]	AAEQ Benefits	Present Value Costs	AAEQ Costs	Net Annual Benefits	Benefit-Cost Ratio
1	N/A	N/A	N/A	N/A	N/A	N/A
2	$35,645,000	$1,320,000	$62,453,000	$2,313,000	-$993,000	0.57
3	$29,478,000	$1,092,000	$10,631,000	$394,000	$698,000	2.77
4	$74,540,000	$2,761,000	$51,366,000	$1,903,000	$858,000[2]	1.45
5	$79,598,000	$2,948,000	$51,366,000	$1,903,000	–$546,000	0.84

Notes:

1. This table shows benefits for the “most likely” benefit scenario considered, which was estimated through Monte Carlo simulations. The BCR for Alternative 3 ranges from 1.2 to 4.5 based on the portion of vessels affected during low-tide cycles.
2. Alternative 4 meets the study objectives and provides additional opportunities for development of marine infrastructure in Scow Bay, resulting in higher net benefits than Alternative 3. In addition to providing the benefits estimated for Alternative 3, this alternative would produce additional transportation cost savings to vessels currently using haul-out facilities at other harbors in the region.

4.6 Risk and Sensitivity

In the interest of further testing the sensitivity of project justification to uncertainty in parameters, future scenarios must be assessed. The analysis of these scenarios is intended to illustrate the effect of changes in different assumptions on project benefits and project justification.

Because of the inherent uncertainty surrounding the forecast of any growth in fisheries and related marine resources, a conservative “no growth” approach was taken in determining the future fleet in Petersburg. As discussed in the marine resources section of this appendix, the fishing industry in Petersburg is considered strong and is expected to continue to support demand for moorage and other harbor facilities at Petersburg. Fishery activities will continue to fluctuate as resource abundance varies, regulations change, or technological breakthroughs are made. Possible regulatory actions likely would result in an easing of catch regulations given the stability of the fisheries in the Southeast Alaska/Yakutat region, leading to an increase in fish harvests and demand for harbor facilities at Petersburg. The impact of growing foreign fisheries on the domestic fish export industry may cause prices for some exports to fall but, more likely, this would result in an overall increase in global demand for fish exports, also leading to an increase in harvests and demand for harbor facilities. At this time, however, not enough information is known to assign probabilities to any of these scenarios. They are simply intended to provide information to better understand the economic risks associated with the recommended plan.

Alaska District economists conducted a sensitivity analysis regarding expected project benefits based on the assumed percent of commercial fishing and subsistence vessels impacted by depth constraints during low-tide cycles. This resulted in a range of benefit scenarios for each alternative. The most conservative scenario assumes 25 percent of vessels would be affected during each cycle, which likely results in an underestimation of benefits. Given that most vessels run multiple gear types and essentially fish year round, it is likely that a larger portion of vessels would be affected during each low-tide cycle, and would therefore benefit from the proposed navigation improvements. The "mid" and "high" scenarios assume 50 percent and 100 percent of vessels would be impacted by depth constraints during low-tide cycles. The "most likely" scenario is based on Monte Carlo simulations using @Risk, a Microsoft Excel add-in.

Under all scenarios considered, Alternative 3 is economically justified and reasonably maximizes net benefits, with a BCR ranging from 1.2 to 4.5, and net annual benefits of $95,000 to $1.4 million. Table 32 through Table 39 summarize results of the sensitivity analysis for each alternative. Two tables are presented for each alternative: a detailed breakdown of project benefits by scenario, and a summary of costs and benefits by scenario.

Alternative 2 is not economically justified, with a BCR ranging from 0.32 to 0.88. Given the depth constraints remaining in the entrance channel and maneuvering basin, the "low" scenario is considered most applicable for Alternative 2.

Table 32. Sensitivity Analysis: Present Value Benefits, Alternative 2

Category:	**Low**	**Mid**	**Most Likely**	**High**
Commercial Fishing	**$10,463,000**	**$20,927,000**	**$31,390,000**	**$41,853,000**
Opportunity Cost of Time	$7,698,000	$15,396,000	$23,094,000	$30,792,000
Vessel Operating Costs	$2,765,000	$5,531,000	$8,296,000	$11,061,000
Subsistence	**$1,160,000**	**$2,322,000**	**$3,482,500**	**$4,643,000**
Opportunity Cost of Time	$543,000	$1,086,000	$1,629,000	$2,172,000
Vessel Operating Costs	$458,000	$917,000	$1,375,000	$1,833,000
Increased Subsistence Harvest	$159,000	$319,000	$478,500	$638,000
Labor Resources	**$8,522,000**	**$8,522,000**	**$8,522,000**	**$8,522,000**
Total	**$20,145,000**	**$31,771,000**	**$43,394,500**	**$55,018,000**
Total, Monte Carlo Simulation	**$20,320,489**	**N/A**	**$35,644,957**	**$54,969,384**

Table 33. Sensitivity Analysis: Summary for Alternative 2

Scenario	**PV Benefits**	**AAEQ Benefits**	**PV Costs**	**AAEQ Costs**	**Net Annual Benefits**	**Benefit-Cost Ratio**
Low	$20,145,000	$746,000	$62,453,000	$2,313,000	–$1,567,000	0.32
Mid	$31,771,000	$1,177,000	$62,453,000	$2,313,000	–$1,136,000	0.51
Most Likely	$35,645,000	$1,320,000	$62,453,000	$2,313,000	–$993,000	0.57
High	$55,018,000	$2,039,000	$62,453,000	$2,313,000	–$274,000	0.88

Alternative 3 is economically justified under all scenarios considered with a BCR ranging from 1.2 to 4.5.

Table 34. Sensitivity Analysis: Present Value Benefits, Alternative 3

Category:	**Low**	**Mid**	**Most Likely**	**High**
Commercial Fishing	**$10,463,000**	**$20,927,000**	**$31,390,000**	**$41,853,000**
Opportunity Cost of Time	$7,698,000	$15,396,000	$23,094,000	$30,792,000
Vessel Operating Costs	$2,765,000	$5,531,000	$8,296,000	$11,061,000
Subsistence	**$1,160,000**	**$2,322,000**	**$3,482,500**	**$4,643,000**
Opportunity Cost of Time	$543,000	$1,086,000	$1,629,000	$2,172,000
Vessel Operating Costs	$458,000	$917,000	$1,375,000	$1,833,000
Increased Subsistence Harvest	$159,000	$319,000	$478,500	$638,000
Labor Resources	**$1,582,000**	**$1,582,000**	**$1,582,000**	**$1,582,000**
Total	**$13,205,000**	**$24,831,000**	**$36,454,500**	**$48,078,000**
Total, Monte Carlo Simulation	**$14,078,976**	**N/A**	**$29,478,196**	**$48,586,296**

Table 35. Sensitivity Analysis: Summary for Alternative 3

Scenario	**PV Benefits**	**AAEQ Benefits**	**PV Costs**	**AAEQ Costs**	**Net Annual Benefits**	**Benefit-Cost Ratio**
Low	$13,9205,000	$489,000	$10,631,000	$394,000	$95,000	1.24
Mid	$24,831,000	$920,000	$10,631,000	$394,000	$526,000	2.34
Most Likely	$29,478,000	$1,092,000	$10,631,000	$394,000	$698,000	2.77
High	$48,078,000	$1,782,000	$10,631,000	$394,000	$1,388,000	4.53

Alternative 4 is economically justified under all but the most conservative scenario considered with a BCR ranging from 0.64 to 2.0.

Table 36. Sensitivity Analysis: Present Value Benefits, Alternative 4

Category:	**Low**	**Mid**	**Most Likely**	**High**
Commercial Fishing	**$22,810,000**	**$45,619,000**	**$68,429,000**	**$91,239,000**
Opportunity Cost of Time	$11,177,000	$22,353,000	$33,530,000	$44,707,000
Vessel Operating Costs	$11,633,000	$23,266,000	$34,899,000	$46,532,000
Subsistence	**$1,160,000**	**$2,322,000**	**$3,482,500**	**$4,643,000**
Opportunity Cost of Time	$543,000	$1,086,000	$1,629,000	$2,172,000
Vessel Operating Costs	$458,000	$917,000	$1,375,000	$1,833,000
Increased Subsistence Harvest	$159,000	$319,000	$478,500	$638,000
Labor Resources	**$8,851,000**	**$8,851,000**	**$8,851,000**	**$8,851,000**
Total	**$32,821,000**	**$56,792,000**	**$80,762,500**	**$104,733,000**
Total, Monte Carlo Simulation	**$37,425,628**	**N/A**	**$74,540,288**	**$121,297,173**

Table 37. Sensitivity Analysis: Summary for Alternative 4

Scenario	PV Benefits	AAEQ Benefits	PV Costs	AAEQ Costs	Net Annual Benefits	Benefit-Cost Ratio
Low	$32,821,000	$1,216,000	$51,366,000	$1,903,000	–$687,000	0.64
Mid	$56,792,000	$2,104,000	$51,366,000	$1,903,000	$201,000	1.11
Most Likely	$74,540,000	$2,761,000	$51,366,000	$1,903,000	$858,000	1.45
High	$104,733,000	$3,880,000	$51,366,000	$1,903,000	$1,977,350	2.04

Although Alternative 4 is not justified based on the benefits evaluated in this study, it is important to note that benefits associated with installing moorage in Scow Bay were considered beyond the scope of this analysis and were therefore not quantified. As such, this analysis underestimates benefits for Alternative 5; further analysis would be required to better quantify the benefits of installing a new harbor at Scow Bay.

Table 38. Sensitivity Analysis: Present Value Benefits, Alternative 5

Category:	Low	Mid	Most Likely	High
Commercial Fishing	**$22,810,000**	**$45,619,000**	**$68,429,000**	**$91,239,000**
Opportunity Cost of Time	$11,177,000	$22,353,000	$33,530,000	$44,707,000
Vessel Operating Costs	$11,633,000	$23,266,000	$34,899,000	$46,532,000
Subsistence	**$1,160,000**	**$2,322,000**	**$3,482,500**	**$4,643,000**
Opportunity Cost of Time	$543,000	$1,086,000	$1,629,000	$2,172,000
Vessel Operating Costs	$458,000	$917,000	$1,375,000	$1,833,000
Increased Subsistence Harvest	$159,000	$319,000	$478,500	$638,000
Labor Resources	**$13,909,000**	**$13,909,000**	**$13,909,000**	**$13,909,000**
Total	**$37,879,000**	**$61,850,000**	**$85,820,500**	**$109,791,000**
Total, Monte Carlo Simulation	**$42,519,169**	**N/A**	**$79,597,833**	**$126,336,621**

Table 39. Sensitivity Analysis: Summary for Alternative 5

Scenario	PV Benefits	AAEQ Benefits	PV Costs	AAEQ Costs	Net Annual Benefits	Benefit-Cost Ratio
Low	$37,879,000	$1,403,000	$51,366,000	$1,903,000	–$2,091,000	0.40
Mid	$61,850,000	$2,291,000	$51,366,000	$1,903,000	–$1,203,000	0.66
Most Likely	$79,598,000	$2,948,000	$51,366,000	$1,903,000	-$546,000	0.84
High	$109,791,000	$4,067,000	$51,366,000	$1,903,000	$573,000	1.16

4.7 Regional Economic Development Analysis

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

4.7.1 Regional Analysis

The USACE certified Regional Economic System (RECONS) model was developed 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 Recreation, Navigation, and Formerly Utilized Sites Remedial Action Program (FUSRAP). Contributions are measured in terms of economic output, jobs, earnings, and/or value added. The system was used to perform the following regional analysis for the Petersburg Navigation Improvements Project.

4.7.2 Summary

The USACE Institute for Water Resources (IWR), the Louis Berger Group, and Michigan University developed the RECONS model to provide estimates of regional and National job creation and retention and other economic measures such as income, value added, and sales. This modeling tool automates calculations and generates estimates of jobs and other economic measures such as income and sales associated with USACE's ARRA spending and annual Civil Works program spending. This is done by extracting multipliers and other economic measures from more than 1,500 regional economic models that were built specifically for USACE's project locations. These multipliers were then imported to a database, and the tool matches various spending profiles to the appropriate industry sectors by location to produce economic impact estimates. The tool will be used as a means to document the performance of direct investment spending of the USACE as directed by the ARRA. The tool also allows the USACE to evaluate project and program expenditures associated with USACE’s annual expenditure.

4.7.3 Results of Economic Impact Analysis

Alaska District economists evaluated the RED impact using ROM costs for Alternative 3 at three geographical levels: local, state, and National. The local represents the Petersburg Borough impact area. The state-level includes the State of Alaska. The National level includes the 48 contiguous United States.

The following table displays the breakdown of overall spending of the total project construction costs among the major industry sectors. The spending profile also identifies the geographical capture rate, also called Local Purchase Coefficient (LPC) in RECONS, of the cost components. The geographic capture rate is the portion of USACE spending on industries (sales) captured by industries located within the impact area. RECONS utilizes the Impact on Planning (IMPLAN) software and data system, provided by the Minnesota IMPLAN Group, to estimate the economic impacts of Federal spending. In many cases, IMPLAN’s trade flows Regional Purchase Coefficients are utilized as a proxy to estimate where the money flows for each of the receiving industry sectors of the cost components within each of the impact areas. For Petersburg, Regional Purchase Coefficients were not changed from their default values for dredging projects.

Table 40. Input Assumptions (Spending and LPCs)

Category	Spending (%)	Spending Amount	Local LPC (%)	State LPC (%)	National LPC (%)
Fuel	20%	$1,591,512	29%	81%	89%
Consumable Operating Expenses — Textiles, Lubricants, and Metal Valves and Parts	5%	$397,878	19%	22%	71%
Consumable Operating Expenses — Restaurants	1%	$55,703	100%	100%	100%
Repairs and Equipment	30%	$2,387,267	64%	95%	100%
Labor	40%	$3,183,023	5%	5%	100%
Consumable Operating Expenses — Other Food and Beverages	4%	$342,175	22%	33%	92%
Total	**100%**	**$7,957,558**	**-**	**-**	**-**

The table below displays the geographical capture amounts for each of the three geographical impact analyses, which is that portion of spending that is captured in each impact area. It initially measures $1,866,483 at the local impact level and increases to $3,593,709 at the state level, and expands to a $12,113,489 capture at the National level. The labor income represents all forms of employment earnings. In IMPLAN's regional economic model, it is the sum of employee compensation and proprietor income. The Gross Regional Product (GRP) which is also known as value added, is equal to gross industry output (i.e., sales or gross revenues) less its intermediate inputs (i.e., the consumption of goods and services purchased from other U.S. industries or imported). The number of jobs equates to the labor income.

Table 41. Overall Summary of Economic Impacts

Impacts	Impact Areas	Regional	State	National
Total Spending		$7,957,558	$7,957,558	$7,957,558
Direct Impact				
	Output	$2,358,818	$3,962,344	$7,635,801
	Job	26.03	34.29	163.47
	Labor Income	$1,110,471	$1,584,081	$4,830,847
	GRP	$1,457,769	$2,142,914	$5,517,697
Total Impact				
	Output	$3,065,558	$6,326,385	$19,178,884
	Job	32.19	48.06	232.24
	Labor Income	$1,302,958	$2,365,669	$8,565,114
	GRP	$1,866,483	$3,593,709	$12,113,489

The next three tables present the economic impacts by Industry Sector for each geographical region. Impacts at the National level show a tremendous expansion attributable to the multiple turnovers of money that ripple throughout the National economy.

Table 42. Economic Impact at Regional Level

IMPLAN No.	Industry Sector	Sales	Jobs	Labor Income	GRP
	Direct Effects				
115	Petroleum refineries	$420,782	0.05	$9,685	$59,624
198	Valve and fittings other than plumbing manufacturing	$2,404	0.01	$524	$1,053
319	Wholesale trade businesses	$73,008	0.50	$25,518	$54,167
323	Retail Stores - Building material and garden supply	$47,583	0.61	$20,729	$31,486
324	Retail Stores - Food and beverage	$44,339	0.83	$20,759	$31,541
332	Transport by air	$83	0.00	$8	$23
333	Transport by rail	$992	0.00	$314	$531
334	Transport by water	$247	0.00	$44	$73
335	Transport by truck	$16,956	0.14	$6,782	$8,468
337	Transport by pipeline	$2,579	0.00	$700	$662
413	Food services and drinking places	$55,703	1.05	$16,322	$27,404
417	Commercial and industrial machinery and equipment repair and maintenance	$1,527,013	16.18	$848,943	$1,081,797
5001	Labor	$159,151	6.63	$159,151	$159,151
69	All other food manufacturing	$7,981	0.02	$992	$1,789
	Total Direct Effects	$2,358,818	26.03	$1,110,471	$1,457,769
	Secondary Effects	$706,740	6.16	$192,487	$408,714
	Total Effects	**$3,065,558**	**32.19**	**$1,302,958**	**$1,866,483**

Table 43. Economic Impact at State Level

IMPLAN No.	Industry Sector	Sales	Jobs	Labor Income	GRP
	Direct Effects				
115	Petroleum refineries	$1,233,512	0.15	$33,960	$174,785
198	Valve and fittings other than plumbing manufacturing	$2,404	0.01	$524	$1,053
319	Wholesale trade businesses	$79,247	0.54	$28,239	$59,025
323	Retail Stores - Building material and garden supply	$55,745	0.72	$24,657	$37,171
324	Retail Stores - Food and beverage	$50,251	0.94	$23,762	$35,876
332	Transport by air	$356	0.00	$80	$150
333	Transport by rail	$992	0.00	$314	$531
334	Transport by water	$522	0.00	$96	$186
335	Transport by truck	$23,160	0.19	$9,696	$11,985
337	Transport by pipeline	$7,242	0.01	$2,517	$2,409
413	Food services and drinking places	$55,703	1.05	$16,322	$27,404
417	Commercial and industrial machinery and equipment repair and maintenance	$2,258,862	23.93	$1,280,386	$1,625,297
5001	Labor	$159,151	6.63	$159,151	$159,151

69	All other food manufacturing	$35,199	0.11	$4,376	$7,891
	Total Direct Effects	$3,962,344	34.29	$1,584,081	$2,142,914
	Secondary Effects	$2,364,040	13.77	$781,587	$1,450,795
	Total Effects	**$6,326,385**	**48.06**	**$2,365,669**	**$3,593,709**

Table 44. Economic Impact at National Level

IMPLAN No.	Industry Sector	Sales	Jobs	Labor Income	GRP
	Direct Effects				
115	Petroleum refineries	$1,307,459	0.16	$45,486	$221,935
198	Valve and fittings other than plumbing manufacturing	$168,119	0.58	$41,686	$80,947
319	Wholesale trade businesses	$185,681	1.27	$74,919	$141,899
323	Retail Stores - Building material and garden supply	$55,745	0.72	$24,657	$37,171
324	Retail Stores - Food and beverage	$50,862	0.95	$24,073	$36,324
332	Transport by air	$356	0.00	$85	$158
333	Transport by rail	$2,229	0.01	$709	$1,199
334	Transport by water	$523	0.00	$101	$197
335	Transport by truck	$25,763	0.22	$10,919	$13,461
337	Transport by pipeline	$7,451	0.01	$2,850	$2,731
413	Food services and drinking places	$55,703	1.05	$16,322	$27,404
417	Commercial and industrial machinery and equipment repair and maintenance	$2,386,459	25.28	$1,376,735	$1,720,056
5001	Labor	$3,183,023	132.56	$3,183,023	$3,183,023
69	All other food manufacturing	$206,428	0.65	$29,282	$51,192
	Total Direct Effects	$7,635,801	163.47	$4,830,847	$5,517,697
	Secondary Effects	$11,543,083	68.77	$3,734,267	$6,595,792
	Total Effects	**$19,178,884**	**232.24**	**$8,565,114**	**$12,113,489**

The total Petersburg Navigation Improvements Project Economic Impact for the State of Alaska geographical area, as displayed above, is composed of $19,178,884 in sales, 232 jobs, $8,565,114 in labor income, and a contribution of $12,113,489 to GRP.

4.8 Summary of Accounts and Plan Comparison

Plan formulation for this study focused on contributing to NED with consideration of all effects, beneficial or adverse, to each of the four evaluation accounts identified in the Economic and Environmental Principles and Guidelines (P&G) for Water and Related Land Resources Implementation Studies, 10 March 1983. Plan selection was based on a weighting of the projected effects of each alternative on the four evaluation accounts. The PDT reviewed qualitative and quantitative information for major project effects and for major potential effect categories.

4.8.1 National Economic Development

The results of the NED analysis were discussed in the previous sections with Alternative 3 maximizing net benefits. Under all benefit scenarios considered, Alternative 3 is economically justified with a benefit cost ratio ranging from 1.24 to 4.53, and net annual benefits of $95,000 to $1.4 million. The most likely BCR is 2.77 with net annual benefits of $698,000.

4.8.2 Regional Economic Development

Economic benefits that accrue to the region but not necessarily the Nation include increased income and employment associated with the construction of a project. Regarding construction spending, further analysis of regional economic benefits is detailed in the RED analysis section this appendix. The RED analysis includes the use of the RECONS model to provide estimates of regional job creation, retention, and other economic measures such as sales, or value added. Each alternative has a positive effect on RED commensurate with its construction expenditure.

4.8.3 Environmental Quality

Environmental Quality (EQ) displays the non-monetary effects of the alternatives on natural resources and is described more fully in the environmental assessment sections of the draft feasibility report.

4.8.4 Other Social Effects

The categories of effects in the Other Social Effects (OSE) account include urban and community effects; life, health, and safety factors; displacement; long-term productivity; and energy requirements and energy conservation. The OSE can be either beneficial or adverse (positive/negative) depending on the standard being measured.

Construction of this project in Petersburg supports the local economy and provides income to a small community. This injection of income to the Petersburg Borough allows for the provision of social services to the community, increasing community resilience and quality of life. Enhanced revenue to local businesses provides incentive to hire additional personnel, providing income stability to more of the local citizenry.

4.8.5 Four Accounts Evaluation Summary

Based on this analysis of the four accounts, each alternative has positive effects for the RED and OSE accounts, and temporary negative effects for the EQ account. Based on its preference in the NED account, the recommended plan for this study is Alternative 3. Table 45 shows a summary of the four accounts for all alternatives, with the recommended plan highlighted in yellow.

Table 45. Four Accounts Evaluation Summary

Alternative	**Net Annual Benefits (B/C Ratio)**[1]	**EQ**	**RED**	**OSE**
2	($993,000) 0.57	Negative (temporary)	Increased employment and income for the region and state	Beneficial
3	$698,000 2.77	Negative (temporary)	Increased employment and income for the region and state	Beneficial
4	$858,000 1.45	Negative (temporary)	Increased employment and income for the region and state	Beneficial
5	($546,000) 0.84	Negative (temporary)	Increased employment and income for the region and state	Beneficial

Notes:

1. This table shows net benefits and benefit–cost ratios for the “most likely” benefit scenario considered, which was estimated through Monte Carlo simulations. The BCR for Alternative 3 ranges from 1.24 to 4.53 based on the portion of vessels affected during low-tide cycles, with a most likely BCR of 2.77. See the Risk and Sensitivity section for details.
2. Alternative 4 meets the study objectives and provides additional opportunities for development of marine infrastructure in Scow Bay, resulting in higher net benefits than Alternative 3. In addition to providing the benefits estimated for Alternative 3, this alternative would produce additional transportation cost savings to vessels currently using haul-out facilities at other harbors in the region.

Petersburg Navigation Improvements

Appendix D: Essential Fish Habitat (EFH) Evaluation

Petersburg, Alaska

September 2018

US Army Corps of Engineers
Alaska District

Petersburg Navigation Improvements
Petersburg, Alaska

Essential Fish Habitat Assessment

US Army Corps
of Engineers
Alaska District

Prepared by:

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September 2018

I. PREFACE

The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act set forth the essential fish habitat (EFH) provision to identify and protect important habitats of federally-managed marine and anadromous fish species. Federal agencies that fund, permit, or undertake activities that may adversely affect EFH are required to consult with the National Marine Fisheries Service (NMFS) regarding the potential effects of their actions on EFH and respond in writing to NMFS recommendations.

EFH is defined as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. “Waters” include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include aquatic areas historically used by fish where appropriate. ”Substrate” includes sediment, hard bottom, structures underlying the waters, and associated biological communities.

Upon completing the Corps’ EFH-coordination with the NMFS, the Corps will incorporate its EFH evaluation and findings and NMFS conservation recommendations (if any) into the project’s environmental assessment. As a result of recent work in the Sitka area by the Corps and the FAA, and due to the proximity of Petersburg to Sitka, some of the same EFH information was used and is reflected in this analysis.

II. PROJECT PURPOSE

The U.S. Army Corps of Engineers (Corps) is proposing to dredge shoaled areas of the South Boat Harbor at Petersburg, Alaska. The purpose of the proposed dredging project is to restore design depths to allow for safe passage of vessels using the harbor. The harbor is shoaling in four areas with varying design depth requirements. A total of approximately 62,500-92,500 CYs of sediments are expected to be dredged with a mechanical dredge.

III. PROJECT AUTHORITY

Section 107 of the 1960 Rivers and Harbors Act (P.L. 86-645) and Section 915(d) of the 1986 Water Resources Development Act (P.L. 99-662) authorize the USACE to, without specific authorization, study, adopt, construct, and maintain navigation projects using the same procedures and policies that apply to Congressionally authorized projects. The Federal share of the initial implementation costs for any one project may not exceed $4 million and the program limit is $35 million per year. A Fact Sheet must be submitted to the HQUSACE for concurrence with the ASA (CW) before construction funds can be committed and prior to executing a Project Cooperation Agreement. Non-Federal sponsors must participate in project costs and Operation, Maintenance, Repair, Replacement and Rehabilitation in accordance with the established requirements herein set forth for navigation projects or measures (general harbor features, inland waterways, or recreational harbor features, as the case may be). The non-Federal sponsor must also hold and save the U.S. free from damages due to the construction, maintenance, and operation of the project. The non-Federal sponsor is also responsible for all project and maintenance dredging costs in excess of the Federal cost limit.

IV. PROJECT AREA DESCRIPTION

Petersburg, Alaska, and its harbor are located on the northwesterly tip of Mitkof Island at the intersection of Fredrick Sound and Wrangell Narrows. The nearest comparable ports are Ketchikan, Alaska, 116 miles to the southeast and Juneau, Alaska, 107 miles to the northwest (Figure EA-B-1).

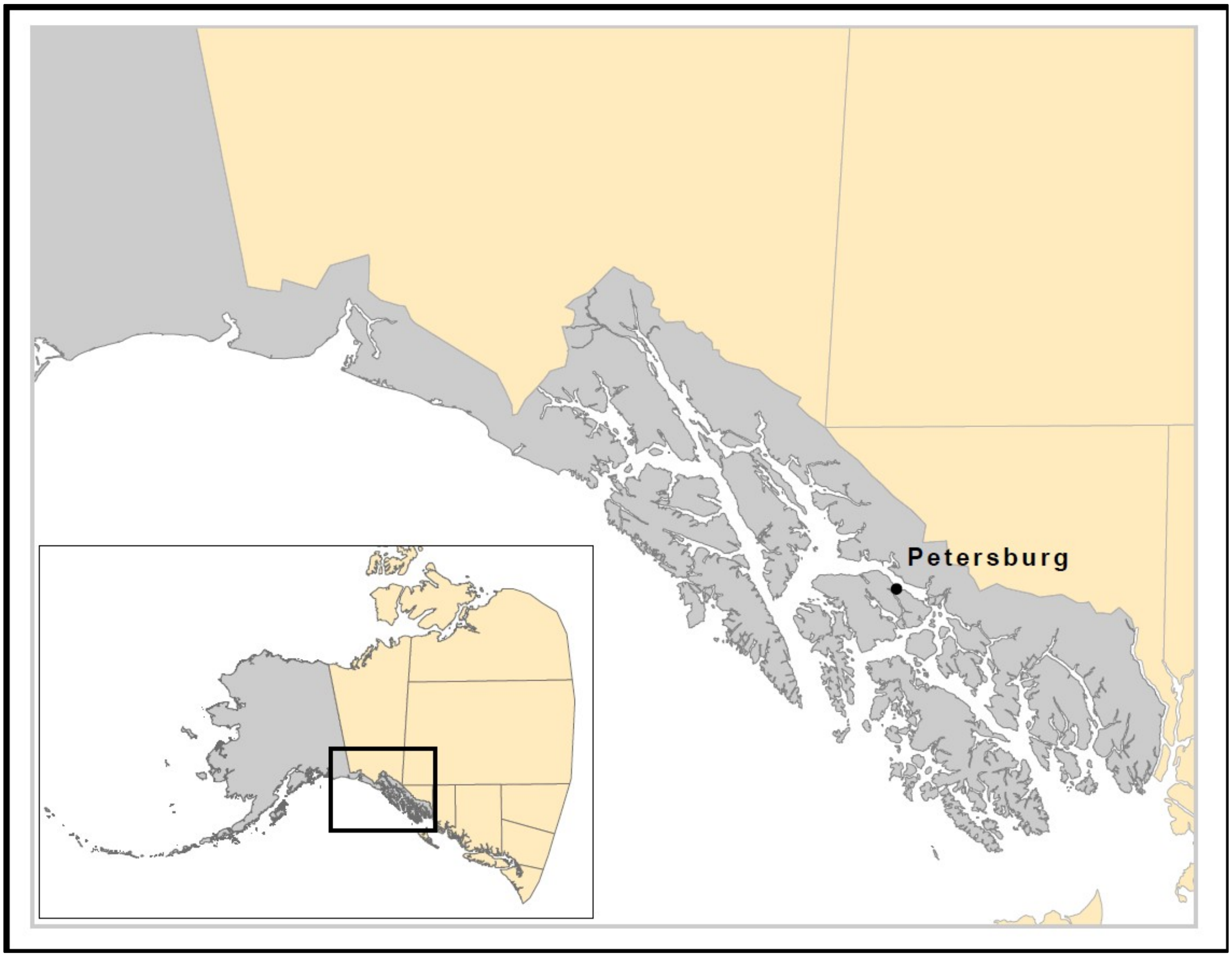


Figure E-B-1. Petersburg Location and Vicinity Map

Construction of the South Harbor was completed by the City of Petersburg in the mid-1980s and initial depths are not readily available. The Harbor was expanded in 2002 and some of that material was used to construct the drive down dock. The remaining material was disposed in the Frederick Sound disposal area. The 2002 determination regarding the jurisdictional status of the Frederick Sound disposal site was based on an earlier baseline. Current knowledge places the Frederick Sound disposal area in ocean waters and its use would be regulated under Section 103 of the Marine Protection, Research, and Sanctuaries Act (MPRSA). Evaluation of the Frederick Sound disposal site in accordance with 40 CFR 227-228. The burden of information required for designating a site under the MPRSA is not commensurate with the disposal needs for the proposed South Harbor dredging project, whereas a one-time disposal in the estuarine waters of Thomas Bay would not be expected to constitute more than minor impacts to the aquatic environment.

Thomas Bay lies 12 miles across Frederick Sound from the proposed dredging project location. It is a glacial fjord with deep (120-140 fathom) water and substrate consisting mostly of mud and sandy areas. Large volumes of alluvium are discharged from Baird Glacier at the north head of the bay, forming plumes of turbidity visible from aerial photography. The bay is largely confined by the headlands and a moraine lying four fathoms below the surface across the mouth of the bay.

V. PROJECT DESCRIPTION

The Alaska District proposes to dredge the South Harbor to a depth of 19.25 feet below mean lower low water (MLLW) in order to allow safe navigation, improve efficiency of harbor operation, and reduce fishing vessel downtime. Preliminary estimates of dredged material are between 59,310 and 82,740 CYs of sand with silt over clay (Table E-B-1). A mechanical dredge would likely be required to dislodge the hard clay material underlying the sand and silt. Construction could last up to three months. If the dredged material is suitable for in-water placement, it would be transported 12 miles across Frederick Sound to Thomas Bay for disposal inside the baseline. Chemical contamination precluding in-water placement would require upland disposal in a rock quarry or similar location on Mitkof Island.

Table E-B-1. Estimated quantities of dredged material from the South Harbor

Dredge Area	Dredge Depth [ft]	Dredge Volume [cy]	Dredge	One Foot Overdepth Allowance [cy]	Total Dredge Volume [cy]
Maneuvering Channel	-19.25	33,750	322,074	11,930	45,680
Between	-18	5,820	237,369	8,800	14,620
Landward of	-10	17,370	62,390	2,320	19,690
Behind Floats	-9	2,370	10,191	380	2,750
Total		59,310		23,410	82,740

The primary source of sediments is Hammer Slough, which enters Wrangell Narrows between Middle Harbor and South Harbor. Hammer Slough is a short stream system that drains the hillside above Petersburg. The system is interrupted by the Petersburg Airport; the runway impedes hydrology and fish passage. Bidirectional flow dominates the lower reaches of Hammer Slough and the Slough becomes nearly dry at low tide. Bathymetric survey of the area indicates the Slough flow is channelized and directed towards Middle and North Harbor. The frequency of infilling and need to dredge for the proposed South Harbor project is assumed to be similar to or less than the infilling in the North Harbor.

Timing of the dredging would be influenced by salmon migration, juvenile herring presence, marine mammal distribution, seasonal harbor activity, and constructability. The Petersburg fishing fleet is busiest during the summer, which would increase vessel traffic in the project area and potentially increase delays or the likelihood of accidents. Herring spawn in near-shore marine waters in the springtime, juvenile salmon also out-migrate from freshwater in the spring. Marine mammal abundance in Southeast Alaska, most notably humpback whales, increases in the summer. Adult salmon return to freshwater to spawn in the late summer and early fall.

VI. ESSENTIAL FISH HABITAT

NMFS authority to manage EFH is directly related to those species covered under Fishery Management Plans (FMPs) in the United States. The Corps' maintenance dredging action is within an area designated as EFH for two FMPs—Gulf of Alaska (GOA) Groundfish and Alaska Stocks of Pacific salmon. These two FMPs include species or species complexes of groundfish and invertebrate resources and all Pacific salmon species, including those listed in Table E-B-1.

See Attachment 1 for a description of GOA Groundfish resources. No EFH "habitat areas of particular concern" are in the Corps' project area.

Table E-B-2. Species With Established Fisheries Management Plans in the Project Area

Gulf of Alaska Groundfish	Alaska Stocks of Pacific Salmon
Skates (Rajidae)	Chinook
Pacific cod	Coho
Walleye Pollock	Sockeye
Thornyheads	Chum
Pacific ocean perch	Pink
Rougheye rockfish	
Yelloweye rockfish	
Rex sole	
Dover sole	
Flathead sole	
Sablefish	
Atka mackerel	
Shortraker rockfish	
Northern rockfish	
Dusky rockfish	
Yellowfin sole	
Arrowtooth flounder	
Rock sole	
Alaska plaice	
Sculpins (Cottidae)	
Sharks	
Forage fish complex	

Squid	
Octopus	

Near-shore habitats in proximity to the harbor are expected to be used by juvenile salmonids during their early marine life history. According to the Alaska Department of Fish and Game, approximately six streams in the Petersburg area are used by Chinook, coho, pink, and sockeye salmon. Juvenile salmon from these streams may use the near-shore project area during their spring outmigration, feeding along marine shorelines, gaining size and swimming ability before moving into more offshore waters. Young-of-the-year (all fish less than 1 year old) coho and sockeye salmon may also be found along the shoreline.

Rocky and mixed-soft shorelines provide a prey base of gammarid amphipods and harpacticoid copepods. Near-shore waters also harbor a myriad of predators on juvenile salmonids, including larger fish (e.g., rockfish and other salmonids), piscivorous birds (e.g., grebes, cormorants, herons), and marine mammals (seals, sea lions, and humpback whales). To avoid these predators, juvenile salmonids benefit from the presence of shoreline complexity (e.g., large wood, rocks, and kelp beds) that provide escape and hiding spaces. Offshore kelp beds in proximity to the harbor may provide an abundance of larval fish that are favored prey of juvenile pink and coho salmon. Both juvenile and adult salmon have been known to use kelp beds, but the association has not been well documented.

Larval, juvenile, and adult life stages of several rockfish species could occur in and in proximity to the Corps' project area.

Larval, juvenile, and adult life stages of several flatfish species are expected to occur on soft and mixed bottom habitats. EFH species of flatfish may be present in the project area, particularly common species such as yellowfin sole and rock sole.

Several taxa of EFH sculpin are expected to occur in both rocky and mixed bottom habitats in their project area. It is conceivable that all life stages of sculpin are likely present. EFH forage species such as eulachon, capelin, and Pacific sand lance could also occur as they are also known to be abundant in the Sitka area.

Pacific herring are not included in the Gulf of Alaska Groundfish FMP and hence are not an EFH species; however, they serve an important ecological role within Frederick Sound. Pacific herring provide an abundant, high energy food source for a wide variety of fishes, mammals, and birds. Herring are also commercially important and support a roe fishery in Southeast Alaska that remains one of the largest and most valuable roe fisheries in Alaska.

All stages of herring are found in the HPC and are central to the area's marine food web. The largest herring stock in Southeast Alaska migrates to Sitka Sound each spring for an annual spawning event, spanning several days to several weeks from mid-March to late-April. Based on Alaska Department of Fish and Game surveys over the last 30 years, herring spawning areas have been highly variable, but observed on marine vegetation around the perimeter of the Sitka Airport. Herring spawn from the intertidal zone down to about −40 feet MLLW, targeting areas with substantial macroalgae concentrations. Egg deposition can occurs on all species of kelp as observed in the Sitka area, particularly *Macrocystis* and *Saccharina*, but herring also use eelgrass, *Fucus*, coralline algae, red algae, and hard rocky substrates.

VII. ASSESSMENT OF PROJECT EFFECTS ON ESSENTIAL FISH HABITAT

The Corps' assessment of its project on EFH mirrors the approach and findings of FAA's Sitka Airport improvements EFH assessment (FAA, 2009), as the FAA project is adjacent to the Corps' project area in Sitka and includes similar features, such as fill placed in the marine near- shore environment and construction activities.

The types of impacts that would possibly affect EFH species/species complexes (five Pacific salmon species, the sculpin complex, and several species of flatfish, rockfish, and forage fish) known or highly likely to occur within the project area are separated into short-term and long-term impacts.

Short-term impacts include: (1) water quality impacts in the form of increased levels of turbidity resulting from fill and rock placement and oil/grease releases from work vessels and equipment; noise disturbance from operation of heavy equipment, cranes, or barges; and (2) disturbance from increased construction-related work boat traffic in the project area and along supply routes.

No significant long-term impacts are expected.

VIII. SHORT-TERM IMPACTS

Water Quality. Any turbidity would be temporary, occur only in the immediate vicinity of clamshell dredging, and dissipate rapidly by tidal mixing. Turbidity in the Thomas Bay disposal area is naturally high from the glacial silt inputs, so temporarily elevating turbidity in the immediate vicinity of the placement area would not have a serious impact on water quality. All dredged material that would be placed in Thomas Bay has been tested for chemical constituents of concern and determined to be suitable for in-water placement in accordance with the Seattle District Dredged Material Management Plan.

Juvenile salmon have been shown to avoid areas of high turbidities (Servizi 1988), although they may seek out areas of moderate turbidity (10 to 80 NTU), presumably as refuge against predation (Cyrus and Blaber 1987a and 1987b). Feeding efficiency of juveniles is impaired by turbidities in excess of 70 NTU, well below sublethal stress levels (Bisson and Bilby 1982). Reduced preference by adult salmon homing to spawning areas has been demonstrated where turbidities exceed 30 NTU (20 mg/L suspended sediments). However, Chinook salmon exposed to 650 mg/L of suspended volcanic ash were still able to find their natal water (Whitman et al. 1982).

Based on these data, it is unlikely that short-term (measured in hours based on tidal exchange frequency) and localized elevated turbidities generated by the proposed action would directly affect EFH juvenile or adult salmonids and EFH groundfish, such as flatfish, sculpins, and rockfish that may be present. Potential impacts would be further minimized by conducting all in- water work within approved regulatory work windows that would avoid major periods of juvenile salmon outmigration.

Except for the short-term, localized turbidity associated with transition dredging and disposal, no adverse impacts to water or sediment quality is expected to occur as a result of the recommended dredging action.

Waterborne Noise. Waterborne noise would result from construction activities, such as the noise generated directly by work vessels (propulsion, power generators, on-board cranes, etc.) or by activities conducted by those vessels (e.g., clamshell dredging and placing material into the barge).

Underwater noise or sound pressure from construction activities can have a variety of impacts on marine biota, especially fish and marine mammals. The most adverse impacts are associated with activities like underwater explosions and impact pile driving that produce a sharp sound through the water column (Hastings and Popper, 2005). However, in-water activities associated with the Corps' recommended maintenance dredging (e.g., work vessel traffic and operation) do not have the potential to generate the type and intensity of sound pressures that would result in adverse impacts to fish. At levels of sound resulting from the work activities anticipated, the primary reaction of EFH fish species/species complexes is expected to be simply a movement away from the work area. These affects would be further minimized by restricting in-water work to periods when few juvenile salmonids are in the area. Groundfish species such as flatfish, rockfish, and sculpins can be present year-round, so they may move out of the area during the construction period as well.

Construction-related Work Boat Traffic. Constructing the Corps' proposed project would heavily involve mechanical dredging and the placement of materials onto a barge. For EFH fish, interactions with tug and barge traffic would be relatively benign, consisting of the animals simply moving away from the vessels as they transit back and forth. Vessels and barges would not be permitted to ground themselves on the bottom during low tide periods, thus no destruction or alteration of bottom habitats that constitute EFH for several pelagic and groundfish would occur.

Long-term Impacts

Loss and Conversion of Marine Habitat. No loss or conversion of marine habitat is expected as a result of the maintenance dredging activity. Dredged material disposed in Thomas Bay is substantially similar to the native substrate and would be covered by alluvial deposition within a short time period.

Water Quality. Except for the previously discussed short term, localized turbidity associated with the placement of breakwater material into the marine environment, no adverse impacts to water or sediment quality, EFH, and EFH-related species/species complexes are expected to occur as a result of the recommended maintenance dredging.

Mitigation Measures. "Mitigation" is the process used to avoid, minimize, and compensate for environmental consequences of an action. Incorporating the following mitigation measures and conservation measures into the recommended corrective action will help to ensure that no significant adverse impacts would occur to EFH and EFH-managed species/species complexes and other fish and wildlife resources in the project area.

- The proposed action shall cease in-water construction between March 15 and June 15 during peak herring spawning activities, juvenile salmon outmigration and rearing activities, and when Steller sea lion and humpback whale feeding and abundance is expected to be greatest in the project area.
- To minimize the danger to marine mammals from project-related vessels, speed limits (e.g. less than 8 knots) shall be imposed on vessels moving in and around the project area.
- Project-related vessels and barges shall not be permitted to ground themselves on the bottom during low tide periods, unless there is a human safety issue requiring it.
- A construction oil spill prevention plan shall be prepared.
- Project-related vessels shall not travel within 3,000 feet of designated Steller sea lion critical habitat (haulouts or rookeries).
- The Corps will conduct post-dredge bathymetry surveys to ensure that only the material identified to be dredged was removed to the authorized depth.
- A scow barge will be loaded so that enough of the freeboard remains to allow for safe movement of the barge and its material on the route to the offloading site to be identified.

IX. CONCLUSIONS AND DETERMINATION OF EFFECT

The project actions described above have the potential to affect the EFH for several GOA groundfish species (e.g., rockfish, sculpin, and flatfish) and for Alaska stocks of Pacific salmon, in the short term. Short-term effects in the form of avoidance because of noise disturbances, boat traffic, and turbidity would be intermittent and low level. No long-term effects are expected.

The potential effects of turbidity would be intermittent and low level. No adverse impacts related to circulation and harbor-flushing is expected. Year-round resident EFH species such as rockfish, flatfish, and sculpins would likely respond by temporarily moving out of work areas during construction.

The Corps' recommended maintenance dredging would likely occur over a period of months and within an anticipated in-water work window. Seasonal work restrictions would minimize any impacts to out-migrating juvenile salmonids and to spawning herring by prohibiting work in open waters between approximately March 15 and June 15. Work would be allowed in marine waters from June 16 to March 14, to avoid herring spawning activities. The actual start and finish of the spring timing window may shift to accommodate earlier or later herring spawns.

Potential impacts to EFH and EFH-managed species/species complexes are likely to be highly localized, temporary, and minimal, and not reduce the overall value of EFH in Frederick Sound. The aforementioned mitigation measures will be implemented to offset the potential impacts of the Corps' maintenance dredging activity. Therefore, the Corps concludes that its Federal action may affect, but is not likely to adversely affect, EFH and EFH-managed species/species complexes for GOA groundfish and Alaska stocks of Pacific salmon.

X. REFERENCES

Alaska Department of Fish and Game. 1998. Sitka Boat Harbor Herring Deposition Study, Final Report with 1997 and 1998 Survey results. Commercial Fisheries Management and Development Division, Juneau, Alaska. November. 37 pp.

Bisson, P.A. and R.E. Bilby, 1982. Avoidance of Suspended Sediment by Juvenile Coho Salmon. North American Journal of Fisheries Management, 4:371-374.

Carr, H., and E. Amaral, 1981. Review of the Potential for Artificial Reefs along Coastal Massachusetts. In Proc. Oceans '81, p. 765-769.

Cyrus, D.P. and S.J.M. Blaber, 1987a. The Influence of Turbidity on Juvenile Marine Fishes in Estuaries. Part 1: Field Studies at Lake St. Lucia on the Southeastern Coast of Africa. Journal of Experimental Marine Biology and Ecology, 109:53-70.

Cyrus, D.P. and S.J.M. Blaber, 1987b. The Influence of Turbidity on Juvenile Marine Fishes in Estuaries. Part 2: Laboratory Studies, Comparisons with Field Data and Conclusions. Journal of Experimental Marine Biology and Ecology, 109:71-91.

Federal Aviation Administration. 2009. Final Environmental Impact Statement. Sitka Rocky Gutierrez Airport, Sitka, Alaska. Anchorage, AK. May. http://www.sitkaeis.com/feis.htm

Hastings, M.C. and A.N. Popper, 2005. Effects of Sound on Fish. Prepared for the California Department of Transportation by Jones and Stokes, Sacramento, California.

Lewis, L., J. Davenport, and T. Kelly, 2002. A Study of the Impact of a Pipeline Construction on Estuarine Benthic Invertebrate Communities. Estuar. Coast. Shelf Sci. Vol. 55, no. 2, pp. 213- 221.

NMFS, 2005a. Essential Fish Habitat Assessment Report for the Groundfish Resources of the Gulf of Alaska Region. Appendix F.1. NMFS, NMFS Alaska Region, Juneau, Alaska.

2005b. Essential Fish Habitat Assessment Report for the Salmon Fisheries in the EEZ off the Coast of Alaska. Appendix F.5. NMFS, NMFS Alaska Region, Juneau, Alaska.

Servizi, J.A., 1988. Sublethal Effects of Dredged Sediments on Juvenile Salmon. C.A. Simenstad, editor. Effects of Dredging on Anadromous Pacific Coast Fishes. University of Washington, Seattle, Washington.

Underwood, A., 2000. Experimental Ecology of Rocky Intertidal Habitats: What are We Learning? J. Exp. Mar. Biol. Ecol. Vol. 250, no. 1-2, pp. 51-76.

U.S. Fish and Wildlife Service. 2005. A Survey of Herring Spawning Habitat on the New Thompson Breakwaters, Sitka, Alaska. June 9-12, 2005. Juneau Field Office. For U.S. Army Corps of Engineers Alaska District. July. 29 pp.

1996. Report of Field Investigations for Sitka Breakwater Colonization and Herring Spawning Survey. Sitka, Alaska. Southeast Alaska Ecological Services, Juneau, Alaska. April. 5 pp.

Whitman, R.P., T.P. Quinn, and E.L. Brannon, 1982. Influence of Suspended Volcanic Ash on Homing Behavior of Adult Chinook Salmon. Transactions of the American Fisheries Society, 111:63-69.

ATTACHMENT 1

Description of Essential Fish Habitat (EFH) for the Groundfish Resources of the Gulf of Alaska Region

Walleye Pollock

Eggs. EFH for walleye Pollock eggs is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 meters), upper slope (200 to 500 meters), and intermediate slope (500 to 1,000 meters) throughout the Gulf of Alaska (GOA).

Larvae. EFH for larval walleye Pollock is the general distribution area for this life stage, located in epipelagic waters along the entire shelf (0 to 200 meters), upper slope (200 to 500 meters), and intermediate slope (500 to 1,000 meters) throughout the GOA.

Early Juveniles—No EFH Description Determined. Limited information exists to describe walleye Pollock early juvenile larval general distribution.

Late Juveniles. EFH for late juvenile walleye Pollock is the general distribution area for this life stage, located in the lower and middle portion of the water column along the inner (0 to 50 meters), middle (50 to 100 meters), and outer (100 to 200 meters) shelf throughout the GOA. No known preference for substrates exists.

Adults. EFH for adult walleye Pollock is the general distribution area for this life stage, located in the lower and middle portion of the water column along the entire shelf (0 to 200 meters) and slope (200 to 1,000 meters) throughout the GOA. No known preference for substrates exists.

Pacific Cod

Eggs. EFH for Pacific cod eggs is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 meters) and upper (200 to 500 meters) slope throughout the GOA wherever there are soft substrates consisting of mud and sand.

Larvae. EFH for larval Pacific cod is the general distribution area for this life stage, located in pelagic waters along the inner (0 to 50 meters) and middle (50 to 100 meters) shelf throughout the GOA wherever there are soft substrates consisting of mud and sand.

Early Juveniles—No EFH Description Determined. Insufficient information is available.

Late Juveniles. EFH for late juvenile Pacific cod is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 meters), middle (50 to 100 meters), and outer (100 to 200 meters) shelf throughout the Bering Sea and Aleutian Islands (BSAI) wherever there are soft substrates consisting of sand, mud, sandy mud, and muddy sand.

Adults. EFH for adult Pacific cod is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 meters), middle (50 to 100 meters), and outer (100 to 200 meters) shelf throughout the GOA wherever there are soft substrates consisting of sand, mud, sandy mud, muddy sand, and gravel.

Yellowfin Sole

Eggs. EFH for yellowfin sole eggs is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 meters) and upper (200 to 500 meters) slope throughout the GOA.

Larvae. EFH for larval yellowfin sole is the general distribution area for this life stage, located in pelagic waters along the shelf (0 to 200 meters) and upper slope (200 to 500 meters) throughout the GOA.

Early Juveniles—No EFH Description Determined. Insufficient information is available.

Late Juveniles. EFH for late juvenile yellowfin sole is the general distribution area for this life stage, located in the lower portion of the water column within near-shore bays and along the inner (0 to 50 meters), middle (50 to 100 meters), and outer (100 to 200 meters) shelf throughout the GOA wherever there are soft substrates consisting mainly of sand.

Adults. EFH for adult yellowfin sole is the general distribution area for this life stage, located in the lower portion of the water column within near-shore bays and along the inner (0 to 50 meters), middle (50 to 100 meters), and outer (100 to 200 meters) shelf throughout the GOA wherever there are soft substrates consisting mainly of sand.

Arrowtooth Flounder

Eggs—No EFH Description Determined. Insufficient information is available.

Larvae. EFH for larval arrowtooth flounder is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 meters) and slope (200 to 3,000 meters) throughout the GOA.

Early Juveniles—No EFH Description Determined. Insufficient information is available.

Late Juveniles. EFH for late juvenile arrowtooth flounder is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 meters), middle (50 to 100 meters), and outer (100 to 200 meters) shelf and upper slope (200 to 500 meters) throughout the GOA wherever there are softer substrates consisting of gravel, sand, and mud.

Adults. EFH for adult arrowtooth flounder is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 meters), middle (50 to 100 meters), and outer (100 to 200 meters) shelf and upper slope (200 to 500 meters) throughout the GOA wherever there are softer substrates consisting of gravel, sand, and mud.

Rock Sole

Eggs—No EFH Description Determined. Insufficient information is available.

Larvae. EFH for larval rock sole is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 meters) and upper slope (200 to 1,000 meters) throughout the GOA.

Early Juveniles—No EFH Description Determined. Insufficient information is available.

Late Juveniles. EFH for late juvenile rock sole is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 meters), middle (50 to 100 meters), and outer (100 to 200 meters) shelf throughout the BSAI wherever there are softer substrates consisting of sand, gravel, and cobble.

Adults. EFH for adult rock sole is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 meters), middle (50 to 100 meters), and outer (100 to 200 meters) shelf throughout the BSAI wherever there are softer substrates consisting of sand, gravel, and cobble.

Alaska Plaice

Eggs. EFH for Alaska plaice eggs is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 meters) and upper slope (200 to 500 meters) throughout the GOA in the spring.

Larvae. EFH for larval Alaska plaice is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 meters) and upper slope (200 to 500 meters) throughout the GOA.

Early Juveniles—No EFH Description Determined. Insufficient information is available.

Late Juveniles. EFH for late juvenile Alaska plaice is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 meters), middle (50 to 100 meters), and outer (100 to 200 meters) shelf throughout the BSAI wherever there are softer substrates consisting of sand and mud.

Adults. EFH for adult Alaska plaice is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 meters), middle (50 to 100 meters), andouter (100 to 200 meters) shelf throughout the BSAI wherever there are softer substrates consisting of sand and mud.

Rex Sole

Eggs. EFH for rex sole eggs is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 meters) and upper slope (200 to 500 meters) throughout the GOA in the spring.

Larvae. EFH for larval rex sole is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 meters) and upper slope (200 to 500 meters) throughout the GOA.

Early Juveniles—No EFH Description Determined. Insufficient information is available.

Late Juveniles. EFH for juvenile rex sole is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 meters), middle (50 to 100 meters), and outer (100 to 200 meters) shelf throughout the GOA wherever there are substrates consisting of gravel, sand, and mud.

Adults. EFH for adult rex sole is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 meters), middle (50 to 100 meters), and outer (100 to 200 meters) shelf throughout the GOA wherever there are substrates consisting of gravel, sand, and mud.

Dover Sole

Eggs. EFH for Dover sole eggs is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 meters) and slope (200 to 3,000 meters) throughout the GOA.

Larvae. EFH for larval Dover sole is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 meters) and slope (200 to 3,000 meters) throughout the GOA.

Early Juveniles—No EFH Description Determined. Insufficient information is available.

Late Juveniles. EFH for late juvenile Dover sole is the general distribution area for this life stage, located in the lower portion of the water column along the middle (50 to 100 meters), and outer (100 to 200 meters) shelf and upper slope (200 to 500 meters) throughout the GOA wherever there are substrates consisting of sand and mud.

Adults. EFH for adult Dover sole is the general distribution area for this life stage, located in the lower portion of the water column along the middle (50 to 100 meters), and outer (100 to

200 meters) shelf and upper slope (200 to 500 meters) throughout the GOA wherever there are substrates consisting of sand and mud.

Flathead Sole

Eggs. EFH for flathead sole eggs is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 meters) and slope (200 to 3,000 meters) throughout the GOA.

Larvae. EFH for larval flathead sole is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 meters) and slope (200 to 3,000 meters) throughout the GOA.

Early Juveniles—No EFH Description Determined. Insufficient information is available.

Late Juveniles. EFH for juvenile flathead sole is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 meters), middle (50 to 100 meters), and outer (100 to 200 meters) shelf throughout the GOA wherever there are softer substrates consisting of sand and mud.

Adults. EFH for adult flathead sole is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 meters), middle (50 to 100 meters), and outer (100 to 200 meters) shelf throughout the GOA wherever there are softer substrates consisting of sand and mud.

Sablefish

Eggs. EFH for sablefish eggs is the general distribution area for this life stage, located in deeper waters along the slope (200 to 3,000 meters) throughout the GOA.

Larvae. EFH for larval sablefish is the general distribution area for this life stage, located in epipelagic waters along the middle shelf (50 to 100 meters), outer shelf (100 to 200 meters), and slope (200 to 3,000 meters) throughout the GOA.

Early Juveniles—No EFH Description Determined. Insufficient information is available.

Late Juveniles. EFH for late juvenile sablefish is the general distribution area for this life stage, located in the lower portion of the water column, varied habitats, generally softer substrates, and deep shelf gulleys along the slope (200 to 1,000 meters) throughout the GOA.

Adults. EFH for adult sablefish is the general distribution area for this life stage, located in the lower portion of the water column, varied habitats, generally softer substrates, and deep shelf gulleys along the slope (200 to 1,000 meters) throughout the GOA.

Pacific Ocean Perch

Eggs—No EFH Description Determined. Insufficient information is available.

Larvae. EFH for larval Pacific Ocean perch is the general distribution area for this life stage, located in the middle to lower portion of the water column along the inner shelf (0 to 50 meters), middle shelf (50 to 100 meters), outer shelf (100 to 200 meters), and upper slope (200 to 500 meters) throughout the GOA.

Early Juveniles—No EFH Description Determined. Insufficient information is available.

Late Juveniles. EFH for late juvenile Pacific Ocean perch is the general distribution area for this life stage, located in the middle to lower portion of the water column along the inner shelf (0 to 50 meters), middle shelf (50 to 100 meters), outer shelf (100 to 200 meters), and upper slope (200 to 500 meters) throughout the GOA wherever there are substrates consisting of cobble, gravel, mud, sandy mud, or muddy sand.

Adults. EFH for adult Pacific Ocean perch is the general distribution area for this life stage, located in the lower portion of the water column along the outer shelf (100 to 200 meters) and upper slope (200 to 500 meters) throughout the GOA wherever there are substrates consisting of cobble, gravel, mud, sandy mud, or muddy sand.

Shortraker and Rougheye Rockfish

Eggs—No EFH Description Determined. Insufficient information is available.

Larvae. EFH for larval shortraker and rougheye rockfish is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 meters) and slope (200 to 3,000 meters) throughout the GOA.

Early Juveniles—No EFH Description Determined. Insufficient information is available.

Late Juveniles—No EFH Description Determined. Insufficient information is available.

Adults. EFH for adult shortraker and rougheye rockfish is the general distribution area for this life stage, located in the lower portion of the water column along the outer shelf (100 to 200 meters) and upper slope (200 to 500 meters) regions throughout the GOA wherever there are substrates consisting of mud, sand, sandy mud, muddy sand, rock, cobble, and gravel.

Northern Rockfish

Eggs—No EFH Description Determined. Insufficient information is available.

Larvae. EFH for larval northern rockfish is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 meters) and slope (200 to 3,000 meters) throughout the GOA.

Early Juveniles—No EFH Description Determined. Insufficient information is available.

Late Juveniles—No EFH Description Determined. Insufficient information is available.

Adults. EFH for adult northern rockfish is the general distribution area for this life stage, located in the middle and lower portions of the water column along the outer slope (100 to 200 meters) and upper slope (200 to 500 meters) throughout the GOA wherever there are substrates of cobble and rock.

Thornyhead Rockfish

Eggs—No EFH Description Determined. Insufficient information is available.

Larvae. EFH for larval thornyhead rockfish is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 meters) and slope (200 to 3,000 meters) throughout the GOA.

Early Juveniles—No EFH Description Determined. Insufficient information is available.

Late Juveniles. EFH for late juvenile Thornyhead rockfish is the general distribution area for this life stage, located in the lower portion of the water column along the middle and outer shelf (50 to 200 meters) and upper to lower slope (200 to 1,000 meters) throughout the GOA wherever there are substrates of mud, sand, rock, sandy mud, muddy sand, cobble, and gravel.

Adults. EFH for adult Thornyhead rockfish is the general distribution area for this life stage, located in the lower portion of the water column along the middle and outer shelf (50 to 200 meters) and upper to lower slope (200 to 1,000 meters) throughout the GOA wherever there are substrates of mud, sand, rock, sandy mud, muddy sand, cobble, and gravel.

Yelloweye Rockfish

Eggs—No EFH Description Determined. Insufficient information is available.

Larvae. EFH for larval yelloweye rockfish is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 meters) and slope (200 to 3,000 meters) throughout the GOA.

Early Juveniles—No EFH Description Determined. Insufficient information is available.

Late Juveniles. EFH for late juvenile Yelloweye rockfish is the general distribution area for this life stage, located in the lower portion of the water column within bays and island passages and along the inner (0 to 50 meters), middle (50 to 100 meters), and outer shelf (100 to 200 meters) throughout the GOA wherever there are substrates of rock and in areas of vertical relief, such as crevices, overhangs, vertical walls, coral, and larger sponges.

Adults. EFH for adult Yelloweye rockfish is the general distribution area for this life stage, located in the lower portion of the water column within bays and island passages and along the inner shelf (0 to 50 meters), middle shelf (50 to 100 meters), outer shelf (100 to 200 meters) and upper slope (200 to 500 meters) throughout the GOA wherever there are substrates of rock and in areas of vertical relief, such as crevices, overhangs, vertical walls, coral, and larger sponges.

Dusky Rockfish

Eggs—No EFH Description Determined. Insufficient information is available.

Larvae. EFH for larval dusky rockfish is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 meters) and slope (200 to 3,000 meters) throughout the GOA.

Early Juveniles—No EFH Description Determined. Insufficient information is available.

Late Juveniles—No EFH Description Determined. Insufficient information is available.

Adults. EFH for adult Dusky rockfish is the general distribution area for this life stage, located in the middle and lower portions of the water column along the outer shelf (100 to 200 meters) and upper slope (200 to 500 meters) throughout the GOA wherever there are substrates of cobble, rock, and gravel.

Atka Mackerel

Eggs—No EFH Description Determined. Insufficient information is available.

Larvae. EFH for larval Atka mackerel is the general distribution area for this life stage, located in epipelagic waters along the shelf (0 to 200 meters), upper slope (200 to 500 meters), and intermediate slope (500 to 1,000 meters) throughout the GOA.

Early Juveniles —No EFH Description Determined. Insufficient information is available.

Late Juveniles—No EFH Description Determined. Insufficient information is available.

Adults. EFH for adult Atka mackerel is the general distribution area for this life stage, located in the entire water column, from sea surface to the sea floor, along the inner (0 to 50 meters), middle (50 to 100 meters), and outer shelf (100 to 200 meters) throughout the GOA wherever there are substrates of gravel and rock and in vegetated areas of kelp

Sculpins

Eggs—No EFH Description Determined. Insufficient information is available.

Larvae—No EFH Description Determined. Insufficient information is available.

Juveniles. EFH for juvenile sculpins is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 meters), middle (50 to 100 meters), outer shelf (100 to 200 meters) and portions of the upper slope (200 to 500 meters) throughout the GOA wherever there are substrates of rock, sand, mud, cobble, and sandy mud.

Adults. EFH for adult sculpins is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 meters), middle (50 to 100 meters), outer shelf (100 to 200 meters) and portions of the upper slope (200 to 500 meters) throughout the GOA wherever there are substrates of rock, sand, mud, cobble, and sandy mud.

Skates

Eggs—No EFH Description Determined. Insufficient information is available.

Larvae—No EFH Description Determined. Insufficient information is available.

Early Juveniles—No EFH Description Determined. Insufficient information is available.

Late Juveniles—No EFH Description Determined. Insufficient information is available.

Adults. EFH for adult skates is the general distribution area for this life stage, located in the lower portion of the water column on the shelf (0 to 200 meters) and the upper slope (200 to 500 meters) throughout the GOA wherever there are of substrates of mud, sand, gravel, and rock.

Sharks

Eggs—No EFH Description Determined. Insufficient information is available.

Larvae—No EFH Description Determined. Insufficient information is available.

Early Juveniles—No EFH Description Determined. Insufficient information is available.

Late Juveniles—No EFH Description Determined. Insufficient information is available.

Adults—No EFH Description Determined. Insufficient information is available.

Forage Fish Complex—Eulachon, Capelin, Sand Lance, Sand Fish, Euphausiids, Myctophids, Pholids, Gonostomatids, etc.

Eggs—No EFH Description Determined. Insufficient information is available.

Larvae—No EFH Description Determined. Insufficient information is available.

Early Juveniles—No EFH Description Determined. Insufficient information is available.

Late Juveniles—No EFH Description Determined. Insufficient information is available.

Adults. No EFH Description Determined. Insufficient information is available.

Squid

Eggs—No EFH Description Determined. Insufficient information is available.

Young Juveniles—No EFH Description Determined. Insufficient information is available.

Late Juveniles. EFH for older juvenile squid is the general distribution area for this life stage, located in the entire water column, from the sea surface to sea floor, along the inner (0 to 50 meters), middle (50 to 100 meters), and outer (200 to 500 meters) shelf and the entire slope (500 to 1,000 meters) throughout the GOA.

Adults. EFH for adult squid is the general distribution area for this life stage, located in the entire water column, from the sea surface to sea floor, along the inner (0 to 50 meters), middle (50 to 100 meters), and outer (200 to 500 meters) shelf and the entire slope (500 to 1,000 meters) throughout the GOA.

Octopus

Eggs—No EFH Description Determined. Insufficient information is available.

Young Juveniles—No EFH Description Determined. Insufficient information is available.

Late Juveniles—No EFH Description Determined. Insufficient information is available.

Adults. No EFH Description Determined. Insufficient information is available.

Petersburg Navigation Improvements

Appendix E: Cost Engineering

Petersburg, Alaska

September 2018

US Army Corps
of Engineers
Alaska District

PETERSBURG NAVIGATION IMPROVEMENTS

PETERSBURG BOROUGH, ALASKA

COST ENGINEERING

Basis OVERVIEW

This Cost Engineering Basis will be consolidated into the decision document Feasibility Report for Petersburg, Alaska. The purpose of the feasibility study is to evaluate alternatives for a potential construction contract. This Appendix discusses the cost assumptions, methodology, materials, labor, and equipment, utilized in the contract construction cost estimates.

SCOPE - PROJECT TYPE, FEATURES & ALTERNATIVES

Petersburg municipality is a census-designated place in Petersburg Borough, Alaska. Petersburg Borough was incorporated on January 3, 2013. This project for Petersburg Harbor, is intended as dredging the protective harbor improvement measures. Petersburg, Latitude 56.8143, Longitude -132.9523, is located in Alaska's southeast panhandle, on the northwest end of Mitkof Island, where the Wrangell Narrows meet Frederick Sound. It lies midway between Juneau and Ketchikan, about 120 miles from either community.

Petersburg falls within the southeast maritime climate zone, characterized by cool summers, mild winters and heavy rain throughout the year. Petersburg has developed into one of Alaska's major fishing communities. Across the narrows is the town of Kupreanof, which was once busy with fur farms, a boat repair yard, and a saw mill.

Petersburg is accessed by air and water. Freight arrives by barge, ferry, or cargo plane. It is on the mainline state ferry route and has ferry terminals on the north and south ends of Mitkof Island. The state-owned James A. Johnson Airport has a runway for scheduled jet service and small plane charter services. Lloyd R. Roundtree Seaplane Base (on the Wrangell Narrows) allows for float plane services. Remote areas of the Borough are served by small state-owned boat docks at Papke's Landing in the Wrangell Narrows, on Kupreanof Island at the City of Kupreanof, and in Hobart Bay.

Petersburg Harbor facilities include a petroleum wharf, barge terminals, three boat harbors (North, Middle, and South) with moorage for 700 boats, a boat launch, and a boat haul-out. There is no deep-water dock for large ships (such as cruise ships); passengers are lightered to shore. Boat launch ramps are located on the south end of Mitkof Island at Banana Point, Blaquerie Point, and Woodpecker Cove. The state owned Mitkof Highway carries traffic north and south and is paved or chip sealed for 28 miles between the South Mitkof Ferry Terminal and the airport.

Currently marine vessels experience delays and damages due to lack of sufficient harbor draft and isostatic rebound. The primary purpose for the study is to determine feasibility of navigation improvements that would that would decrease transportation inefficiencies within the harbor system.

The primary selected project feature is dredging the South Harbor (about 14.5 acres). The Entrance Channel areas will be dredged to a max pay depth of about -20 MLLW. The commercial and recreational floats will be dredged to a maximum of -19 MLLW and -11 MLLW, respectively. The sump area will be dredged to -10 MLLW. A 1ft allowance is calculated into the max pay dredge quantity. There is about a 14 foot tide level difference between MLW and MHW, with a Mean Tide of 8.3 ft above MLLW.

The minor project feature is dredge material handling and disposal. The dredge material was tested with low or no contamination that qualifies as clean disposal which could be either, truck-hauled and stockpiled upland for some beneficial use, or barge-transported for in-water disposal in an acceptable area. The TSP Current Working Estimate assumes 20-mile barge haul to in-water disposal.

Disposal of dredge spoil options will be evaluated before or during PED to determine least likely cost in accordance with current guidance. Several alternatives to dredge/dispose a harbor basin to different depths and footprints were reviewed. For purposes of this TSP, it is assumed that 100% of the dredge quantity is eligible to be disposed in-water at Thomas Bay.

MAJOR ASSUMPTIONS - COST ESTIMATE BASIS SUMMARY

Documents Referenced for Cost Scope of Work: Alternatives Sketches, Geotechnical Survey Drawings, Quantities from Designers, and the Feasibility Report. Quantities and dimensions were provided by the project designers (see APPENDIX, HYDRAULIC DESIGN). Project conditions and construction costing were based upon the alternatives presented. Lands and Damages costs were provided by the Real Estate Branch, POA. The PED, SIOH, Cost Share, and the Cultural Resources costs were provided by the project PM/PF.

Labor rates are based on Alaska Laborers' & Mechanics' Minimum Rates of Pay, 1 Apr 2018. Equipment rates are based on MII Equipment 2018 Region 09. CEDEP was used to calculate most likely direct cost of dredging and disposal. On-Road Diesel was assumed at $3.75/Gal. Marine diesel is currently about $3.12/Gal. Fuel price is volatile across Alaska, and contractors often purchase bulk quantities and mobilize the majority of the fuel they expect to use to have a reliable supply and known price because third party deliveries to remote sites are uncertain and subject to rapid price increases.

Construction Prime Contractor Markups include Alaska payroll tax, and WCI for Excavation; a 15.0% FOOH, 7% HOOH, 8.4% PWG, and 1.0% Bond. A Tug & Barge owned by the Prime contractor was used to calculate mob/demob of assumed dredge plant and support equipment. A Drill/Blast Sub-contractor was used for alternatives as needed, as this work can be specialized, hazardous, and likely executed concurrently with the dredging.

The dredging work is well understood, and access to the harbor would be with marine floating equipment, as was in dredging Petersburg North Harbor in 2013. Dredging with disposal in-water has been accomplished a number of times in previous Alaska dredging contracts. Weather is a direct impact on working in the marine coastal environment with both land-based and floating equipment. There may be local ordinance constraints and environmental windows to complete the work, and marine vessel traffic accessing Petersburg may experience delays and temporary mooring relocations. The proposed construction work would start by May 2020 and finish by November 2020. Winter work may be possible, but was not presumed for this CWE.

Project cost risks include encountering large rocks or marine debris; mischaracterization of dredge materials; vessel traffic delays; freezing temperatures; storms and increased wind/waves. The project dredge Max Pay depth is about 30 feet below MSL and is not anticipated to contain scarce or unique cultural, historic, or tribal resources. This work has moderate to average project cost risk.

Contingency for alternative selection was derived from the Cost Abbreviated Risk Analysis (ARA). The ARA defined contingencies for the project budget. Construction Escalation is based on the Civil Works Construction Cost Index System (CWCCIS), EM 1110-2-1304, dated 30 Sep 2017. Please refer to the Total Project Cost Summary (TPCS) for cost share breakdown.

The Construction Contractor will furnish all labor, equipment, supplies and materials to accomplish the work. Contract acquisition is assumed to be IFB. Construction can occur throughout the year. Any exceptions when no in-water work will be performed is being coordinated with concerned agencies. Off-season dredge work may be required.

COST ESTIMATE SUMMARY – ARA - TPCS

The initial cost range of the Alt#3 project is $4-$6 million at the Contract Cost level. Initial Abbreviated Risk Analysis put the project cost Contingency moderate to high because of the lack of field/design data, the possibility of contaminated upland disposal, and the uncertainty of the need to remove hard material. The dredged material may have beneficial use. These issues are being reviewed and it is anticipated the data will be refined before and during PED. The current Total Project Cost of the Tentatively Selected Plan is under $10 million including a contingency of 23% and escalation of 3.24%.

2020 Navigation Improvements, Petersberg, Alaska Alt #3 TSP CWE

Petersburg municipality is a census-designated place in Petersburg Borough, Alaska. Petersburg Borough was incorporated on January 3, 2013. This project for Petersberg Harbor, is intended as dredging the protective harbor improvement measures. Petersberg, Latitude 56.8143, Longitude -132.9523, is located in Alaska’s southeast panhandle, on the northwest end of Mitkof Island, where the Wrangell Narrows meet Frederick Sound. It lies midway between Juneau and Ketchikan, about 120 miles from either community. The proposed construction work would start by May 2020 and finish by November 2020.

Harbormaster's Office
223 Harbor Way in downtown Petersburg.
mailing address: P.O. Box 329, Petersburg, Alaska 99833
Phone: (907) 772-4688
Fax: (907) 772-4687
VHF Channel 16, CB-9
Harbormaster Glo Wollen
Port Administrator/Office Manager Ed Tagaban

Borough Sales Tax Rate 6%
Transient Room Tax 4%
Tobacco Excise Tax $2.03 each pack of cigarettes
Marijuana Excise Tax $25.00 per ounce

Estimated by	Al Arruda
Designed by	POA-EC-CW-HH
Prepared by	Al Arruda
Preparation Date	8/6/2018
Effective Date of Pricing	7/15/2018
Estimated Construction Time	150 Days

Designed by
POA-EC-CW-HH
Estimated by
Al Arruda
Prepared by
Al Arruda

Design Document	Hydraulic Design Appendix
Document Date	7/16/2018
District	Alaska District
Contact	Karl Harvey
Budget Year	2020
UOM System	Original

Direct Costs

LaborCost
EQCost
MatlCost
SubBidCost
CEDEP

Timeline/Currency

Preparation Date	8/6/2018
Escalation Date	9/30/2017
Eff. Pricing Date	7/15/2018
Estimated Duration	150 Day(s)
Currency	US dollars
Exchange Rate	1.000000

Costbook CB15Eng: MII English Cost Book 2015

Labor AKDOL: Alaska Labor & Mech 2018
Note: Updated 1 Mar 2018

Labor Rates

LaborCost1
LaborCost2
LaborCost3
LaborCost4

Equipment EP18R09: MII Equipment 2018 Region 09

09 ALASKA

Sales Tax	0.00
Working Hours per Year	1,040
Labor Adjustment Factor	1.19
Cost of Money	2.38
Cost of Money Discount	25.00
Tire Recap Cost Factor	1.50
Tire Recap Wear Factor	1.80
Tire Repair Factor	0.15
Equipment Cost Factor	1.10
Standby Depreciation Factor	0.50

Fuel

Electricity	0.179
Gas	3.290
Diesel Off-Road	3.010
Diesel On-Road	3.190

Shipping Rates

Over 0 CWT	63.98
Over 240 CWT	53.95
Over 300 CWT	43.11
Over 400 CWT	49.09
Over 500 CWT	33.08
Over 700 CWT	31.15
Over 800 CWT	27.79

Direct Cost Markups	**Category**	**Method**
Productivity	Productivity	Productivity
OT 7-10	Overtime	Overtime

	Days/Week	*Hours/Shift*	*Shifts/Day*	*1st Shift*	*2nd Shift*	*3rd Shift*
Standard	*5.00*	*8.00*	*1.00*	*8.00*	*0.00*	*0.00*
Actual	*7.00*	*8.00*	*1.00*	*10.00*	*0.00*	*0.00*

Day	*OT Factor*	*Working*	*OT Percent*	*FCCM Percent*
Monday	*1.50*	*Yes*	*21.43*	*(42.86)*
Tuesday	*1.50*	*Yes*		
Wednesday	*1.50*	*Yes*		
Thursday	*1.50*	*Yes*		
Friday	*1.50*	*Yes*		
Saturday	*1.50*	*Yes*		
Sunday	*1.50*	*Yes*		

Sales Tax	TaxAdj	Running % on Selected Costs
MatlCost		
UserCost2		
Bed Tax	TaxAdj	Running % on Selected Costs
SubBidCost		

Contractor Markups	**Category**	**Method**
FOOH	Allowance	Running %
JOOH (Small Tools)	JOOH	% of Labor
JOOH	JOOH	JOOH (Calculated)
HOOH	HOOH	Running %
Sub Profit	Allowance	Running %
Prime Profit	Profit	Profit Weighted Guidelines

Guideline	*Value*	*Weight*	*Percentage*
Risk	*0.090*	*20*	*1.80*
Difficulty	*0.075*	*15*	*1.13*
Size	*0.040*	*15*	*0.60*
Period	*0.060*	*15*	*0.90*
Invest (Contractor's)	*0.120*	*5*	*0.60*
Assist (Assistance by)	*0.075*	*5*	*0.38*
SubContracting	*0.120*	*25*	*3.00*
Total		*100*	*8.40*

Bond	Bond	Running %

Owner Markups	**Category**	**Method**
Esc to 2020 MP	Escalation	Escalation

StartDate	*StartIndex*	*EndDate*	*EndIndex*	*Escalation*
8/1/2018	*835.59*	*7/1/2020*	*869.95*	*4.11*

Contingency	Contingency	Running %
SIOH	SIOH	Running %

Description	Quantity	UOM	ContractCost	Contingency	Escalation	MiscOwner	SIOH	ProjectCost
Project Cost Summary Report			**4,694,091**	**0**	**192,105**	**0**	**0**	**4,886,196**
			20,000.00					*20,000.00*
01 REAL ESTATE	**1.00**	**EA**	**20,000**	**0**	**0**	**0**	**0**	**20,000**
(Note: Assume $20k Placeholder for administrative costs. Final cost estimate to be provided by RE Officer.)								
			56.49					*58.81*
12 NAVIGATION, PORTS & HARBORS	**82,740.00**	**BCY**	**4,674,091**	**0**	**192,105**	**0**	**0**	**4,866,196**
(Note: The primary selected project feature is dredging the South Harbor (about 14.5 dredged acres). The inner and outer harbor areas will be dredged to a max depth of about -20 MLLW. The commercial and recreational floats will be dredged to -19 MLLW and -11 MLLW, respectively. The sump area will be dredged to -10 MLLW. A 1ft allowance is calculated into the total dredge quantity. There is about a 14 foot tide level difference between MLW and MHW, with a Mean Tide of 8.3 ft above MLLW.)								
CLIN 0002 Mobilization and Demobilization	**1.00**	**LS**	**1,030,265**	**0**	**42,344**	**0**	**0**	**1,072,609**
(Note: Assume Dredge Contractor mobilizes from the Pacific West Coast of the Lower 48 (Seattle, WA). Assume 1980 barge miles from Seattle to Dutch Hbr.)								
			15,482.51					*16,118.84*
Submittals	**1.00**	**EA**	**15,483**	**0**	**636**	**0**	**0**	**16,119**
			501,053.34					*521,646.63*
Mob/Demob Dredge Plant & Crew	**2.00**	**EA**	**1,002,107**	**0**	**41,187**	**0**	**0**	**1,043,293**
			2,321.25					*2,416.65*
Road Mobilization	**2.00**	**EA**	**4,642**	**0**	**191**	**0**	**0**	**4,833**
(Note: Assume transport equipment to/from port.)								
			2,435.15					*2,535.24*
Field Office Personnel Mob/Demob	**16.00**	**PN**	**38,962**	**0**	**1,601**	**0**	**0**	**40,564**
(Note: Assume 2 Management and 6 Engineering office personnel from SEA RT. Additional office personnel are local hire. Dredge crew travel are covered under Dredge mobilization. Tug crew travel aboard their vessel.)								
			479,250.89					*498,948.10*
Dredge Mobilization	**2.00**	**EA**	**958,502**	**0**	**39,394**	**0**	**0**	**997,896**
(Note: It is assumed that the contractor will mob from the Seattle area.)								
			12,675.74					*13,196.71*
Pre-Work	**1.00**	**EA**	**12,676**	**0**	**521**	**0**	**0**	**13,197**
			41.85					*43.57*

Description	Quantity	UOM	ContractCost	Contingency	Escalation	MiscOwner	SIOH	ProjectCost
Dredging	**82,740.00**	**BCY**	**3,463,052**	**0**	**142,331**	**0**	**0**	**3,605,383**
(Note: Dredge Petersberg Harbor. Existing floats to remain. Year-round vessel traffic. Assume uncontaminated material disposal in-water. Assume existing harbor float removal and vessel relocation is the responsibility of the City.)								
			2,669.71					*2,779.43*
Nav Bouys	**6.00**	**EA**	**16,018**	**0**	**658**	**0**	**0**	**16,677**
(Note: Set and remove navigation bouys for the work area. Markers will be set and removed for each Site.)								
			1,334.85					*1,389.72*
Marker Bouys	**6.00**	**EA**	**8,009**	**0**	**329**	**0**	**0**	**8,338**
(Note: Set and remove channel markers while dredging within the area.)								
			41.56					*43.27*
Dredging - Thomas Bay disposal	**82,740.00**	**BCY**	**3,439,024**	**0**	**141,344**	**0**	**0**	**3,580,368**
(Note: Dredge sedimentary materials with excavator or crane and 8 cy environmental bucket. CEDEP determined unit cost for dredging & 20-mile barge haul/disposal with offloading time. Assume 1500 cy dump scows with tug hauling 20 miles to disposal. Assume 1 work shifts, 10 hrs/shift, 7 days/week due to local noise ordinances. Dredging work duration is expected to be about 100 days production with surveys and disposal time. Stormy weather, equipment breakdowns, vessel traffic, and other unforseen events may well extend that time.)								
			0.29					*0.30*
Surveys	**632,024.00**	**SF**	**180,774**	**0**	**7,430**	**0**	**0**	**188,204**
(Note: Harbor Surface area: 70,225 sq yds. Assume Survey Surface Area is 110% the dredged area for overlap both sides and ends.)								
			25,272.30					*26,310.99*
Hydrographic Surveys for Harbor Base Items, Complete - Petersberg	**6.00**	**EA**	**151,634**	**0**	**6,232**	**0**	**0**	**157,866**
(Note: Assume harbor survey limits could be covered in 5-8 hours work.)								
			25,272.30					*26,310.99*
0006 Hydrographic Surveys for Harbor Area, Complete	**6.00**	**EA**	**151,634**	**0**	**6,232**	**0**	**0**	**157,866**
(Note: The contractor is to provide a pre survey of the project limits and a post survey of the dredgecd locations. Also interim surveys of dredged areas will be used to verify depth reached.)								
			28,732.15					*29,913.04*
Pre/Post Survey Field Work	**2.00**	**EA**	**57,464**	**0**	**2,362**	**0**	**0**	**59,826**
			11,196.41					*11,656.58*

Description	Quantity	UOM	ContractCost	Contingency	Escalation	MiscOwner	SIOH	ProjectCost
Interim Survey Field Work	**4.00**	**EA**	**44,786**	**0**	**1,841**	**0**	**0**	**46,626**
(Note: Assume one interim survey per month.)								
Survey Office Work	**6.00**	**EA**	*8,230.64* **49,384**	**0**	**2,030**	**0**	**0**	*8,568.92* **51,414**
0012 Hydrographic Surveys for Disposal Area, Complete - Thomas Bay	**2.00**	**EA**	*14,569.97* **29,140**	**0**	**1,198**	**0**	**0**	*15,168.80* **30,338**
(Note: The contractor is to provide a pre survey of the project limits and a post survey of the disposal location.)								
Pre/Post Survey Field Work	**2.00**	**EA**	*6,339.33* **12,679**	**0**	**521**	**0**	**0**	*6,599.88* **13,200**
(Note: Done concurrently with Harbor Pre/Post Surveys.)								
Survey Office Work	**2.00**	**EA**	*8,230.64* **16,461**	**0**	**677**	**0**	**0**	*8,568.92* **17,138**

Abbreviated Risk Analysis

Project (less than $40M): **Petersberg SBH Dredging**

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

Risk Category: **Moderate Risk: Typical Project Construction Type**

Alternative: **Alt#3 Dredging & Disposal South Hbr**

Meeting Date: **5/11/2018**

Total Estimated Construction Contract Cost = **$ 4,674,091**

	CWWBS	Feature of Work	Contract Cost		% Contingency	$ Contingency	Total
	01 LANDS AND DAMAGES	Real Estate	**$ 20,000**		**20.00%**	$ 4,000	$ 24,000
1			$ -		0.00%	$ -	$ -
2	**12 NAVIGATION, PORTS AND HARBORS**	**Mob/Demob**	**$ 1,030,265**		28.77%	$ 296,452	$ 1,326,717
3	**12 NAVIGATION, PORTS AND HARBORS**	**Slope Protection**	**$ -**		0.00%	$ -	$ -
4	**12 NAVIGATION, PORTS AND HARBORS**	**South Hbr Basin Dredging & Disposal**	**$ 3,643,826**		22.40%	$ 816,289	$ 4,460,114
5	**12 NAVIGATION, PORTS AND HARBORS**		**$ -**		0.00%	$ -	$ -
6	**12 NAVIGATION, PORTS AND HARBORS**		**$ -**		0.00%	$ -	$ -
7	**12 NAVIGATION, PORTS AND HARBORS**		**$ -**		0.00%	$ -	$ -
8	**12 NAVIGATION, PORTS AND HARBORS**		**$ -**		0.00%	$ -	$ -
9	**12 NAVIGATION, PORTS AND HARBORS**		**$ -**		0.00%	$ -	$ -
10	**12 NAVIGATION, PORTS AND HARBORS**	**Remove / Replace New South Hbr Floats**	**$ -**		0.00%	$ -	$ -
11			**$ -**		0.00%	$ -	$ -
12	All Other	**Remaining Construction Items**	**$ -**	*0.0%*	0.00%	$ -	$ -
13	30 PLANNING, ENGINEERING, AND DESIGN	**Planning, Engineering, & Design**	**$ 1,161,227**	24.8%	20.55%	$ 238,666	$ 1,399,893
14	31 CONSTRUCTION MANAGEMENT	**Construction Management**	**$ 619,321**	13.3%	20.43%	$ 126,513	$ 745,834
XX	FIXED DOLLAR RISK ADD (EQUALLY DISPERSED TO ALL, MUST INCLUDE JUSTIFICATION SEE BELOW)					**$ -**	

Totals				
Real Estate	$ 20,000	20.00%	$ 4,000	$ 24,000.00
Total Construction Estimate	$ 4,674,091	23.81%	$ 1,112,741	$ 5,786,831
Total Planning, Engineering & Design	$ 1,161,227	20.55%	$ 238,666	$ 1,399,893
Total Construction Management	$ 619,321	20.43%	$ 126,513	$ 745,834
Total Excluding Real Estate	**$ 6,454,639**	**23%**	**$ 1,477,919**	**$ 7,932,558**

	Base	**50%**	**80%**
Confidence Level Range Estimate ($000's)	$6,455k	$7,342k	$7,933k

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

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

Petersberg SBH Dredging CAP 107		Current Estimated Cost **1-Oct-18**			**Current Project Scope**			**Cost Share Breakout**			
CW Account		**Contract Cost**	**Contingency**	**Cost + Contingency**	**Dredge CY Qty**	**FootPrint Area**	**Bank Ht**	**FED %**	**LSF%**	**FED $**	**LSF $**
01	REAL ESTATE										
	Administration	$ 20,000.00	$ 4,000.00	$ 24,000.00				90.0%	10.0%	$ 21,600.00	$ 2,400.00
12	NAVIGATION, PORTS & HARBORS										
	Mobilization and Demobilization	$ 1,030,264.93	$ 296,451.88	$ 1,326,716.81				90.0%	10.0%	$ 1,194,045.12	$ 132,671.68
	Dredging - Thomas Bay disposal										
	Nav Bouys	$ 16,018.25	$ 3,588.40	$ 19,606.65				90.0%	10.0%	$ 17,645.99	$ 1,960.67
	Marker Bouys	$ 8,009.12	$ 1,794.20	$ 9,803.32				90.0%	10.0%	$ 8,822.99	$ 980.33
	Dredge Maneuver Channel -19.25 (ALL GNF)	$ 1,763,739.96	$ 395,112.54	$ 2,158,852.50	45,680	322,074	3.83	90.0%	10.0%	$ 1,942,967.25	$ 215,885.25
	Dredge Basin -18 (ALL LSF)	$ 1,102,216.77	$ 246,918.30	$ 1,349,135.07	13,620	237,369	1.55	0.0%	100.0%	$ -	$ 1,349,135.07
	Dredge Basin -18 (ALL GNF)	$ 80,926.34	$ 18,129.10	$ 99,055.44	1,000	237,369	0.11	90.0%	10.0%	$ 89,149.89	$ 9,905.54
	Dredge Basin -10 (ALL LSF)	$ 429,196.83	$ 96,148.56	$ 525,345.39	19,690	62,390	8.52	0.0%	100.0%	$ -	$ 525,345.39
	Dredge Basin -9 (ALL LSF)	$ 62,944.58	$ 14,100.83	$ 77,045.41	2,750	10,191	7.29	0.0%	100.0%	$ -	$ 77,045.41
	Surveys										
	Hydrographic Surveys for Harbor - Petersberg	$ 151,633.77	$ 33,968.96	$ 185,602.73				90.0%	10.0%	$ 167,042.45	$ 18,560.27
	Hydrographic Surveys for Disposal Area - Thomas Bay	$ 29,139.94	$ 6,527.92	$ 35,667.86				90.0%	10.0%	$ 32,101.08	$ 3,566.79
30	PED 15.0%	$ 701,113.58	$ 144,099.11	$ 845,212.69				90.0%	10.0%	$ 760,691.42	$ 84,521.27
31	S&A 8.0%	$ 373,927.24	$ 76,384.44	$ 450,311.68				90.0%	10.0%	$ 405,280.52	$ 45,031.17
TOTAL PROJECT (No Escalation)		**$ 5,769,131.31**	**$ 1,337,224.24**	**$ 7,106,355.54**	82,740	869,393		**65.3%**	**34.7%**	$ 4,639,346.71	$ 2,467,008.83

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

PROJECT: **Petersburg SBH Dredging CAP 107**
PROJECT NO: **P2 447803**
LOCATION: **PETERSBURG HARBOR, ALASKA**

DISTRICT: **ALASKA DISTRICT, POA** PREPARED: **8/9/2018**
POC: **CHIEF, COST ENGINEERING, Karl Harvey**

This Estimate reflects the scope and schedule in report; Petersburg CAP 107 Final Array of Alternatives 7 May 2018

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
								Program Year (Budget EC):		2019					
								Effective Price Level Date:		1-Oct- 18					
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	REMAINING COST ($K)	Spent Thru: 1-Oct-18 ($K)	TOTAL FIRST COST ($K)	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
12	NAVIGATION PORTS & HARBORS	$1,030	$296	29%	$1,327		$1,030	$296	$1,327		$1,327	3.0%	$1,061	$305	$1,367
12	NAVIGATION PORTS & HARBORS	$3,644	$816	22%	$4,460		$3,644	$816	$4,460		$4,460	3.0%	$3,754	$841	$4,595
	#N/A			-		-						-			
				-		-						-			
	CONSTRUCTION ESTIMATE TOTALS:	$4,674	$1,113		$5,787		$4,674	$1,113	$5,787		$5,787	3.0%	$4,816	$1,146	$5,962
01	LANDS AND DAMAGES	$20	$4	20%	$24		$20	$4	$24		$24	2.0%	$20	$4	$24
30	PLANNING, ENGINEERING & DESIGN	$699	$144	21%	$843		$699	$144	$843		$843	3.1%	$721	$148	$869
31	CONSTRUCTION MANAGEMENT	$374	$76	20%	$450	0.0%	$374	$76	$450		$450	6.3%	$398	$81	$479
	PROJECT COST TOTALS:	$5,767	$1,337	23%	$7,104		$5,767	$1,337	$7,104		**$7,104**	3.2%	$5,954	$1,380	$7,334

CHIEF, COST ENGINEERING, Karl Harvey

PROJECT MANAGER, Jeff Herzog

CHIEF, REAL ESTATE, Michael Coy

CHIEF, PLANNING, Cindy Upah

CHIEF, ENGINEERING SERVICES, Doug Bliss

CHIEF, OPERATIONS, Julie Anderson

CHIEF, CONSTRUCTION, Jim Jeffords

CHIEF, CONTRACTING, Chris Tew

CHIEF, RM, Karen Farmer

CHIEF, DPM-CW, Bruce Sexauer

ESTIMATED TOTAL PROJECT COST:		**$7,334**
ESTIMATED FEDERAL COST:	65%	$4,788
ESTIMATED NON-FEDERAL COST:	**35%**	$2,546
22 - FEASIBILITY STUDY (CAP studies):		**$2**
ESTIMATED FEDERAL COST:	50%	$1
ESTIMATED NON-FEDERAL COST:	50%	$1
ESTIMATED FEDERAL COST OF PROJECT		**$4,789**

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

**** CONTRACT COST SUMMARY ****

PROJECT: Petersberg SBH Dredging CAP 107
LOCATION: PETERSBURG HARBOR, ALASKA
This Estimate reflects the scope and schedule in report; Petersburg CAP 107 Final Array of Alternatives 7 May 2018

DISTRICT: ALASKA DISTRICT, POA
POC: CHIEF, COST ENGINEERING, Karl Harvey

PREPARED: 8/9/2018

WBS Structure		**ESTIMATED COST**				**PROJECT FIRST COST (Constant Dollar Basis)**				**TOTAL PROJECT COST (FULLY FUNDED)**				
		Estimate Prepared:			8-Aug-18	Program Year (Budget EC):			2019					
		Estimate Price Level:			1-Oct-18	Effective Price Level Date:			1 -Oct-18					
WBS NUMBER *A*	Civil Works Feature & Sub-Feature Description *B*	COST ($K) *C*	CNTG ($K) *D*	RISK BASED CNTG (%) *E*	TOTAL ($K) *F*	ESC (%) *G*	COST ($K) *H*	CNTG ($K) *I*	TOTAL ($K) *J*	Mid-Point Date *P*	ESC (%) *L*	COST ($K) *M*	CNTG ($K) *N*	FULL ($K) *O*
	FEDERAL SHARED - CONTRACT 1													
12	NAVIGATION PORTS & HARBORS	$1,030	$296	28.8%	$1,327		$1,030	$296	$1,327	2020Q3	3.0%	$1,061	$305	$1,367
12	NAVIGATION PORTS & HARBORS	$3,644	$816	22.4%	$4,460		$3,644	$816	$4,460	2020Q3	3.0%	$3,754	$841	$4,595
	#N/A													
	CONSTRUCTION ESTIMATE TOTALS:	$4,674	$1,113	23.8%	$5,787		$4,674	$1,113	$5,787			$4,816	$1,146	$5,962
01	LANDS AND DAMAGES	$20	$4	20.0%	$24		$20	$4	$24	2020Q1	2.0%	$20	$4	$24
30	PLANNING, ENGINEERING & DESIGN													
4.0%	Project Management	$187	$38	20.6%	$225		$187	$38	$225	2019Q3	2.1%	$191	$39	$230
1.0%	Planning & Environmental Compliance	$47	$10	20.6%	$57		$47	$10	$57	2019Q3	2.1%	$48	$10	$58
4.5%	Engineering & Design	$210	$43	20.6%	$253		$210	$43	$253	2019Q3	2.1%	$214	$44	$258
0.5%	Reviews, ATRs, IEPRs, VE	$23	$5	20.6%	$28		$23	$5	$28	2019Q3	2.1%	$23	$5	$28
0.5%	Life Cycle Updates (cost, schedule, risks)	$23	$5	20.6%	$28		$23	$5	$28	2019Q3	2.1%	$23	$5	$28
0.5%	Contracting & Reprographics	$23	$5	20.6%	$28		$23	$5	$28	2020Q3	6.3%	$24	$5	$29
1.0%	Engineering During Construction	$47	$10	20.6%	$57		$47	$10	$57	2020Q3	6.3%	$50	$10	$60
0.5%	Planning During Construction	$23	$5	20.6%	$28		$23	$5	$28	2019Q3	2.1%	$23	$5	$28
2.0%	Adaptive Management & Monitoring	$93	$19	20.6%	$112		$93	$19	$112	2020Q2	5.2%	$98	$20	$118
0.5%	Project Operations	$23	$5	20.6%	$28		$23	$5	$28	2020Q4	7.4%	$25	$5	$30
31	CONSTRUCTION MANAGEMENT													
3.5%	Construction Management	$164	$34	20.4%	$198		$164	$34	$198	2020Q3	6.3%	$174	$36	$210
2.5%	Project Operation:	$117	$24	20.4%	$141		$117	$24	$141	2020Q3	6.3%	$124	$25	$150
2.0%	Project Management	$93	$19	20.4%	$112		$93	$19	$112	2020Q3	6.3%	$99	$20	$119
	CONTRACT COST TOTALS:	$5,767	$1,337		$7,104		$5,767	$1,337	**$7,104**		3.2%	$5,954	$1,380	**$7,334**

Petersburg Navigation Improvements

Appendix F: Clean Water Act

Petersburg, Alaska

September 2018

US Army Corps of Engineers
Alaska District

DRAFT FINDING OF NO SIGNIFICANT IMPACT

In accordance with the National Environmental Policy Act of 1969, as amended, the U.S. Army Corps of Engineers, Alaska District (Corps) has assessed the environmental effects of the following action: **Petersburg Navigation Improvements, Petersburg, Alaska**

The Alaska District will deepen South Harbor in Petersburg, Alaska in order to enable safe navigation. The existing condition poses a navigational hazard for the deeper drafting vessels that call on the South Harbor. The dredging project is divided into four dredging units according to depth; ranging from minus 9 feet mean lower low water (MLLW) to minus 19.25 feet MLLW. The total volume of material that will be excavated from the South Harbor is approximately 82,720 CY. The sediment will be placed in the Frederick Sound Disposal Area in accordance with the site selection study and Ocean Dumping Permit issued by the US EPA under Section 103 of the Marine Protection, Research and Sanctuaries Act (MPRSA). Project depth would be achieved through the use of an excavator mounted on a barge in order to dislodge the consolidated clay underlying the granular sediment. Incorporating the following mitigation measures into the recommended plan will help to minimize adverse impacts that could occur on local fish and wildlife resources, including Endangered Species Act-listed species, marine mammals, and Essential Fish Habitat.

- The Federal action shall cease in-water construction between March 15 and June 15 during peak herring spawn activities, juvenile salmon outmigration and rearing activities, and when Steller sea lion and humpback whale feeding and abundance is expected to be greatest in the project area.
- To minimize the danger to marine mammals from project-related vessels, speed limits (e.g. less than 8 knots) shall be imposed on vessels moving in and around the project area.
- Project-related vessels and barges shall not be permitted to ground themselves on the bottom during low tide periods, unless there is a human safety issue requiring it.
- A construction oil spill prevention plan shall be prepared.
- A scow barge will be loaded so that enough freeboard remains to allow for safe movement of the barge and its material to the offloading site to be identified.

This action has been evaluated for its effects on several significant resources, including fish and wildlife, vegetation, wetlands, threatened or endangered species, marine resources, and cultural resources. No significant short-term or long-term adverse effects were identified. This Corps action complies with the National Historic Preservation Act, the Endangered Species Act, the Clean Water Act, the Magnuson-Stevens Fishery Conservation and Management Act, and the National Environmental Policy Act. The completed environmental assessment supports the conclusion that the action does not constitute a major Federal action significantly affecting the quality of the human and natural environment. An environmental impact statement is therefore not necessary for the Alaska District's proposed alterations to the Corps' project at the South Harbor in Petersburg, Alaska.

________________________________ ________________________________

Phillip J. Borders Date
Colonel, U.S. Army
Commanding

Petersburg Navigation Improvements
Petersburg, Alaska

404(b)(1) Analysis

US Army Corps
of Engineers
Alaska District

Prepared by:

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, ALASKA
P.O. BOX 6898
ELMENDORF AFB, ALASKA 99506-0898

September 2018

EVALUATION UNDER SECTION 404(b)(1) of the CLEAN WATER ACT Petersburg South Harbor Dredging and Dredged Material Placement

This is the factual documentation of evaluations conducted under Section 404 of the Clean Water Act of 1977. This report covers the removal of material from Petersburg South Harbor, the incidental re-suspension of sediment during dredging and dewatering, and the placement of dredged material in the Thomas Bay disposal area.

I. PROJECT DESCRIPTION

A. Location. The City of Petersburg, Alaska, is on Mitkof Island roughly 120 miles southeast of Juneau. The City has three adjacent harbor basins fronting Wrangell Narrows: North, Middle, and South.

B. General Description. The Environmental Assessment, to which this evaluation is appended, contains a discussion of the navigation problems and discussion of alternatives. The South Harbor was initially constructed by the City of Petersburg in the mid-1980s. The proposed action provides dredging in four areas where shoaling has become apparent within the harbor basin, landward of the spine float, and within the crane dock basin. (Figure E-A-1 and Table E-A-1)

A mechanical dredge would likely be required to dislodge the hard clay material underlying the sand and silt. Construction could last up to 3 months. If the dredged material is suitable for in-water placement, it would be transported 12 miles across Frederick Sound to Thomas Bay for disposal inside the baseline.

Chemical sampling of the South Harbor sediments in 2018 showed the sediments did not contain chemical concentrations exceeding the screening levels in the Seattle District Dredge Material Management Program (DMMP) for unconfined in-water placement. The sediment also screened below Alaska Department of Environmental Conservation (ADEC) screening levels for upland placement. In-water disposal is the more cost effective disposal method and the discharge of the sediments in waters of the United States is regulated by Section 404 of the Clean Water Act.

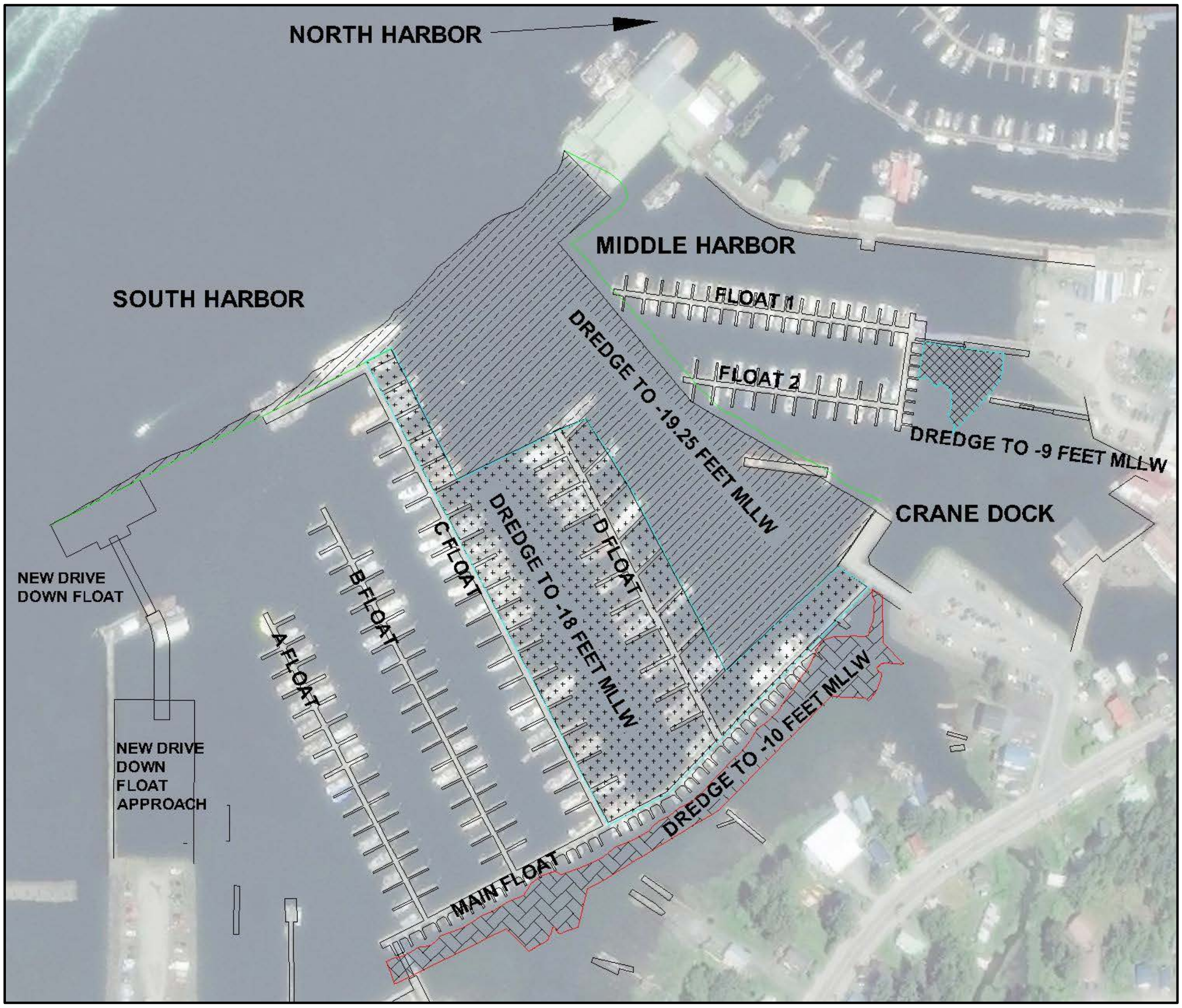


Figure E-A-1. Map of the South Harbor Dredge Areas

Table E-A-1. Summary of Proposed Dredging Depths and Volumes

Dredge Area	Dredge Depth [ft]	Dredge Volume [cy]	Dredge Area [sf]	One Foot Overdepth Allowance [cy]	Total Dredge Volume [cy]
Maneuvering Channel	-19.25	33,750	322,074	11,930	45,680
Between C and D Floats	-18	5,820	237,369	8,800	14,620
Landward of Main Float	-10	17,370	62,390	2,320	19,690
Behind Floats 1 and 2	-9	2,370	10,191	380	2,750
Total		59,310		23,410	82,740

C. Authority. Section 107 of the 1960 Rivers and Harbors Act (P.L. 86-645) and Section 915(d) of the 1986 Water Resources Development Act (P.L. 99-662) authorize the USACE to, without specific authorization, study, adopt, construct, and maintain navigation projects using the same procedures and policies that apply to Congressionally-authorized projects. The Federal share of the initial implementation costs for any one project may not exceed $4 million and the program limit is $35 million per year. A Fact Sheet must be submitted to the HQUSACE for concurrence with the ASA (CW) before construction funds can be committed and prior to executing a Project Cooperation Agreement PCA. Non-Federal sponsors must participate in project costs and Operation, Maintenance, Repair, Replacement and Rehabilitation in accordance with the established requirements herein set forth for navigation projects or measures (general harbor features, inland waterways, or recreational harbor features, as the case may be). The non-Federal sponsor must also hold and save the U.S. free from damages due to the construction, maintenance, and operation of the project. The non-Federal sponsor is also responsible for all project and maintenance dredging costs in excess of the Federal cost limit.

D. General Description of Dredged or Fill Material. The material to be dredged from South Harbor is predominantly sand, silt, clay, and gravel (Table E-A-2). The physical characteristics of the sediments that would be removed range from clay to gravel, with the modal dredged material management unit containing sandy silt (10/24), flowed by silty sand (9/24), and poorly graded sand (5/24). Some of the cores contained small proportions of gravel. The Corps collected sediment samples for chemical analysis from the South Harbor in 2018. The analyses showed those sediments to be clean enough for unrestricted in-water or upland placement in accordance with DMMP and ADEC concentration thresholds, respectively (Table E-A-3).

Table E-A-2. Summary of Geotechnical Laboratory Results from the South Harbor

Test Bore	Composition (percent)			Unified Soil Classification ASTM 02487
	Gravel	Sand	Silt/Clay	
TB-01	2	58	40	(SM) Silty sand
TB-02	6.6	89.8	3.6	(SP) Poorly-graded sand
TB-03	4.6	58.5	36.9	(SM) Silty sand
TB-04	0.2	82	17.8	(SM) Silty sand
TB-05	21.3	27.9	50.8	(Ml) Sandy silt w/ gravel
TB-05	8.2	25	66.8	(Cl-Ml) Sandy silty clay
TB-06	8.7	41	50.3	(ML) Sandy silt
TB-06A	10.9	28.3	60.8	(CL-Ml) Sandy silty clay
TB-07	20.8	68.4	10.8	(SP-SM) Poorly-graded sand w/ silt and gravel
TB-08	13.4	82.8	3.8	(SP) Poorly-graded sand
TB-08	19.1	75	5.9	(SP-SM) Poorly-graded sand w/ silt and gravel
TB-09	24.1	56.4	19.5	(SM) Silty sand w/ gravel
TB-10	7.8	86.6	5.6	(SP-SM) Poorly-graded sand w/ silt
TB-11	18.6	36.9	44.5	(SM) Silty sand w/ gravel
TB-12	13.6	36.7	49.7	(SM) Silty sand
TB-12A	12.6	31.1	56.3	(ML) Sandy silt
TB-12A	12.4	30.7	56.9	(Ml) Sandy silt
TB-13	11.2	34.8	54	(Ml) Sandy silt
TB-13	15.3	26.4	58.3	(Ml) Sandy silt w/ gravel
TB-14	16.2	37.5	46.3	(SM) Silty sand w/ gravel
TB-14	3.6	31.2	65.2	(Ml) Sandy silt
TB-15	23.7	30.2	46.1	(SM) Silty sand w/ gravel
TB-15	6.1	28.9	65	(CL-ML) Sandy silty clay
TB-16	28.9	41.2	29.9	(SM) Silty sand w/ gravel

Table E-A-3. Chemical Concentrations With Respect to DMMP Screening Criteria

			Sample ID	18PSBH-D1PSE	18PSBH-D1ZSE	18PSBH-D2PSE	18PSBH-D2ZSE	18PSBH-D3PSE	18PSBH-D3ZSE	18PSBH-D4PSE	18PSBH-D5PSE	18PSBH-D5ZSE	18PSBH-D6PSE	18PSBH-D7PSE	18PSBH-1001SE
			Location ID	DMMU1P	DMMU1Z	DMMU2P	DMMU2Z	DMMU3P	DMMU3Z	DMMU4P	DMMU5P	DMMU5Z	DMMU6P	DMMU7P	TRIP
			Collection Date	04/10/2018 16:31	04/10/2018 16:37	04/10/2018 11:03	04/10/2018 11:10	04/10/2018 10:27	04/10/2018 10:44	04/10/2018 09:58	04/10/2018 09:00	04/10/2018 09:50	04/10/2018 10:35	04/10/2018 11:00	04/10/2018 18:00
			Lab Sample ID	580-76580-1	580-76580-2	580-76580-3	580-76580-4	580-76580-5	580-76580-6	580-76580-7	580-76580-8	580-76580-9	580-76580-10	580-76580-11	580-76580-12
			Matrix	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Method	**Units**	**Analyte**	**DMMP**					**MS/MSD**						**Dupe of -D3PSE (VOCs) and -D6PSE**	**Trip Blank**
350.1	mg/kg	Ammonia (un-ionized)		54 [32] J	90 [44] J	64 [34] J	63 [34] J	78 [31] J	51 [30] J	43 [26] J	54 [32] J	51 [30] J	49 [28] J	34 [22] J	
6020A	mg/kg	Antimony	150	0.19 [0.16]	0.61 [0.20]	0.26 [0.17]	0.23 [0.18]	0.18 [0.14]	0.12 [0.18] J	0.14 [0.13]	0.24 [0.14]	0.21 [0.14]	0.17 [0.13]	0.15 [0.12]	
6020A	mg/kg	Arsenic	57	3.4 [0.33]	3.6 [0.40]	5.5 [0.35]	6.5 [0.35]	3.7 [0.28]	1.9 [0.36]	3.1 [0.27]	5.7 [0.28]	6.4 [0.28]	3.6 [0.25]	3.7 [0.23]	
6020A	mg/kg	Cadmium	5.1	0.41 [0.16]	0.39 [0.20] J	0.17 [0.17] J	0.15 [0.18] J	0.21 [0.14] J	0.13 [0.18] J	0.14 [0.13] J	0.16 [0.14] J	0.14 [0.14] J	0.10 [0.13] J	0.072 [0.12] J	
6020A	mg/kg	Chromium	260	25 [0.20]	28 [0.25]	45 [0.22]	44 [0.22]	21 [0.17]	22 [0.23]	25 [0.17]	39 [0.17]	42 [0.17]	27 [0.16]	28 [0.15]	
6020A	mg/kg	Copper	390	34 [0.49]	41 [0.60]	41 [0.52]	39 [0.53]	18 [0.42]	9.1 [0.54]	19 [0.40]	39 [0.42]	44 [0.42]	21 [0.38]	23 [0.35]	
6020A	mg/kg	Lead	450	8.6 [0.16]	20 [0.19]	4.7 [0.16]	4.9 [0.17]	3.7 [0.13]	1.7 [0.17]	2.9 [0.13]	4.4 [0.13]	5.2 [0.13]	3.6 [0.12]	3.0 [0.11]	
6020A	mg/kg	Nickel	NA	17 [0.41]	21 [0.50]	42 [0.43]	39 [0.44]	18 [0.35]	14 [0.45]	20 [0.34]	37 [0.35]	39 [0.35]	19 [0.31]	21 [0.29]	
6020A	mg/kg	Selenium	3	0.54 [0.82] J	0.61 [1.0] J	0.89 [0.87]	0.83 [0.88] J	0.45 [0.69] J	0.29 [0.91] J	0.42 [0.67] J	0.72 [0.69]	0.81 [0.70]	0.49 [0.63] J	0.54 [0.59] J	
6020A	mg/kg	Silver	6.1	0.075 [0.041] J	0.071 [0.050] J	0.12 [0.043] J	0.11 [0.044] J	0.053 [0.035] J	ND [0.045]	0.045 [0.034] J	0.11 [0.035] J	0.13 [0.035] J	0.063 [0.031] J	0.065 [0.029] J	
6020A	mg/kg	Zinc	410	57 [4.1]	58 [5.0]	73 [4.3]	69 [4.4]	35 [3.5]	29 [4.5]	34 [3.4]	63 [3.5]	75 [3.5]	39 [3.1]	40 [2.9]	
7471A	mg/kg	Mercury	0.41	0.033 [0.020] J	0.046 [0.021]	0.016 [0.015] J	0.021 [0.016] J	0.013 [0.017] J	ND [0.017]	0.064 [0.013]	0.017 [0.015] J	0.025 [0.014]	ND [0.014]	0.012 [0.012] J	
8081A	mg/kg	4,4'-DDD	0.016	ND [0.0054]	ND [0.006]	ND [0.00083]	ND [0.00086]	ND [0.0026]	ND [0.00091]	ND [0.0025]	ND [0.00078]	ND [0.00083]	ND [0.0024]	ND [0.0024]	
8081A	mg/kg	4,4'-DDE	0.009	ND [0.0054]	ND [0.006]	ND [0.00083]	ND [0.00086]	ND [0.0026]	ND [0.00091]	ND [0.0025]	ND [0.00078]	ND [0.00083]	ND [0.0024]	ND [0.0024]	
8081A	mg/kg	4,4'-DDT	0.012	ND [0.0054]	ND [0.006]	ND [0.00083]	ND [0.00086]	ND [0.0026]	ND [0.00091]	ND [0.0025]	ND [0.00078]	ND [0.00083]	ND [0.0024]	ND [0.0024]	
8081A	mg/kg	Aldrin	0.0095	ND [0.0029]	ND [0.0032]	ND [0.00044]	ND [0.00046]	ND [0.0014]	ND [0.00048]	ND [0.0013]	ND [0.00041]	ND [0.00045]	ND [0.0013]	ND [0.0013]	
8081A	mg/kg	alpha-BHC		ND [0.0029]	ND [0.0032]	ND [0.00044]	ND [0.00046]	ND [0.0014]	ND [0.00048]	ND [0.0013]	ND [0.00041]	ND [0.00045]	ND [0.0013]	ND [0.0013]	
8081A	mg/kg	alpha-Chlordane	0.0028	**ND [0.011]**	**ND [0.012]**	ND [0.0017]	ND [0.0017]	**ND [0.0051]**	ND [0.0018]	**ND [0.005]**	ND [0.0016]	ND [0.0017]	**ND [0.0048]**	**ND [0.0048]**	
8081A	mg/kg	beta-BHC		ND [0.0054]	ND [0.006]	ND [0.00083]	ND [0.00086]	ND [0.0026]	ND [0.00091]	ND [0.0025]	ND [0.00078]	ND [0.00083]	ND [0.0024]	ND [0.0024]	
8081A	mg/kg	delta-BHC		ND [0.0054]	ND [0.006]	ND [0.00083]	ND [0.00086]	ND [0.0026]	ND [0.00091]	ND [0.0025]	ND [0.00078]	ND [0.00083]	ND [0.0024]	ND [0.0024]	
8081A	mg/kg	Dieldrin	0.0019	**ND [0.0054]**	**ND [0.006]**	ND [0.00083]	ND [0.00086]	**ND [0.0026]**	ND [0.00091]	**ND [0.0025]**	ND [0.00078]	ND [0.00083]	**ND [0.0024]**	**ND [0.0024]**	
8081A	mg/kg	Endosulfan I		ND [0.0054]	ND [0.006]	ND [0.00083]	ND [0.00086]	ND [0.0026]	ND [0.00091]	ND [0.0025]	ND [0.00078]	ND [0.00083]	ND [0.0024]	ND [0.0024]	
8081A	mg/kg	Endosulfan II		ND [0.0054]	ND [0.006]	ND [0.00083]	ND [0.00086]	ND [0.0026]	ND [0.00091]	ND [0.0025]	ND [0.00078]	ND [0.00083]	ND [0.0024]	ND [0.0024]	
8081A	mg/kg	Endosulfan sulfate		ND [0.0054]	ND [0.006]	ND [0.00083]	ND [0.00086]	ND [0.0026]	ND [0.00091]	ND [0.0025]	ND [0.00078]	ND [0.00083]	ND [0.0024]	ND [0.0024]	
8081A	mg/kg	Endrin		ND [0.0054]	ND [0.006]	ND [0.00083]	ND [0.00086]	ND [0.0026]	ND [0.00091]	ND [0.0025]	ND [0.00078]	ND [0.00083]	ND [0.0024]	ND [0.0024]	
8081A	mg/kg	Endrin aldehyde		ND [0.11]	ND [0.12]	ND [0.017]	ND [0.017]	ND [0.051]	ND [0.018]	ND [0.05]	ND [0.016]	ND [0.017]	ND [0.048]	ND [0.048]	
8081A	mg/kg	Endrin ketone		ND [0.0054]	ND [0.006]	ND [0.00083]	ND [0.00086]	ND [0.0026]	ND [0.00091]	ND [0.0025]	ND [0.00078]	ND [0.00083]	ND [0.0024]	ND [0.0024]	
8081A	mg/kg	gamma-BHC (Lindane)	0.01	ND [0.0029]	ND [0.0032]	ND [0.00044]	ND [0.00046]	ND [0.0014]	ND [0.00048]	ND [0.0013]	ND [0.00041]	ND [0.00045]	ND [0.0013]	ND [0.0013]	
8081A	mg/kg	gamma-Chlordane	0.0028	**ND [0.0054]**	**ND [0.006]**	ND [0.00083]	ND [0.00086]	ND [0.0026]	ND [0.00091]	ND [0.0025]	ND [0.00078]	ND [0.00083]	ND [0.0024]	ND [0.0024]	
8081A	mg/kg	Heptachlor	0.0015	**ND [0.0029]**	**ND [0.0032]**	ND [0.00044]	ND [0.00046]	ND [0.0014]	ND [0.00048]	ND [0.0013]	ND [0.00041]	ND [0.00045]	ND [0.0013]	ND [0.0013]	
8081A	mg/kg	Heptachlor Epoxide		ND [0.0054]	ND [0.006]	ND [0.00083]	ND [0.00086]	ND [0.0026]	ND [0.00091]	ND [0.0025]	ND [0.00078]	ND [0.00083]	ND [0.0024]	ND [0.0024]	
8081A	mg/kg	Methoxychlor		ND [0.0054]	ND [0.006]	ND [0.00083]	ND [0.00086]	ND [0.0026]	ND [0.00091]	ND [0.0025]	ND [0.00078]	ND [0.00083]	ND [0.0024]	ND [0.0024]	
8081A	mg/kg	Toxaphene		ND [0.57]	ND [0.64]	ND [0.088]	ND [0.091]	ND [0.27]	ND [0.097]	ND [0.27]	ND [0.083]	ND [0.089]	ND [0.26]	ND [0.26]	
8082	mg/kg	PCB-1016 (Aroclor 1016)	0.13	ND [0.021]	ND [0.024]	ND [0.017]	ND [0.017]	ND [0.018]	ND [0.018]	ND [0.017]	ND [0.017]	ND [0.017]	ND [0.016]	ND [0.016]	
8082	mg/kg	PCB-1221 (Aroclor 1221)	0.13	ND [0.014]	ND [0.016]	ND [0.011]	ND [0.011]	ND [0.012]	ND [0.012]	ND [0.011]	ND [0.011]	ND [0.011]	ND [0.011]	ND [0.011]	
8082	mg/kg	PCB-1232 (Aroclor 1232)	0.13	ND [0.014]	ND [0.016]	ND [0.011]	ND [0.011]	ND [0.012]	ND [0.012]	ND [0.011]	ND [0.011]	ND [0.011]	ND [0.011]	ND [0.011]	
8082	mg/kg	PCB-1242 (Aroclor 1242)	0.13	ND [0.0086]	ND [0.0096]	ND [0.0067]	ND [0.0068]	ND [0.0072]	ND [0.0071]	ND [0.0067]	ND [0.0066]	ND [0.0067]	ND [0.0066]	ND [0.0065]	
8082	mg/kg	PCB-1248 (Aroclor 1248)	0.13	ND [0.0086]	ND [0.0096]	ND [0.0067]	ND [0.0068]	ND [0.0072]	ND [0.0071]	ND [0.0067]	ND [0.0066]	ND [0.0067]	ND [0.0066]	ND [0.0065]	
8082	mg/kg	PCB-1254 (Aroclor 1254)	0.13	ND [0.014]	ND [0.016]	ND [0.011]	ND [0.011]	ND [0.012]	ND [0.012]	ND [0.011]	ND [0.011]	ND [0.011]	ND [0.011]	ND [0.011]	
8082	mg/kg	PCB-1260 (Aroclor 1260)	0.13	ND [0.021]	ND [0.024]	ND [0.017]	ND [0.017]	ND [0.018]	ND [0.018]	ND [0.017]	ND [0.017]	ND [0.017]	ND [0.016]	ND [0.016]	
8083	mg/kg	Total PCBs	0.13	ND [0.021]	ND [0.024]	ND [0.017]	ND [0.017]	ND [0.018]	ND [0.018]	ND [0.017]	ND [0.017]	ND [0.017]	ND [0.016]	ND [0.016]	
8260B	mg/kg	1,1,1-Trichloroethane		ND [0.013]	ND [0.017]	ND [0.0076]	ND [0.0076]	ND [0.0074]	ND [0.008]	ND [0.0074]	ND [0.0069]	ND [0.0079]	ND [0.0053]	ND [0.0061]	ND [0.01]
8260B	mg/kg	1,1-Dichloroethane		ND [0.013]	ND [0.017]	ND [0.0076]	ND [0.0076]	ND [0.0074]	ND [0.008]	ND [0.0074]	ND [0.0069]	ND [0.0079]	ND [0.0053]	ND [0.0061]	ND [0.01]

Table E-A-3. Chemical Concentrations With Respect to DMMP Screening Criteria (cont.)

			Sample ID	18PSBH-D1PSE	18PSBH-D1ZSE	18PSBH-D2PSE	18PSBH-D2ZSE	18PSBH-D3PSE	18PSBH-D3ZSE	18PSBH-D4PSE	18PSBH-D5PSE	18PSBH-D5ZSE	18PSBH-D6PSE	18PSBH-D7PSE	18PSBH-1001SE
			Location ID	DMMU1P	DMMU1Z	DMMU2P	DMMU2Z	DMMU3P	DMMU3Z	DMMU4P	DMMU5P	DMMU5Z	DMMU6P	DMMU7P	TRIP
			Collection Date	04/10/2018 16:31	04/10/2018 16:37	04/10/2018 11:03	04/10/2018 11:10	04/10/2018 10:27	04/10/2018 10:44	04/10/2018 09:58	04/10/2018 09:00	04/10/2018 09:50	04/10/2018 10:35	04/10/2018 11:00	04/10/2018 18:00
			Lab Sample ID	580-76580-1	580-76580-2	580-76580-3	580-76580-4	580-76580-5	580-76580-6	580-76580-7	580-76580-8	580-76580-9	580-76580-10	580-76580-11	580-76580-12
			Matrix	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Method	**Units**	**Analyte**	**DMMP**					**MS/MSD**						**Dupe of -D3PSE (VOCs) and -D6PSE**	**Trip Blank**
8260B	mg/kg	1,1-Dichloropropene		ND [0.022]	ND [0.029]	ND [0.013]	ND [0.013]	ND [0.013]	ND [0.014]	ND [0.013]	ND [0.012]	ND [0.014]	ND [0.0093]	ND [0.011]	ND [0.018]
8260B	mg/kg	1,2,3-Trichlorobenzene		ND [0.038]	ND [0.05]	ND [0.023]	ND [0.023]	ND [0.022]	0.033 [0.024]	ND [0.022]	ND [0.021]	ND [0.024]	ND [0.016]	ND [0.018]	0.071 [0.03]
8260B	mg/kg	1,2,3-Trichloropropane		ND [0.038]	ND [0.05]	ND [0.023]	ND [0.023]	ND [0.022]	ND [0.024]	ND [0.022]	ND [0.021]	ND [0.024]	ND [0.016]	ND [0.018]	ND [0.03]
8260B	mg/kg	1,2,4-Trichlorobenzene	0.031	**ND [0.063]**	**ND [0.083]**	**ND [0.038]**	**ND [0.038]**	**ND [0.037]**	**0.019 [0.04] J**	**ND [0.037]**	**ND [0.035]**	**ND [0.039]**	ND [0.027]	ND [0.03]	**0.043 [0.05] J**
8260B	mg/kg	1,2,4-Trimethylbenzene		ND [0.022]	ND [0.029]	ND [0.013]	ND [0.013]	ND [0.013]	ND [0.014]	ND [0.013]	ND [0.012]	ND [0.014]	ND [0.0093]	ND [0.011]	ND [0.018]
8260B	mg/kg	1,2-Dibromo-3-chloropropane	NA	ND [0.25]	ND [0.33]	ND [0.15]	ND [0.15]	ND [0.15]	ND [0.16]	ND [0.15]	ND [0.14]	ND [0.16]	ND [0.11]	ND [0.12]	ND [0.2]
8260B	mg/kg	1,2-Dichlorobenzene	0.035	ND [0.013]	ND [0.017]	ND [0.0076]	ND [0.0076]	ND [0.0074]	ND [0.008]	ND [0.0074]	ND [0.0069]	ND [0.0079]	ND [0.0053]	ND [0.0061]	0.0059 [0.01] J
8260B	mg/kg	1,2-Dichloropropane	NA	ND [0.012]	ND [0.016]	ND [0.0073]	ND [0.0073]	ND [0.0071]	ND [0.0077]	ND [0.0071]	ND [0.0067]	ND [0.0076]	ND [0.0051]	ND [0.0058]	ND [0.0096]
8260B	mg/kg	1,3,5-Trimethylbenzene		ND [0.022]	ND [0.029]	ND [0.013]	ND [0.013]	ND [0.013]	ND [0.014]	ND [0.013]	ND [0.012]	ND [0.014]	ND [0.0093]	ND [0.011]	ND [0.018]
8260B	mg/kg	1,3-Dichlorobenzene	0.17	ND [0.022]	ND [0.029]	ND [0.013]	ND [0.013]	ND [0.013]	ND [0.014]	ND [0.013]	ND [0.012]	ND [0.014]	ND [0.0093]	ND [0.011]	ND [0.018]
8260B	mg/kg	1,3-Dichloropropane	NA	ND [0.022]	ND [0.029]	ND [0.013]	ND [0.013]	ND [0.013]	ND [0.014]	ND [0.013]	ND [0.012]	ND [0.014]	ND [0.0093]	ND [0.011]	ND [0.018]
8260B	mg/kg	2,2-Dichloropropane	NA	ND [0.038]	ND [0.05]	ND [0.023]	ND [0.023]	ND [0.022]	ND [0.024]	ND [0.022]	ND [0.021]	ND [0.024]	ND [0.016]	ND [0.018]	ND [0.03]
8260B	mg/kg	2-Butanone		ND [0.63]	ND [0.83]	ND [0.38]	ND [0.38]	ND [0.37]	ND [0.4]	ND [0.37]	ND [0.35]	ND [0.39]	ND [0.27]	ND [0.3]	ND [0.5]
8260B	mg/kg	2-Chlorotoluene		ND [0.022]	ND [0.029]	ND [0.013]	ND [0.013]	ND [0.013]	ND [0.014]	ND [0.013]	ND [0.012]	ND [0.014]	ND [0.0093]	ND [0.011]	ND [0.018]
8260B	mg/kg	4-Chlorotoluene		ND [0.038]	ND [0.05]	ND [0.023]	ND [0.023]	ND [0.022]	ND [0.024]	ND [0.022]	ND [0.021]	ND [0.024]	ND [0.016]	ND [0.018]	ND [0.03]
8260B	mg/kg	4-Isopropyltoluene	NA	ND [0.022]	ND [0.029]	ND [0.013]	ND [0.013]	ND [0.013]	ND [0.014]	ND [0.013]	ND [0.012]	ND [0.014]	ND [0.0093]	ND [0.011]	0.0084 [0.018] J
8260B	mg/kg	4-Methyl-2-pentanone		ND [0.063]	ND [0.083]	ND [0.038]	ND [0.038]	ND [0.037]	ND [0.04]	ND [0.037]	ND [0.035]	ND [0.039]	ND [0.027]	ND [0.03]	ND [0.05]
8260B	mg/kg	Acetone		ND [0.63]	ND [0.83]	ND [0.38]	ND [0.38]	ND [0.37]	ND [0.4]	ND [0.37]	ND [0.35]	ND [0.39]	ND [0.27]	ND [0.3]	ND [0.5]
8260B	mg/kg	Bromobenzene		ND [0.063]	ND [0.083]	ND [0.038]	ND [0.038]	ND [0.037]	ND [0.04]	ND [0.037]	ND [0.035]	ND [0.039]	ND [0.027]	ND [0.03]	ND [0.05]
8260B	mg/kg	Bromochloromethane	NA	ND [0.022]	ND [0.029]	ND [0.013]	ND [0.013]	ND [0.013]	ND [0.014]	ND [0.013]	ND [0.012]	ND [0.014]	ND [0.0093]	ND [0.011]	ND [0.018]
8260B	mg/kg	Carbon disulfide		0.028 [0.038] J	0.037 [0.05] J	0.0099 [0.023] J	ND [0.023]	0.0082 [0.022] J	ND [0.024]	ND [0.022]	ND [0.021]	ND [0.024]	ND [0.016]	0.012 [0.018] J	ND [0.03]
8260B	mg/kg	Carbon tetrachloride		ND [0.013]	ND [0.017]	ND [0.0076]	ND [0.0076]	ND [0.0074]	ND [0.008]	ND [0.0074]	ND [0.0069]	ND [0.0079]	ND [0.0053]	ND [0.0061]	ND [0.01]
8260B	mg/kg	Chlorobenzene		ND [0.038]	ND [0.05]	ND [0.023]	ND [0.023]	ND [0.022]	ND [0.024]	ND [0.022]	ND [0.021]	ND [0.024]	ND [0.016]	ND [0.018]	ND [0.03]
8260B	mg/kg	Chloroethane		ND [0.063]	ND [0.083]	ND [0.038]	ND [0.038]	ND [0.037]	ND [0.04]	ND [0.037]	ND [0.035]	ND [0.039]	ND [0.027]	ND [0.03]	ND [0.05]
8260B	mg/kg	Chloromethane		ND [0.038]	ND [0.05]	ND [0.023]	ND [0.023]	ND [0.022]	ND [0.024]	ND [0.022]	ND [0.021]	ND [0.024]	ND [0.016]	ND [0.018]	ND [0.03]
8260B	mg/kg	cis-1,2-Dichloroethene		ND [0.013]	ND [0.017]	ND [0.0076]	ND [0.0076]	ND [0.0074]	ND [0.008]	ND [0.0074]	ND [0.0069]	ND [0.0079]	ND [0.0053]	ND [0.0061]	ND [0.01]
8260B	mg/kg	Dichlorodifluoromethane		ND [0.13]	ND [0.17]	ND [0.076]	ND [0.076]	ND [0.074]	ND [0.08]	ND [0.074]	ND [0.069]	ND [0.079]	ND [0.053]	ND [0.061]	ND [0.1]
8260B	mg/kg	Ethylbenzene	NA	ND [0.038]	ND [0.05]	ND [0.023]	ND [0.023]	ND [0.022]	ND [0.024]	ND [0.022]	ND [0.021]	ND [0.024]	ND [0.016]	ND [0.018]	ND [0.03]
8260B	mg/kg	Isopropylbenzene		ND [0.022]	ND [0.029]	ND [0.013]	ND [0.013]	ND [0.013]	ND [0.014]	ND [0.013]	ND [0.012]	ND [0.014]	ND [0.0093]	ND [0.011]	ND [0.018]
8260B	mg/kg	Methylene chloride		ND [0.25]	ND [0.33]	ND [0.15]	ND [0.15]	ND [0.15]	ND [0.16]	ND [0.15]	ND [0.14]	ND [0.16]	ND [0.11]	ND [0.12]	ND [0.2]
8260B	mg/kg	Methyl-tert-butyl ether (MTBE)		ND [0.022]	ND [0.029]	ND [0.013]	ND [0.013]	ND [0.013]	ND [0.014]	ND [0.013]	ND [0.012]	ND [0.014]	ND [0.0093]	ND [0.011]	ND [0.018]
8260B	mg/kg	n-Butylbenzene		ND [0.038]	ND [0.05]	ND [0.023]	ND [0.023]	ND [0.022]	ND [0.024]	ND [0.022]	ND [0.021]	ND [0.024]	ND [0.016]	ND [0.018]	0.014 [0.03] J
8260B	mg/kg	n-Propylbenzene		ND [0.022]	ND [0.029]	ND [0.013]	ND [0.013]	ND [0.013]	ND [0.014]	ND [0.013]	ND [0.012]	ND [0.014]	ND [0.0093]	ND [0.011]	ND [0.018]
8260B	mg/kg	o-Xylene		ND [0.038]	ND [0.05]	ND [0.023]	ND [0.023]	ND [0.022]	ND [0.024]	ND [0.022]	ND [0.021]	ND [0.024]	ND [0.016]	ND [0.018]	ND [0.03]
8260B	mg/kg	sec-Butylbenzene		ND [0.022]	ND [0.029]	ND [0.013]	ND [0.013]	ND [0.013]	ND [0.014]	ND [0.013]	ND [0.012]	ND [0.014]	ND [0.0093]	ND [0.011]	0.0084 [0.018] J
8260B	mg/kg	Styrene		ND [0.022]	ND [0.029]	ND [0.013]	ND [0.013]	0.019 [0.013] J	ND [0.014]	0.0056 [0.013] J	ND [0.012]	ND [0.014]	ND [0.0093]	ND [0.011]	ND [0.018]
8260B	mg/kg	tert-Butylbenzene		ND [0.022]	ND [0.029]	ND [0.013]	ND [0.013]	ND [0.013]	ND [0.014]	ND [0.013]	ND [0.012]	ND [0.014]	ND [0.0093]	ND [0.011]	ND [0.018]
8260B	mg/kg	Toluene		ND [0.13]	ND [0.17]	ND [0.076]	ND [0.076]	ND [0.074]	ND [0.08]	ND [0.074]	ND [0.069]	ND [0.079]	ND [0.053]	ND [0.061]	ND [0.1]
8260B	mg/kg	trans-1,2-Dichloroethene		ND [0.038]	ND [0.05]	ND [0.023]	ND [0.023]	ND [0.022]	ND [0.024]	ND [0.022]	ND [0.021]	ND [0.024]	ND [0.016]	ND [0.018]	ND [0.03]
8260B	mg/kg	Trichlorofluoromethane		ND [0.13]	ND [0.17]	ND [0.076]	ND [0.076]	ND [0.074]	ND [0.08]	ND [0.074]	ND [0.069]	ND [0.079]	ND [0.053]	ND [0.061]	ND [0.1]
8260B	mg/kg	Xylene, Isomers m & p		ND [0.13]	ND [0.17]	ND [0.076]	ND [0.076]	ND [0.074]	ND [0.08]	ND [0.074]	ND [0.069]	ND [0.079]	ND [0.053]	ND [0.061]	ND [0.1]
8270D	mg/kg	1,2,4-Trichlorobenzene	0.031	**ND [0.037]**	**ND [0.042]**	ND [0.0028]	ND [0.0029]	ND [0.015]	ND [0.003]	ND [0.015]	ND [0.0028]	ND [0.0029]	ND [0.014]	ND [0.014]	
8270D	mg/kg	1,2-Dichlorobenzene	0.035	**ND [0.037]**	**ND [0.042]**	ND [0.0028]	ND [0.0029]	ND [0.015]	ND [0.003]	ND [0.015]	ND [0.0028]	ND [0.0029]	ND [0.014]	ND [0.014]	

Table 3. Chemical Concentrations With Respect to DMMP Screening Criteria (cont.)

			Sample ID	18PSBH-D1PSE	18PSBH-D1ZSE	18PSBH-D2PSE	18PSBH-D2ZSE	18PSBH-D3PSE	18PSBH-D3ZSE	18PSBH-D4PSE	18PSBH-D5PSE	18PSBH-D5ZSE	18PSBH-D6PSE	18PSBH-D7PSE	18PSBH-1001SE
			Location ID	DMMU1P	DMMU1Z	DMMU2P	DMMU2Z	DMMU3P	DMMU3Z	DMMU4P	DMMU5P	DMMU5Z	DMMU6P	DMMU7P	TRIP
			Collection Date	04/10/2018 16:31	04/10/2018 16:37	04/10/2018 11:03	04/10/2018 11:10	04/10/2018 10:27	04/10/2018 10:44	04/10/2018 09:58	04/10/2018 09:00	04/10/2018 09:50	04/10/2018 10:35	04/10/2018 11:00	04/10/2018 18:00
			Lab Sample ID	580-76580-1	580-76580-2	580-76580-3	580-76580-4	580-76580-5	580-76580-6	580-76580-7	580-76580-8	580-76580-9	580-76580-10	580-76580-11	580-76580-12
			Matrix	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Method	**Units**	**Analyte**	**DMMP**					**MS/MSD**						**Dupe of -D3PSE (VOCs) and -D6PSE**	**Trip Blank**
8270D	mg/kg	1,4-Dichlorobenzene	0.11	ND [0.037]	ND [0.042]	ND [0.0028]	ND [0.0029]	ND [0.015]	ND [0.003]	ND [0.015]	ND [0.0028]	ND [0.0029]	ND [0.014]	ND [0.014]	
8270D	mg/kg	2,4-Dimethylphenol	0.029	**ND [0.074]**	**ND [0.085]**	ND [0.0057]	ND [0.0058]	**ND [0.03]**	ND [0.0061]	ND [0.029]	ND [0.0055]	ND [0.0058]	ND [0.028]	ND [0.028]	
8270D	mg/kg	2-Methylnaphthalene	0.67	ND [0.037]	ND [0.042]	ND [0.0028]	ND [0.0029]	ND [0.015]	ND [0.003]	ND [0.015]	ND [0.0028]	ND [0.0029]	ND [0.014]	ND [0.014]	
8270D	mg/kg	2-Methylphenol (o-Cresol)	0.063	ND [0.037]	ND [0.042]	ND [0.0028]	ND [0.0029]	ND [0.015]	ND [0.003]	ND [0.015]	ND [0.0028]	ND [0.0029]	ND [0.014]	ND [0.014]	
8270D	mg/kg	Acenaphthene	0.5	ND [0.037]	ND [0.042]	ND [0.0028]	ND [0.0029]	ND [0.015]	ND [0.003]	ND [0.015]	ND [0.0028]	ND [0.0029]	ND [0.014]	ND [0.014]	
8270D	mg/kg	Acenaphthylene	0.56	ND [0.037]	ND [0.042]	ND [0.0028]	ND [0.0029]	ND [0.015]	ND [0.003]	ND [0.015]	ND [0.0028]	ND [0.0029]	ND [0.014]	ND [0.014]	
8270D	mg/kg	Anthracene	0.96	0.033 [0.037] J	0.032 [0.042] J	ND [0.0028]	ND [0.0029]	ND [0.015]	ND [0.003]	0.014 [0.015] J	ND [0.0028]	ND [0.0029]	ND [0.014]	ND [0.014]	
8270D	mg/kg	Benzo(a)anthracene	1.3	0.11 [0.037] J	0.13 [0.042] J	ND [0.0028]	ND [0.0029]	0.011 [0.015] J	ND [0.003]	0.029 [0.015] J	ND [0.0028]	ND [0.0029]	ND [0.014]	ND [0.014]	
8270D	mg/kg	Benzo(a)pyrene	1.6	ND [0.074]	ND [0.085]	ND [0.0057]	ND [0.0058]	ND [0.03]	ND [0.0061]	ND [0.029]	ND [0.0055]	ND [0.0058]	ND [0.028]	ND [0.028]	
8270D	mg/kg	Benzo(b)fluoranthene	3.2	ND [0.037]	ND [0.042]	ND [0.0028]	ND [0.0029]	ND [0.015]	ND [0.003]	ND [0.015]	ND [0.0028]	ND [0.0029]	ND [0.014]	ND [0.014]	
8270D	mg/kg	Benzo(g,h,i)perylene	0.67	ND [0.37]	ND [0.42]	ND [0.028]	ND [0.029]	ND [0.15]	ND [0.03]	ND [0.15]	ND [0.028]	ND [0.029]	ND [0.14]	ND [0.14]	
8270D	mg/kg	Benzo(k)fluoranthene	3.2	ND [0.074]	ND [0.085]	ND [0.0057]	ND [0.0058]	ND [0.03]	ND [0.0061]	ND [0.029]	ND [0.0055]	ND [0.0058]	ND [0.028]	ND [0.028]	
8270D	mg/kg	Benzyl alcohol	0.057	**ND [0.74]**	**ND [0.85]**	ND [0.057]	**ND [0.058]**	**ND [0.3]**	**ND [0.061]**	**ND [0.29]**	ND [0.055]	**ND [0.058]**	**ND [0.28]**	**ND [0.28]**	
8270D	mg/kg	Benzyl butyl phthalate	0.97	ND [0.37]	ND [0.42]	ND [0.028]	ND [0.029]	ND [0.15]	ND [0.03]	ND [0.15]	ND [0.028]	ND [0.029]	ND [0.14]	ND [0.14]	
8270D	mg/kg	bis-(2-Ethylhexyl)phthalate	8.3	ND [0.74]	ND [0.85]	0.051 [0.057] J	0.031 [0.058] J	ND [0.3]	0.025 [0.061] J	ND [0.29]	0.031 [0.055] J	0.034 [0.058] J	ND [0.28]	ND [0.28]	
8270D	mg/kg	Chrysene	1.4	0.2 [0.037] J	0.16 [0.042] J	ND [0.0028]	ND [0.0029]	0.015 [0.015] J	ND [0.003]	0.041 [0.015] J	ND [0.0028]	ND [0.0029]	ND [0.014]	ND [0.014]	
8270D	mg/kg	Dibenzo(a,h)anthracene	0.23	ND [0.074]	ND [0.085]	ND [0.0057]	ND [0.0058]	ND [0.03]	ND [0.0061]	ND [0.029]	ND [0.0055]	ND [0.0058]	ND [0.028]	ND [0.028]	
8270D	mg/kg	Dibenzofuran	0.54	ND [0.037]	ND [0.042]	ND [0.0028]	ND [0.0029]	ND [0.015]	ND [0.003]	ND [0.015]	ND [0.0028]	ND [0.0029]	ND [0.014]	ND [0.014]	
8270D	mg/kg	Diethyl phthalate	1.2	ND [0.037]	ND [0.042]	ND [0.0028]	ND [0.0029]	ND [0.015]	ND [0.003]	ND [0.015]	ND [0.0028]	ND [0.0029]	ND [0.014]	ND [0.014]	
8270D	mg/kg	Dimethyl phthalate	1.4	ND [0.037]	ND [0.042]	ND [0.0028]	ND [0.0029]	ND [0.015]	ND [0.003]	ND [0.015]	ND [0.0028]	ND [0.0029]	ND [0.014]	ND [0.014]	
8270D	mg/kg	Di-n-butyl phthalate	5.1	ND [0.37]	ND [0.42]	ND [0.028]	ND [0.029]	ND [0.15]	ND [0.03]	ND [0.15]	ND [0.028]	ND [0.029]	ND [0.14]	ND [0.14]	
8270D	mg/kg	Di-n-octyl phthalate	6.2	ND [0.074]	ND [0.085]	ND [0.0057]	ND [0.0058]	ND [0.03]	ND [0.0061]	ND [0.029]	ND [0.0055]	ND [0.0058]	ND [0.028]	ND [0.028]	
8270D	mg/kg	Fluoranthene	1.7	0.32 [0.037] J	0.21 [0.042] J	ND [0.0028]	ND [0.0029]	0.041 [0.015] J	ND [0.003]	0.056 [0.015] J	ND [0.0028]	ND [0.0029]	ND [0.014]	ND [0.014]	
8270D	mg/kg	Fluorene	0.54	ND [0.037]	ND [0.042]	ND [0.0028]	ND [0.0029]	ND [0.015]	ND [0.003]	ND [0.015]	ND [0.0028]	ND [0.0029]	ND [0.014]	ND [0.014]	
8270D	mg/kg	Hexachlorobenzene	0.022	**ND [0.37]**	**ND [0.42]**	**ND [0.028]**	**ND [0.029]**	**ND [0.15]**	**ND [0.03]**	**ND [0.15]**	**ND [0.028]**	**ND [0.029]**	**ND [0.14]**	**ND [0.14]**	
8270D	mg/kg	Hexachlorobutadiene	0.011	**ND [0.037]**	**ND [0.042]**	ND [0.0028]	ND [0.0029]	**ND [0.015]**	ND [0.003]	**ND [0.015]**	ND [0.0028]	ND [0.0029]	**ND [0.014]**	**ND [0.014]**	
8270D	mg/kg	Indeno(1,2,3-cd)pyrene	0.6	ND [0.074]	ND [0.085]	ND [0.0057]	ND [0.0058]	ND [0.03]	ND [0.0061]	ND [0.029]	ND [0.0055]	ND [0.0058]	ND [0.028]	ND [0.028]	
8270D	mg/kg	Naphthalene	2.1	ND [0.037]	ND [0.042]	ND [0.0028]	ND [0.0029]	ND [0.015]	ND [0.003]	ND [0.015]	ND [0.0028]	ND [0.0029]	ND [0.014]	ND [0.014]	
8270D	mg/kg	n-Nitrosodiphenylamine	0.028	**ND [0.074]**	**ND [0.085]**	ND [0.0057]	ND [0.0058]	**ND [0.03]**	ND [0.0061]	**ND [0.029]**	ND [0.0055]	ND [0.0058]	ND [0.028]	ND [0.028]	
8270D	mg/kg	Pentachlorophenol	0.4	**ND [0.74]**	**ND [0.85]**	ND [0.057]	ND [0.058]	ND [0.3]	ND [0.061]	ND [0.29]	ND [0.055]	ND [0.058]	ND [0.28]	ND [0.28]	
8270D	mg/kg	Phenanthrene	1.5	0.12 [0.037] J	0.078 [0.042] J	ND [0.0028]	0.0024 [0.0029] J	0.025 [0.015] J	ND [0.003]	0.025 [0.015] J	0.0019 [0.0028] J	0.0021 [0.0029] J	ND [0.014]	ND [0.014]	
8270D	mg/kg	Phenol	0.42	ND [0.37]	ND [0.42]	ND [0.028]	ND [0.029]	0.15 [0.15] J	ND [0.03]	ND [0.15]	ND [0.028]	ND [0.029]	ND [0.14]	ND [0.14]	
8270D	mg/kg	Pyrene	2.6	0.35 [0.074] J	0.29 [0.085] J	ND [0.0057]	0.002 [0.0058] J	0.044 [0.03] J	ND [0.0061]	0.02 [0.029] J	ND [0.0055]	ND [0.0058]	ND [0.028]	ND [0.028]	
8270D	mg/kg	Benzoic acid	0.65	**ND [0.96]**	**ND [1.1]**	**ND [0.77]**	**ND [0.76]**	**ND [0.82]**	**ND [0.82]**	**ND [0.77]**	**ND [0.74]**	**ND [0.77]**	**ND [0.75]**	**ND [0.74]**	
9060A	mg/kg	Total Organic Carbon (TOC)		13000 [100]	48000 [100]	3800 [100]	4200 [100]	7800 [100]	11000 [100]	4800 [100]	3900 [100]	4700 [100]	4300 [100]	3100 [100]	
AK101	mg/kg	Gasoline Range Organics (C6-C10)		ND [5.9]	ND [7.7]	ND [3.6]	ND [3.6]	ND [3.4]	ND [3.7]	ND [3.4]	ND [3.3]	ND [3.7]	ND [2.5]	ND [2.8]	ND [4.6]
AK103	mg/kg	Diesel Range Organics (C10-C25)		64 [20]	120 [25]	ND [16]	ND [17]	ND [17]	ND [17]	ND [18]	ND [16]	ND [16]	ND [15]	ND [16]	
AK103	mg/kg	Residual Range Organics (C25-C36)		240 [40]	400 [50]	ND [33]	ND [34]	ND [34]	ND [34]	ND [35]	ND [32]	ND [32]	ND [30]	ND [32]	
D2216	PERCENT	Percent Moisture	NA	31.4 [0.1]	40.6 [0.1]	12.3 [0.1]	14.9 [0.1]	16.9 [0.1]	17.7 [0.1]	15.9 [0.1]	9.8 [0.1]	15.0 [0.1]	9.2 [0.1]	10.0 [0.1]	
D2216	PERCENT	Solids, Percent	NA	68.6 [0.1]	59.4 [0.1]	87.7 [0.1]	85.1 [0.1]	83.1 [0.1]	82.3 [0.1]	84.1 [0.1]	90.2 [0.1]	85.0 [0.1]	90.8 [0.1]	90.0 [0.1]	
Organic_Tin	mg/kg	Butyltin		ND [0.025]	ND [0.03]	ND [0.02]	ND [0.019]	ND [0.021]	ND [0.021]	ND [0.019]	ND [0.019]	ND [0.02]	ND [0.019]	ND [0.019]	
Organic_Tin	mg/kg	Dibutyltin		ND [0.011]	ND [0.013]	ND [0.0085]	ND [0.0081]	ND [0.0089]	ND [0.0089]	ND [0.0079]	ND [0.008]	ND [0.0084]	ND [0.0082]	ND [0.0083]	
Organic_Tin	mg/kg	Monobutyltin		ND [0.016]	ND [0.019]	ND [0.012]	ND [0.012]	ND [0.013]	ND [0.013]	ND [0.012]	ND [0.012]	ND [0.012]	ND [0.012]	ND [0.012]	
Organic_Tin	mg/kg	Tributyltin	0.073	ND [0.013]	ND [0.015]	ND [0.0099]	ND [0.0095]	ND [0.01]	ND [0.01]	ND [0.0092]	ND [0.0093]	ND [0.0098]	ND [0.0095]	ND [0.0097]	

E. Description of the Proposed Discharge Site. The dredged sediments removed from the harbor would be transported by barge 12 miles across Frederick Sound to the Thomas Bay inland water disposal site. Thomas Bay is fairly confined by a shallow moraine across the mouth of the Bay. It is a deep fjord, with some areas reaching 140 fathoms. The seafloor in the Bay is described as mud or sand in most areas, with hard and soft modifiers interspersed on the nautical charts.

Baird Glacier melts into the bay and apparently discharges significant amounts of silt, as shown be the aerial photography. The head of the bay appears to be the most turbid, as it is most proximal to the glacier. The Alaska District assumes the seafloor in this area to be covered by depositional silt. Glacial fjords in Scandinavia have been documented to accrete at 1-2 cm year[1] and the Alaska District expects Thomas Bay to accrete at a similar rate. Any dredged material placed in the bay would be covered by silt deposition after a couple of years. It is further reasonable to expect benthic organisms to be adapted for life in turbid and deposition environments; and therefore would be able to quickly recover post-disposal.

Some sediments would be resuspended in the South Harbor during dredging, although the use of a mechanical dredge will severely reduce the amount of material suspended in contrast to a hydraulic dredge. In this context, the “discharge” site in this evaluation refers to the dredging site itself, which may be impacted by sediments suspended in the water column during dredging and dewatering activities.

In general, the South Harbor seafloor is flat, featureless sediment, with few epibenthic organisms except those anchored to bottom debris or pilings. In November 2017, a few sea urchins (*Strongylocentrotus* spp.) were scattered about parts of the harbor floor sediment, and little kelp or other marine algae were evident. Several different genera of sea anemones (mostly *Meretridium* and *Anthopleura* spp.) heavily colonize wood and metal structures.

Water movement within the Petersburg Harbor basins is heavily influenced by strong tidal currents within Wrangell Narrows. The current at flood tides runs to the southwest at an average rate of 3.7 knots, then reverses during ebb tide to an average rate of 3.4 knots; the maximum current is 6.1 knots. The slack tide period before the current reverses is reportedly very brief, perhaps less than an hour. Since most structures within the harbors are on pilings rather than breakwaters, there is little to impede these currents from flowing through the exposed harbor basins. Heavy ripple marks seen in some of the bottom sediments of the harbors attest to the strong currents within the harbors. On the other hand, the harbors experience very little wave action.

F. Description of Disposal Method. Disposal in Thomas Bay would be conducted by the transport barge or series of barges. Material would be excavated from the South Harbor by the dredge plant and loaded onto barges. Dredged material would be passively dewatered during barge loading, with the effluent returning to the harbor basin and settling beneath barge, dredge, or downdrift. Discharge would consist of sediments suspended in the water column during dredging and dewatering. The strong currents within the harbor basin would make a silt curtain impractical.

II. FACTUAL DETERMINATIONS

A. Physical Substrate Determinations. The discharge site (South Harbor basin) is the same site from which the sediment is being dredged, so sediments settling out within the harbor should be essentially the same as the existing substrate. Due to dispersal by the strong currents, the resuspended sediments should settle out in a thin layer, and not significantly alter the existing topography.

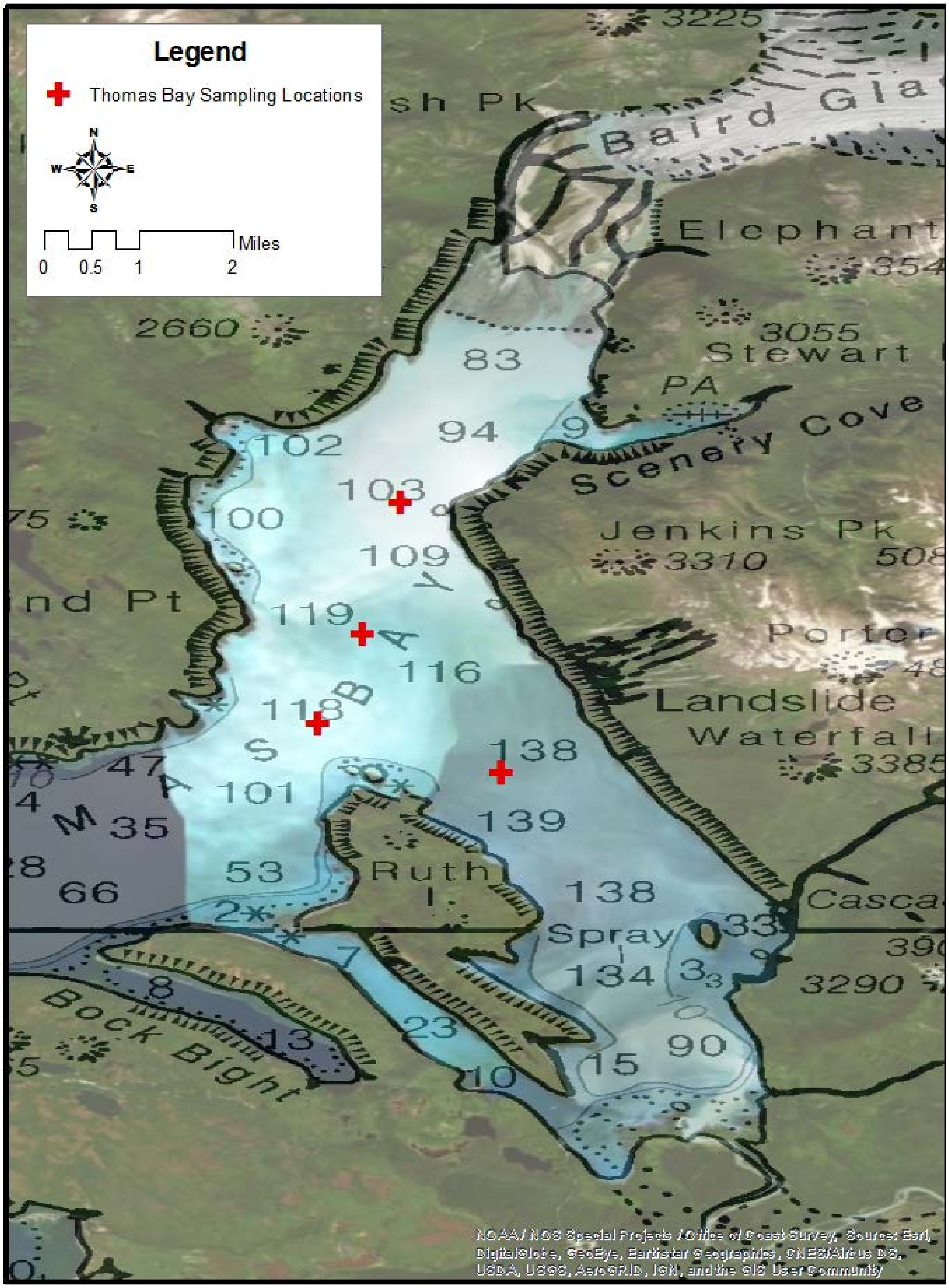
The disposal location in Thomas Bay has not been specifically identified at the time of this writing, but four sampling locations in the head of the bay will be investigated by the Alaska District in order to determine physical and biological compatibility (Figure E-A-2). The substrate in Thomas Bay is believed to consist of areas of mud and sand. High suspended sediment load is presumed to contribute to a silty surface as the glacial alluvium settles out of the water column.

B. Water Circulation, Fluctuation, and Salinity Determinations. The strong tidal currents of Wrangell Narrows flow nearly unimpeded through the Petersburg Harbor system. The sediment suspended in the water column by dredging would be dispersed widely and rapidly, and would not be expected to accumulate in any way that would affect water circulation, tidal fluctuations, or salinity.

Thomas Bay is fairly confined by the headlands and shallow moraine across the mouth of the bay. Aerial photography interpretation indicates little water circulation between the water of upper Thomas Bay and that of Frederick Sound. Alaska Department of Fish and Game stock reports in Thomas Bay depict a low salinity (10-27 psu) lens on the surface and extending to about 20 meters, below which the salinity abruptly increases to about 30 psu, where it begins trending upwards to a maximum of about 33 psu at 250 meters. The water temperature in the near surface lens is about 7.5 degrees Celsius until a depth of 20 meters, where it increases to over 8 degrees Celsius before trending down to 5 degrees Celsius at 250 meters.

C. Suspended Particulate/Turbidity Determinations. The dredging and dewatering activity would result in an unavoidable release of suspended particulates into the water column. However, the strong, unimpeded tidal currents at the dredging location are expected to rapidly disperse the particulates and minimize the extent and duration of high levels of turbidity. These same strong currents are likely to render ineffective conventional sediment control measures, such as silt curtains.

Thomas Bay is fairly confined by the headlands and shallow moraine across the mouth of the bay. Dredged material placed in the upper reaches of the bay are expected to move nearly vertically through the water column and come to rest on the sea floor in deep water more or less below the scow. Some of the fine grain sediment may become suspended in the water column, but Thomas Bay has high natural turbidity from the glacial outwash and additional sediment in suspension would not significantly alter water quality. The ADEC Water Quality Division has been involved in plan development and has not raised substantive concerns regarding the proposed placement of dredged material in Thomas Bay and its impacts on water quality.



NOAA / NOS Special Projects / Office of Coast Survey, Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure E-A-2. Thomas Bay Sampling Locations

D. Contaminant Determinations. The dredged material in the South Harbor does not contain chemical concentrations exceeding the screening thresholds in the DMMP and is deemed suitable for in-water placement without restriction (Table E-A-3).

E. Aquatic Ecosystem and Organism Determinations. The existing ecosystem within the harbor basin has been impacted by the activities and contaminants present within the harbor, and the organisms there are limited to those able to adapt to the contaminants and debris present, and to the periodic re-suspension of sediment caused by turbulence from boats maneuvering within the shallow harbor. The ecosystem outside of the harbor has not been evaluated. Attenuated portions of the re-suspension plume may extend outside the harbor basin but would be rapidly dispersed in the strong tidal currents of Wrangell Narrows.

The proposed disposal locations in Thomas Bay will be evaluated prior to design and implementation of the South Harbor deepening and disposal project in order to verify ecosystem suitability. The affected environment in the disposal location is expected to be mud bottom benthic communities of invertebrates, likely polychaetes and crustaceans. These organisms are believed to be adapted for life in dark, turbid, and depositional environments and would not be significantly impacted by the disposal of dredged sediments at the population level.

F. Proposed Disposal Site Determinations. The re-suspension site would be the South Harbor basin, where the dredging activities would take place. Due to the strong tidal currents, the dispersal of re-suspended sediments would be largely uncontrollable, and the sediment would be spread out in a thin, perhaps undetectable layer over the receiving substrate.

The strongly depositional and turbid environment in Thomas Bay is expected to mitigate the impacts of dredged material placement in the bay. The sediments that would be placed substantially similar to the existing substrate in the bay and would be covered by silt within a couple of years. The water depth in the disposal location is great enough that the change in bottom elevation would not convert any habitat from one type to another by altering photic exposure or any other mechanism.

G. Determination of Cumulative/Secondary Effects. The Petersburg boat harbors require infrequent dredging; North Harbor was last dredged more than 40 years ago. Subsequent dredging of South Harbor and the other harbor basins would occur at long intervals, and cumulative effects from repeated dredging should be negligible. No secondary effects are identified.

III. FINDINGS OF COMPLIANCE

A. Adaptation of the Section (404)(b)(1) Guidelines to This Evaluation. The use of these guidelines to evaluate dredged material placement prior to the designation of an in-water disposal location during dredging activities is the only adaptation of the Section 404(b)(1) Guidelines employed in this evaluation.

B. Evaluation of Availability of Practicable Alternatives. USACE must evaluate alternatives that are practicable and reasonable. Practicable is defined as meaning the alternative is available, and capable of being done after taking into consideration cost, existing technology, and/or logistics in light of the overall project purpose(s). Reasonable is based on consideration of the project purpose as well as technology, economics and common sense. The dredged material from the South Harbor meets upland disposal standards, so upland placement is a practicable alternative from a technological and logistic perspective. Contemporary estimates regarding the cost of upland disposal increase the total project cost from approximately $4 million to $6.9 million, so upland disposal is not a practicable alternative from a cost perspective.

The remaining options are mechanical bucket dredging versus suction dredging. The relatively small area to be dredged, consolidated nature of the clay material, and the restricted confines of the harbor basin, would probably necessitate the use of a bucket dredge. A suction dredge may loft less sediment during sediment removal, but would generate a slurry of much higher water content that would then need to be managed and dewatered at the scow. It is not likely that the use of suction dredging would result in lesser impacts to water quality. The use of a closed-top bucket during dredging may result in less fallback and out-wash of sediment, and therefore, limit the impact on water quality.

C. Compliance with Applicable State Water Quality Standards. The Alaska District has been in coordination with the ADEC Water Quality Division regarding the proposed project. Final determination regarding compliance with State water quality standards cannot be completed until the disposal location is identified, but the Alaska District expects the State to certify the discharge as compliant with water quality standards under Section 401 of the Clean Water Act.

D. Compliance with Endangered Species Act of 1973. The proposed action would not harm any threatened or endangered species or their critical habitat.

E. Compliance with Specified Protection Measures for Marine Sanctuaries Designed by the Marine Protection Research and Sanctuaries Act of 1972. No action associated with the proposed project would violate the above Act. The Corps is evaluating a disposal location in ocean waters and would prepare a site selection study under Section 103 to submit to the US EPA if the potential ocean waters locations is selected.

F. Evaluation of Extent of Degradation of the Waters of the United States. There would be no significant adverse impacts to municipal and private water supplies, recreation and commercial fisheries, plankton, fish, shellfish, wildlife and/or aquatic sites caused by the proposed action. There would be no significant adverse effects on regional aquatic ecosystem diversity, productivity, and/or stability caused by the placement of the fill material nor would there be significant adverse effects on recreation, aesthetic, and/or economic values caused by this project.

G. Appropriate and Practicable Steps Taken to Minimize Potential Adverse Impacts of the Discharge on Aquatic Ecosystems. All appropriate and practicable steps would be taken to minimize potential adverse impacts of the discharge on the aquatic ecosystem. Those steps include timing of dredging and disposal activities to avoid species of concern, selecting the dredging method that results in the smallest amount of re-suspension, and incorporating best management practices and mitigation measures into the project design and construction contract

IV. COORDINATION

On the basis of the Guidelines for Specification of Disposal Sites for Dredged or Fill Material (40 CFR part 230), the proposed project has been specified as complying with the requirements of the guidelines for Section 404 of the Clean Water Act. The ADEC Water Quality Division has been engaged regarding the proposed dredging project and does not object. A Section 401 Water Quality Certificate of Reasonable Assurance will be obtained prior to dredging and disposal.

Petersburg Navigation Improvements

Appendix G: Real Estate

Petersburg, Alaska

September 2018

US Army Corps of Engineers
Alaska District

RJG 28Aug2018

US Army Corps
of Engineers ®
Pacific Ocean Division

REAL ESTATE PLAN

APPENDIX G

Alaska District

NAVIGATIONAL IMPROVEMENT
CAP SECTION 107

PETERSBURG, ALASKA

Real Estate Branch
Alaska District
U.S. Army Corps of Engineers

NAVIGATION IMPROVEMENTS
CAP SECTION 107
PETERSBURG, ALASKA

REAL ESTATE PLAN

I. PURPOSE:

This Real Estate Plan (REP) will be consolidated into the decision document Feasibility Report for Navigation Improvements for Petersburg, Alaska. The purpose of the feasibility study is to determine the feasibility of constructing navigation improvements that would increase the efficiency of navigation in the Petersburg harbor system. The REP identifies and describes the real estate requirements for the lands, easements, rights-of-way, relocations and disposal areas (LERRD) that will be required. The REP is tentative in nature; it is for planning purposes only and both the final real property acquisition lines and the real estate cost estimates provided are subject to change even after approval of the feasibility study.

II. PROJECT TYPE AND APPLICABILITY:

This feasibility study will be conducted under authority granted in Section 107 of the River and Harbor Act of 1960, as amended (33 U.S.C. 577) which states in part:

"The Secretary of the Army is authorized to allot from any appropriations hereafter made for rivers and harbors not to exceed $50,000,000 for any one fiscal year for the construction of small river and harbor improvement projects not specifically authorized by Congress which will result in substantial benefits to navigation and which can be operated consistently with appropriate and economic use of the waters of the Nation for other purposes, when in the opinion of the Chief of Engineers such work is advisable, if benefits are in excess of the cost….Not more than $10,000,000 shall be allotted for the construction of a project under this section at any single locality and the amount allotted shall be sufficient to complete the Federal participation in the project under this section."

Nonfederal Sponsor (NFS) for the project is the Petersburg Borough.

III. PROJECT SCOPE AND CONTENT:

The Petersburg Navigation Improvements Feasibility Study has two primary planning objectives. They are listed below without respect to priority as both will need to be addressed to arrive at an effective solution:

- Improve access to the Petersburg Harbor system:

  - Entrance channel & maneuvering basin
  - Moorage areas
  - Public access facilities
- Reduce vessel delays due to insufficient depths within the harbor system

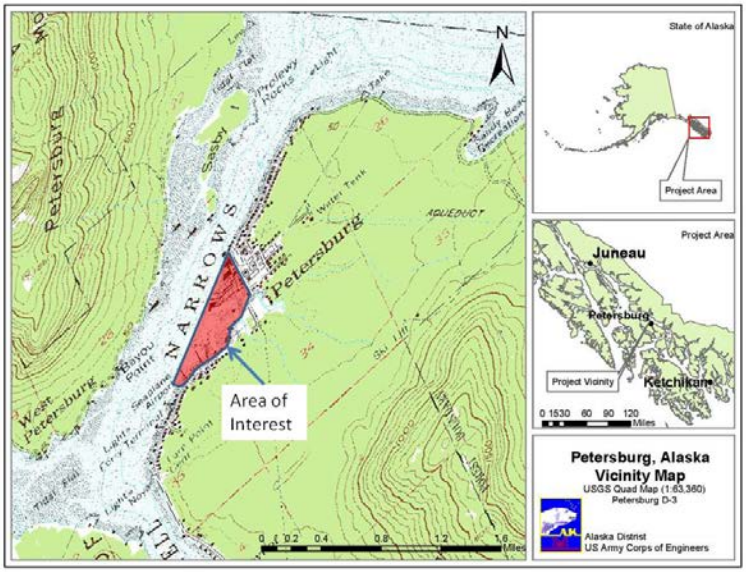


Figure 1. Petersburg, Alaska Vicinity Map

Figure 2. Study Area, Petersburg, Alaska

IV. Project Alternatives:

Four alternatives were evaluated along with the future without project condition (No Action):

Alternative 1: No Action:Small Basin with No Western Entrance Channel:

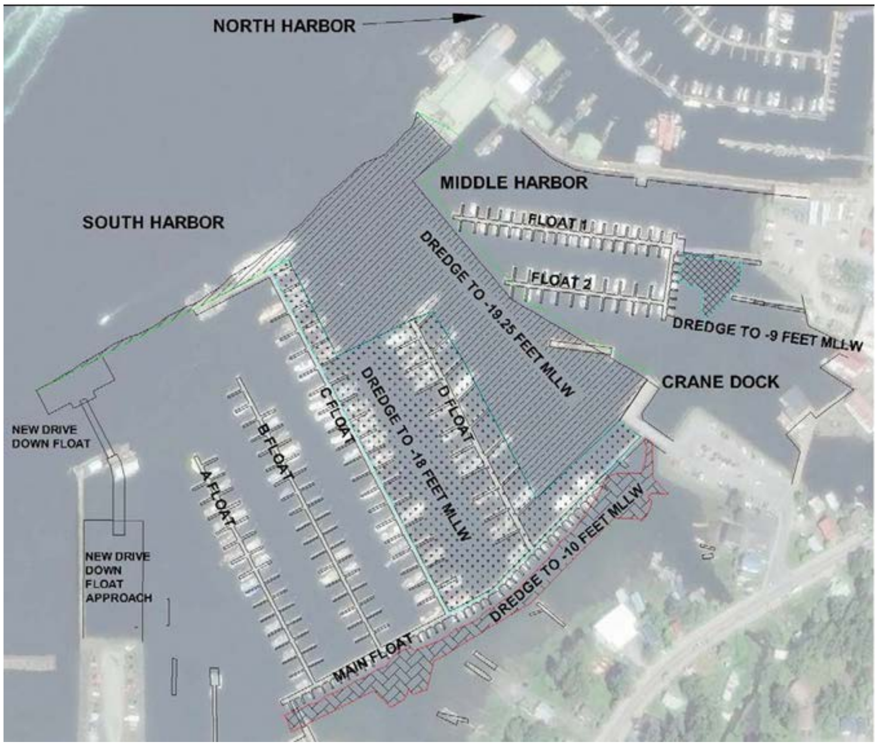
The Harbor depth will remain the same and all vessels in the Petersburg harbor system will remain in their assigned slips. The study objective would not be met and no project benefits or opportunities would be realized.

Alternative 2: Non-Structural Reorganization of Petersburg Harbor System:

This non-structural alternative would require the removal of all boats in the harbor system and a reorganization of floats and slip assignments based on vessel draft and inner harbor depths. This alternative would not address depth issues in the harbor entrance channels or maneuvering basins, so vessel delays would still occur during low tides.

Alternative 3 Tentatively Selected Plan (TSP): South Harbor Dreding Only

Dredging of South Harbor would take place in order to address transportation delays and lost opportunities due to lack of sufficient depth. The inner and outer harbor will be dredged to a depth of -20 MLLW. The commercial and recreational floats will be dredged to -18 MLLW and -10 MLLW, respectively. The sump area will be dredged to -9 MLLW.



Alternative 4: South Harbor Dredging with Haul-out Area at Scow Bay

This alternative includes all features of alternative 3 plus the installation of a vessel haul-out area at Scow Bay. This alternative would provide the infrastructure (a concrete ramp) for hydraulic trailers (provided by private sector) to transport commercial and recreational vessels from the water onto the uplands to access services at adjacent work and storage yards.

Alternative 5: South Harbor Dredging with Haul-out Area and New Harbor Scow Bay

This alternative includes all features of alternative 4 plus the installation of a new harbor at Scow Bay to accommodate excess demand for vessels seeking permanent and transient moorage at Petersburg. The existing 400-foot breakwater would be extended out to 800-ft total length to protect the float system and harbor entrance from wave action. Three rows of stalls supporting up to 32', 42', and 60' vessels, respectively, would be constructed along with an outer slip area for transient moorage.

V. DESCRIPTION OF LANDS, EASEMENTS, RIGHTS-OF-WAY, RELOCATION and DISPOSAL (LERR):

The project area is located on the western coast of Prince of Wales Island, approximately 55 air miles west-northwest of Ketchikan. It lies along the southern end of Klawock Inlet, within Section 6, Township 74 South, Range 81 East, USS 1429A and ATS 212, Copper River Meridian.

Public access is available to the project site. There are no NFS real estate requirements for this project. The Government's dominant right of navigation servitude will be exercised for project tidelands below the Mean High Water (MHW) line for the General Navigation Feature (GNF) portion of the project.

VI. STANDARD ESTATES:

None

VII. NON-STANDARD ESTATES:

None

VIII. FEDERAL LANDS:

None

IX. NEAREST OTHER EXISTING FEDERAL PROJECT:

Nearest existing Federal Project is the Maintence Dredging, Petersburg North Harbor Project, Petersburg, Alaska.

X. NAVIGATION SERVITUDE:

Per 33 CFR § 329.4, navigable waters of the United States are those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. A determination of navigability was discussed with our Office of Counsel (OC) and it was determined that the application of navigational servitude is appropriate for construction of the breakwaters. Navigational servitude will apply laterally over the entire surface of the water-body, and is not extinguished by later actions or events which impede or destroy navigable capacity.

XI. INDUCED FLOODING:

Flooding is not expected as a result of the project.

XII. BASELINE COST ESTIMATE FOR REAL ESTATE:

Baseline Cost Estimate for Real Estate is $0.0.

XIII. UTILITIES & FACILITIES RELOCATIONS:

No known utilities or facilities are located in this area and no relocations are required.

XIV. RELOCATION ASSISTANCE BENEFITS:

There are no Public Law 91-646 businesses or residential relocation assistance benefits required for this project.

XV. HTRW IMPACTS:

No information pertaining to HTRW has been found and no HTRW present within the project footprint.

XVI. MINERAL/TIMBER ACTIVITY:

There are no current or anticipated mineral or timber activities within the vicinity of the proposed project that will affect construction, operation, or maintenance of the proposed project. Nor will any subsurface minerals or timber harvesting take place within the project.

XVII. REAL ESTATE MAP:

Not applicable. No real estate is required for the project.

XVIII. SPONSORSHIP CAPABILITY:

Not applicable. No real estate is required to be provided by the NFS. The Sponsor's point of contact information is:

Mr. Stephen Giesbrecht
Borough Manager
PO Box 329
Petersburg, AK 99833
Email: sgiesbrecht@petersburgak.gov

XIX. NOTIFICATION OF SPONSOR AS TO PRE- PROJECT PARTNERSHIP AGREEMENT (PPA) LAND ACQUISITION OF SPONSOR AS TO PRE-PPA LAND ACQUISITION:

No real estate is required to be provided by the NFS.

XX. ZONING ORDINANCES ENACTED:

No zoning ordinances will be enacted to facilitate the proposed ecosystem restoration activities. Therefore, no takings are anticipated as a result of zoning ordinance changes. No zoning ordinances are proposed in lieu of, or to facilitate acquisition in connection with the project.

XXI. VIEWS OF FEDERAL, STATE, AND REGIONAL AGENCIES:

This project is supported by Federal, State, and Regional agencies. The Corps has met with representatives of the Petersburg Borough and other pertinent parties to discuss aspects of the proposed action. Further coordination will be ongoing. In compliance with NEPA rules/regulations, letters will be sent to resource agencies and residents in the area; public notices will transpire within the project vicinity.

XXII. VIEWS OF LOCAL RESIDENTS:

The Petersburg Borough has conducted public meetings concerning this project. Local residents are in favor of the project with funding remaining an issue to be resolved. Further coordination will be ongoing between the Petersburg Borough, US Army Corps of Engineers, State and Federal resource agencies, and residents in the area.

XXIII. ANY OTHER RELEVANT REAL ESTATE ISSUES:

The in water dredge disposal site has not been determine. For more information, see the In-water disposal locations section of the Consideration of Environmental Impacts Report**.**

PREPARED BY:	**REVIEWED AND APPROVED BY:**
________________________	______________________________
Ronald J. Green	MICHAEL D. COY
Realty Specialist	Chief, Real Estate

Petersburg Navigation Improvements

Appendix H: Agency Coordination and Correspondence

Petersburg, Alaska

September 2018

US Army Corps of Engineers
Alaska District

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, WA 98101-3140

OFFICE OF
ENVIRONMENTAL REVIEW
AND ASSESSMENT

March 15, 2018

Mr. Stephen Giesbrecht, Manager
Petersburg Borough
P.O. Box 329
Petersburg, Alaska 99833

Dear Mr. Giesbrecht:

Thank you for your letter to the U.S. Environmental Protection Agency, dated February 13, 2018, regarding the authorities and acceptable specifications for the use and disposal of dredged material from South Harbor in Petersburg, Alaska. As you may know, the U.S. Army Corps of Engineers, Alaska District is the federal lead agency for the South Harbor dredging project. As such, the Alaska District is responsible for managing the project and coordinating with other federal agencies, including the EPA. The Alaska District has a wealth of experience and expertise in harbor construction and navigational dredging and is well versed in the requirements for the evaluation and testing of dredged material, as well as the specifications for dredged material disposal sites in Alaska. I encourage you to communicate directly with the USACE on this matter. For more information about the Alaska District dredging program, the authorities granted to the USACE by federal law, and the South Harbor project specifically, please contact the USACE Petersburg South Harbor project manager.

The answers to your specific questions are included below:

1. **Who has authority over the specifications of the dredge spoils and how are these specifications developed?**

The discharge of dredged material in Alaska is regulated by several government agencies, including but not limited to the USACE, the EPA, the Alaska Department of Environmental Conservation and the Alaska Department of Natural Resources. If you have questions about the specific state requirements, please contact the appropriate state agency for more information.

The USACE has authorities related to dredging and dredged material under several laws, including but not limited to the Rivers and Harbors Act; the Water Resources Development Act; the Clean Water Act; and the Marine Protection, Research, and Sanctuaries Act.

The EPA has its own authorities for managing dredged material pursuant to the CWA and the MPRSA. This letter addresses some of the EPA's authority under the CWA because the proposed South Harbor improvement project, as described in your letter, appears to be subject to regulation under the CWA and not the MPRSA. The Administrator of the EPA is authorized to prescribe regulations to carry out functions under Section 501(a) the CWA [33 USC § 1361(a)]. In conjunction with the Secretary of the Army, the Administrator is also required to develop guidelines for disposal sites of dredged or fill material, pursuant to Section 404(b)(1) of the CWA [33 USC § 1344(b)(1)].

The "Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material" (Guidelines) are set forth at 40 CFR Part 230. Although the Guidelines are promulgated by the EPA, the USACE, as the permitting agency, is responsible for determining compliance with the Guidelines. The applicable requirements for the evaluation and testing of dredged or fill material are found at 40 CFR Part 230, Subpart G. The first section of Subpart G describes the general evaluation procedures for dredged or fill material, and the second section describes specific procedures for chemical, biological, and physical evaluation and testing (40 CFR §§ 230.60 & 230.61).

The EPA and the USACE have also published joint national and regional manuals on how to evaluate and test dredged material. The Inland Testing Manual provides comprehensive evaluation and testing guidance from a national perspective and is available at: https://www.epa.gov/cwa-404/inland-testing-manual. The Sediment Evaluation Framework is a regional manual for projects in the Pacific Northwest and is available at: https://www.epa.gov/ocean-dumping/sediment-evaluation-framework-pacific-northwest. The User Manual is a regional manual for projects in the State of Washington and is available at: http://www.nws.usace.army.mil/Missions/Civil-Works/Dredging/User-Manual. Although there is no Alaska-specific regional manual at this time, the EPA Region 10 allows for any of these three manuals to be used for implementing dredged material testing and disposal for projects in Alaska.

2. **Is there a methodology in place to help a community like Petersburg request for a more specific set of standards to be used for our community?**

Yes, there is a methodology in place for a request of this type. The Guidelines state that "Guidance on interpreting and implementing these Guidelines may be prepared jointly by EPA and the Corps at the national or regional level from time to time." [40 CFR § 230.2(c)]. Additionally, the national ITM states:

> This manual, which is designed to allow for *regional flexibility* in implementation and application including development of *regional manuals* and documentation, will be periodically revised and updated as warranted by advances in regulatory practice and technical understanding. See ITM, Preface, pg. viii (emphasis added).

The Borough may request the Alaska District and EPA Region 10 develop an Alaska-specific regional manual. This approach could be useful across the State of Alaska; however, the development of an Alaska-specific manual may not align with the specific South Harbor project schedule, as developing a regional testing manual for Alaska will take some time. The South Harbor dredged material assessments that would be required prior to material disposal under the new manual would also take additional time. It typically takes several weeks for a general evaluation of dredged material and several months for specific rounds of physical, chemical and biological testing.

The Petersburg Borough may also request regional flexibility in applying and implementing specific provisions in one of the existing approved manuals (i.e., the ITM, the SEF or the UM). Although the ITM allows for regional flexibility, any proposed changes in implementation from an existing manual must be consistent with the CWA and the Guidelines, approved by the USACE and the EPA, based on the best available science and documented in the administrative record.

If you would be interested in participating in a teleconference including the Petersburg Borough, the USACE, and the EPA, to help clarify your specific concerns and to answer any additional questions you may have, please let us know and we can ask the Alaska District, as the federal lead agency for the South Harbor project, to schedule a conference call in the coming weeks. If you need any more information from the EPA, or would like assistance in locating the relevant EPA guidance documents, please contact Chris Meade in our Juneau office at 907-586-7622 or at meade.chris@epa.gov.

Sincerely,

Jill A. Nogi

Jill A. Nogi, Manager
Environmental Review and Sediment Management Unit

Cc: Chris Hladick, Regional Administrator, EPA Region 10
Michael Montone, Acting Chief, Regulatory Division, Alaska District Corps of Engineers
Mark Jensen, Mayor, Petersburg Borough
Glorianne Wollen, Harbormaster, Petersburg Borough
Brad Gilman, Robertson, Monagle & Eastaugh

3130-1R COE-Res

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

DEPARTMENT OF THE ARMY
ALASKA DISTRICT, U.S. ARMY CORPS OF ENGINEERS
P.O. BOX 6898
JOINT BASE ELMENDORF-RICHARDSON, AK 99506-0898

RECEIVED
MAR 0 2 2018
OHA

FEB 2 8 2018

SJM **No Historic Properties Affected**
Alaska State Historic Preservation Officer
Date: 3/30/18 **File No.:** 3130-1R COE 2018-00271
Please review: *36 CFR 800.13* / *A.S. 41.35.070(d)*

Ms. Judith Bittner
State Historic Preservation Officer
Office of History and Archaeology
550 West 7th Avenue, Suite 1310
Anchorage, AK 99501-3565

Dear Ms. Bittner:

The U.S. Army Corps of Engineers (USACE) is planning to conduct sediment sampling in the Petersburg Harbor (Section 27, T58S, R79E, USGS Quad Petersburg D-3, Copper River Meridian; Figure 1), Petersburg, Alaska, in preparation for future dredging activities. In compliance with Section 106 of the National Historic Preservation Act of 1966 [36 CFR § 800.2(a)(4)], the purpose of this letter is to notify you of a Federal undertaking and to seek your concurrence on an assessment of effect.

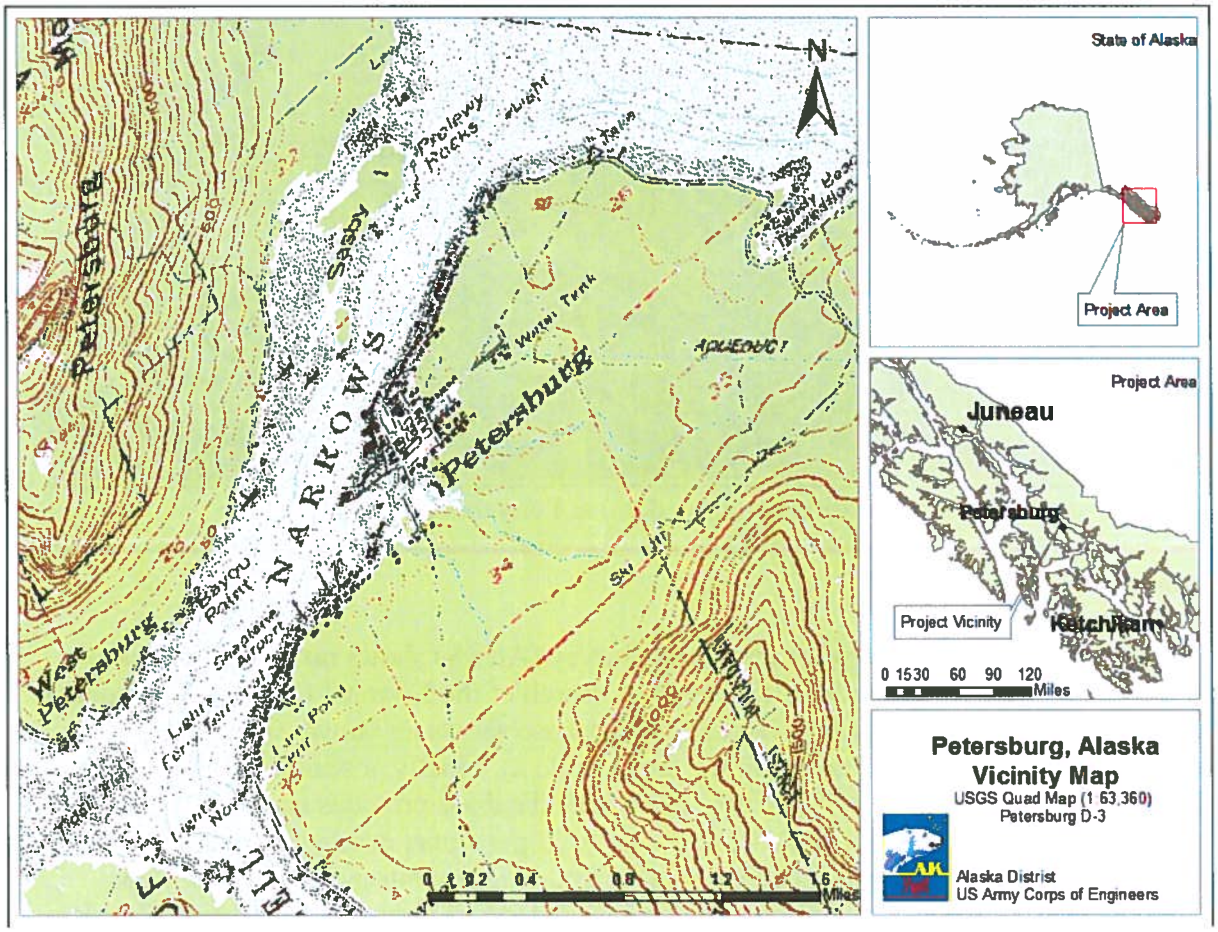


Figure 1. Project Area Overview

2018-00271

Project Description

Shallow depths are affecting the efficient use of portions of the South Petersburg Harbor. Vessels often run aground, and portions of the harbor are inaccessible at lower tidal stages. In April 2018, the USACE is planning to conduct sediment sampling in the harbor in order to create a characterization to be used in future dredged material disposal plans. Sixteen cores will be collected, of which 12 will be collected with a 4-inch-diameter split-spoon vibracore (Figure 2). The remaining four samples will be collected with a 2-inch-diameter push core, operated from the floating docks (Figure 2). Sample depths will be taken to a depth of 4 feet or to refusal. The sampling will be conducted via drill rig placed on a barge.

Figure 2. Proposed boring locations (yellow dots) at Petersburg Harbor.

Assessment of Effect

A search of the Alaska Heritage Resources Survey (AHRS) shows no cultural resources within the limits of the sampling areas (Table 1). A search of the National Oceanic Atmospheric Administration (NOAA) wrecks and obstructions database shows no known wrecks or obstructions within the limits of the sampling area (Table 2). Finally, a search of the Bureau of Ocean Energy Management's (BOEM) 2011 shipwreck database provides no indication that any shipwrecks are within the project area (Table 3). USACE personnel conducted an underwater investigation via waterproof camera and a remote operated underwater vehicle at locations throughout the harbor (Figures 3 and 4). A review of the footage shows a steel plate with bolts attached, cable, and rope at location 5; rope and cable at location 6; a coffee mug at location 7; and pipe and metal debris at location 8.

Figure 3. Locations of underwater surveys.

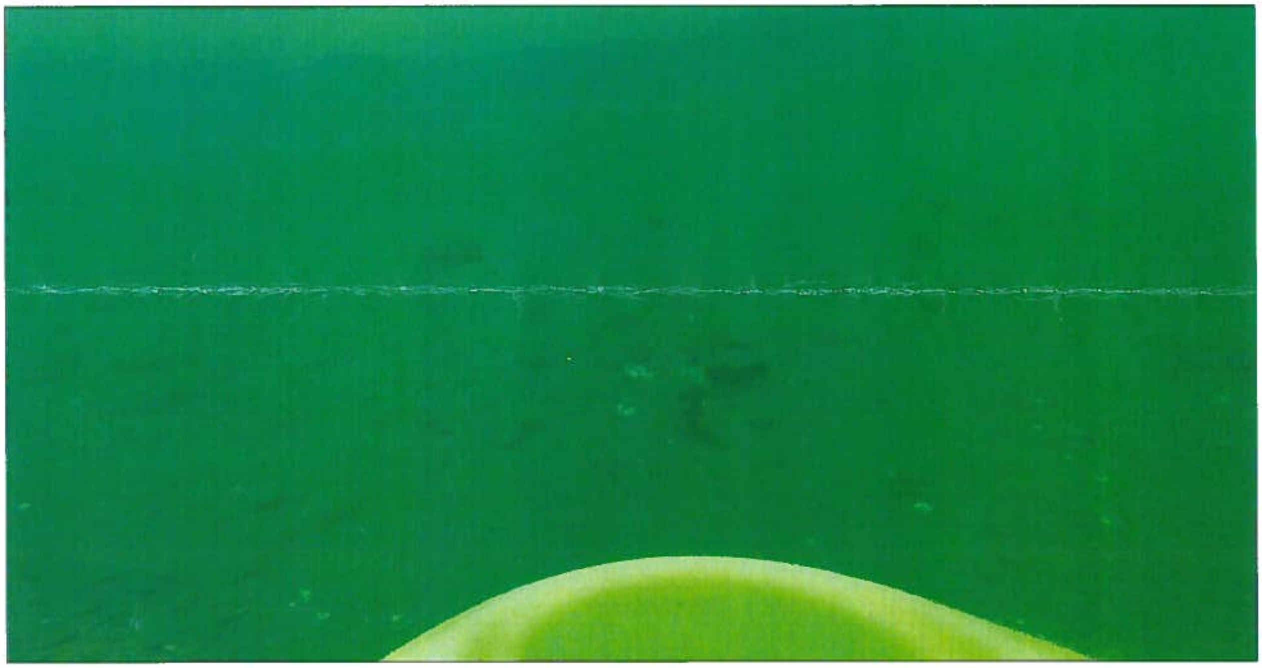


Figure 4. Still image of typical harbor seafloor from underwater digital video recording.

Table 1. Known cultural resources in general area.

AHRS No.	Site Name	NRHP Status	In APE

PET-119	Sons of Norway Hall (Fedrelandet Lodge No. 23)	Listed	
PET-200	Chugach (Ranger Boat)	Listed	
PET-328	Petersburg Fisheries	None	
PET-513	Turn Point Fish Trap	Eligible	
PET-529	Fishing Vessel Charles W.	Listed	
PET-567	Indian Street Viaduct	None	
PET-569	Nelbro/Norquest Cannery	None	
PET-590	Boat Maintenance Shop	Not Eligible	
PET-702	Petersburg Fishing Industry Historic District	None	

Table 2. Wrecks and obstructions in the vicinity of Petersburg (NOAA 2018).

Type	**Status**	**Narrative**	**Latitude**	**Longitude**
Wreck	Visible	Always dry	56.813557	-132.993668
Wreck	Visible	Visible Wreck	56.813545	-132.993576
Wreck	Visible	Always dry	56.817669	-132.971664
Wreck	Visible	Always dry	56.818798	-132.969467
Wreck	Visible	Always dry	56.82283	-132.964508
Wreck	Visible	Always dry	56.822731	-132.963211
Wreck	Visible	Old derelict fishing boat on mud flats	56.823265	-132.963104
Wreck	Visible	Old derelict fishing boat on mud flats	56.812103	-132.961716
Wreck	Visible	Always dry	56.820763	-132.961273
Obstruction	Submerged	Two-fathom-two-foot sounding	56.825409	-132.940216
Obstruction	Submerged	USACE disposal area	56.827778	-132.918335
Obstruction	Submerged	Wooden ATON tower depth 3.71m	56.804085	-132.989243

Table 3. Shipwrecks in the vicinity of Petersburg (BOEM 2011).

Name	**Type**	**Year**	**Location**	**Narrative Summary**
Bonnie Jean	Gas Screw	1922	Scow Bay	Foundered
Liberty Belle	Fishing Vessel	1924	South of Scow Bay	Hit reef
Flora	Gas Screw	1927	Standard Oil Dock, Petersburg	Fire, destroyed
Mission	Gas Screw	1927	Burnet Cannery	Burned
Mildred II	Gas Screw	1928	Off Turn Point, Petersburg	Fire, vessel consumed
Tum Tum	Gas Screw	1933	Petersburg	Burned
St. Martin	Gas Screw F/F	1937	Across from Scow Bay Cannery	Destroyed by fire
31-A-866	Fishing Vessel	1943	Herring Bay near Petersburg	Wrecked
Arab	Gas Screw	1945	Petersburg	Burned
Ronald	Gas Screw	1946	Vicinity of Horn Cliffs	Foundered and lost
Salvor	Oil Screw	1948	Near Petersburg	Burned
31-B-460	Fishing Vessel	1950	Petersburg	Sunk at dock
Odin	Gas Screw	1958	Petersburg	Burned
Lief H.	Fishing Vessel	1965	Channel Light No. 32A	Grounded and sank
Rose	Tug	1977	Kupreanof Beach	Sank and abandoned
Sweetbriar	CG buoy tender	1993	Opposite Scow Bay	Stuck in mud, recovered
Loretta C	Longliner halibut	1998	Petersburg	Burned

Note: The tug *Rose* sank while moored at the Petersburg boat harbor on June 1, 1977 and later became a landmark along the Kupreanof beach where she was abandoned.

The USACE is planning to conduct sediment sampling in sections of the Petersburg Harbor in preparation for future dredging. No sites have been identified within the APE. Following 36

CFR § 800.4(d)(1), the USACE seeks your concurrence on the determination that the 2018 undertaking will result in **no historic properties affected**. If you have any questions about this project, please contact Forrest Kranda by phone at 907-753-2736, or by email at forrest.j.kranda@usace.army.mil.

Sincerely,

Kelly A Eldridge

Kelly A. Eldridge
Archaeologist
Environmental Resources Section

Cc:

Christina Sakamoto, President, Petersburg Indian Association
Michele Metz, Lands Manager, Sealaska Corporation
Desiree Duncan, Native Lands and Resources Manager, Central Council of the Tlingit and Haida Indian Tribes of Alaska

References Cited

Alaska Department of Commerce, Community, and Economic Development (Community Databse). 2018. Community Database Online, Petersburg. Online document, accessed February 15, 2018.

Alaska Heritage Resources Survey (AHRS). 2018. AHRS Database. Alaska Office of History and Archaeology.

Bureau of Ocean Energy Management (BOEM). 2011. Alaskan Shipwrecks Table. Online document, https://www.boem.gov/Alaska-Coast-Shipwrecks/, accessed January 17, 2018.

National Oceanic Atmospheric Administration (NOAA). 2018. Wrecks and Obstructions Database. Online document, https://wrecks.nauticalcharts.noaa.gov/viewer/, accessed January 30, 2018.

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

DEPARTMENT OF THE ARMY
ALASKA DISTRICT, U.S. ARMY CORPS OF ENGINEERS
P.O. BOX 6898
JOINT BASE ELMENDORF-RICHARDSON, AK 99506-0898

May 14, 2018

SUBJECT: Invitation to Participate in the Scoping Process for the *South Harbor Dredging* Environmental Assessment, Petersburg, Alaska

Ladies and Gentlemen,

The U.S. Army Corps of Engineers, Alaska District, in partnership with the City of Petersburg, proposes to deepen the South Harbor in Petersburg, Alaska in order to improve navigability. (Figure 1) A combination of localized areas of sedimentation adjacent to water inflows along with isostatic rebound have resulted in shallow depths impacting efficient use of portions of the harbor. Vessels often run aground and portions of the harbor are inaccessible at lower tidal stages. These delays lead to loss of catch, additional labor costs for both vessel crew and fish processing plant employees and a limited window where vessels can fish ensuring that they leave and return to the harbor at high tide. Reduction in efficiency leads to loss of revenue to captain and crew meaning less money brought into the community ultimately effecting the economy of Petersburg.

The proposed dredging would increase the depth of the Harbor to minus 19.25’ below mean lower low water (MLLW). Preliminary estimates of the volume of dredged material range between 62,000 and 92,000 cubic yards. (Figure 2) The physical characteristics of the sediments will influence the selection of dredge equipment and it is likely that an excavator would be required in order to remove the consolidated clay material underlying the sand with silt epipedon.

Sediment samples were collected from 12 dredged material management units (DMMUs) in April of 2018. Preliminary results indicate that most of the sediment is below screening levels established in the Dredged Material Management Plan (DMMP) and are suitable for unconfined in-water disposal. Polyaromatic hydrocarbon (PAH) testing has not been completed as of the issuance of this scoping letter; results are expected by the 21st of May.

If the final analysis indicates the sediments are suitable for in-water placement, the Alaska District has tentatively identified the estuarine waters of Thomas Bay as the least cost disposal option. In the event the material is unsuitable for in-water placement, it would be disposed in a rock quarry, landfill, or similar location on Mitkof Island.

Resources that have been identified as potentially affected by the construction of the harbor deepening project are migratory birds, fish, marine mammals, recreation, socioeconomics, land use, and water quality. Humpback whales and Steller sea lions are marine mammals protected by the Endangered Species Act (ESA) known to occur in the vicinity of the proposed project. Hammer Slough is an anadromous stream as described by the Anadromous Waters Catalog (AWC) and may contain Coho and pink salmon, as well as Dolly Varden. Additionally, herring are known to spawn in nearby Scow Bay and may be present in the Harbor at various times throughout the year. The proposed action is expected to have a less than significant impact on these resources and will be addressed in an EA in compliance with the National Environmental Policy Act. The draft EA is scheduled to be completed by July 15, 2018.

As part of the process for determining the scope of issues to be addressed in the EA and for identifying the important issues related to the proposed action, we request your comments on the above issues and any other issues that you can identify as important. We intend to use your comments to:

- Identify the range of alternatives and impacts and the important issues to be addressed in the EA.
- Identify and eliminate from detailed study the issues that are not important or that have been covered by prior environmental review.
- Identify other environmental review and consultation requirements.
- Identify potential project modifications to further reduce the level of impact.

We request your comments by June 15, 2018. If you do not reply by that date, we will assume that you have no comments at this stage of project development. If you have any questions regarding the above, please contact me at 907-753-2711 or by email at matthew.w.ferguson@usace.army.mil.

Sincerely,

Matt Ferguson, Biologist
Environmental Resources Section

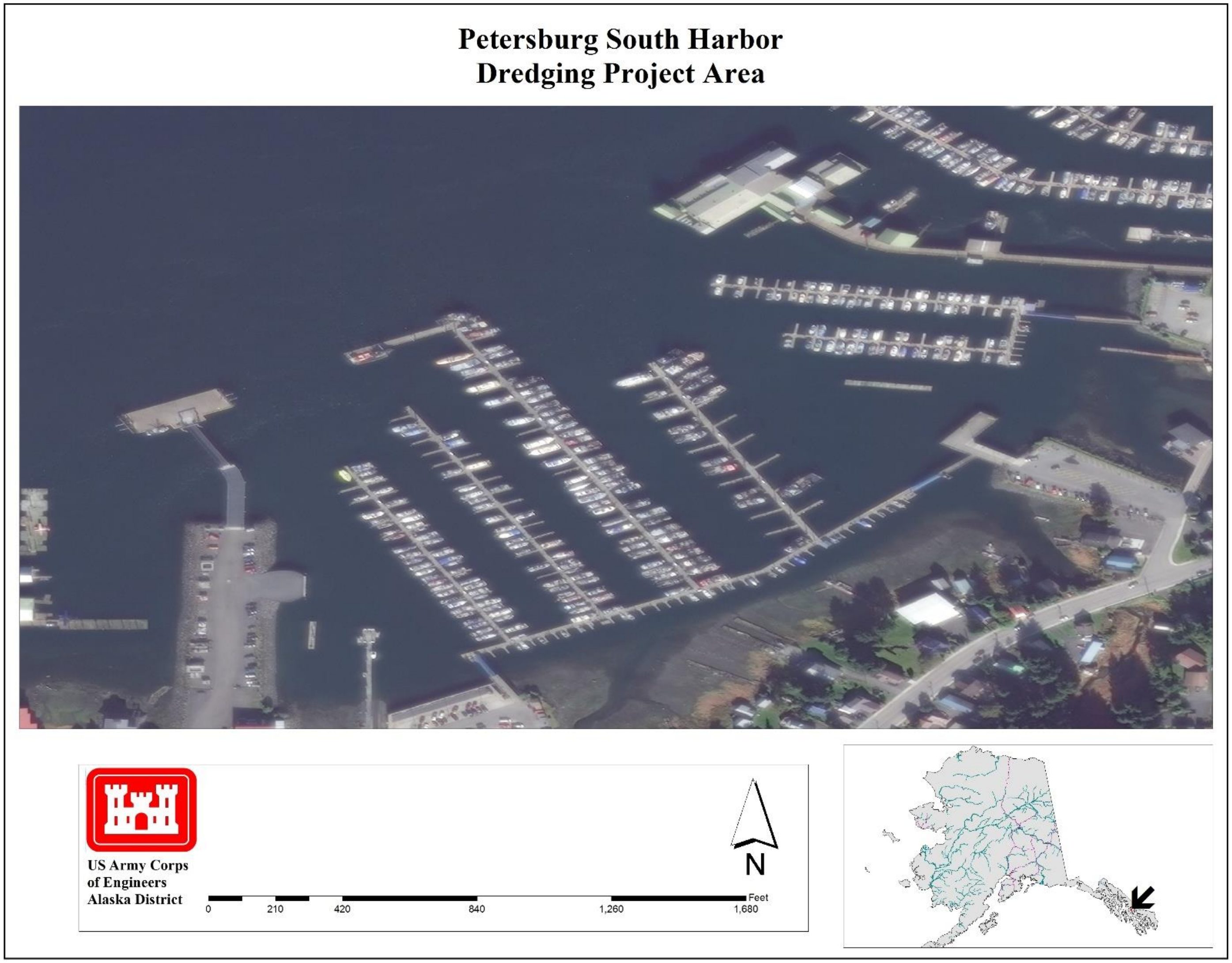
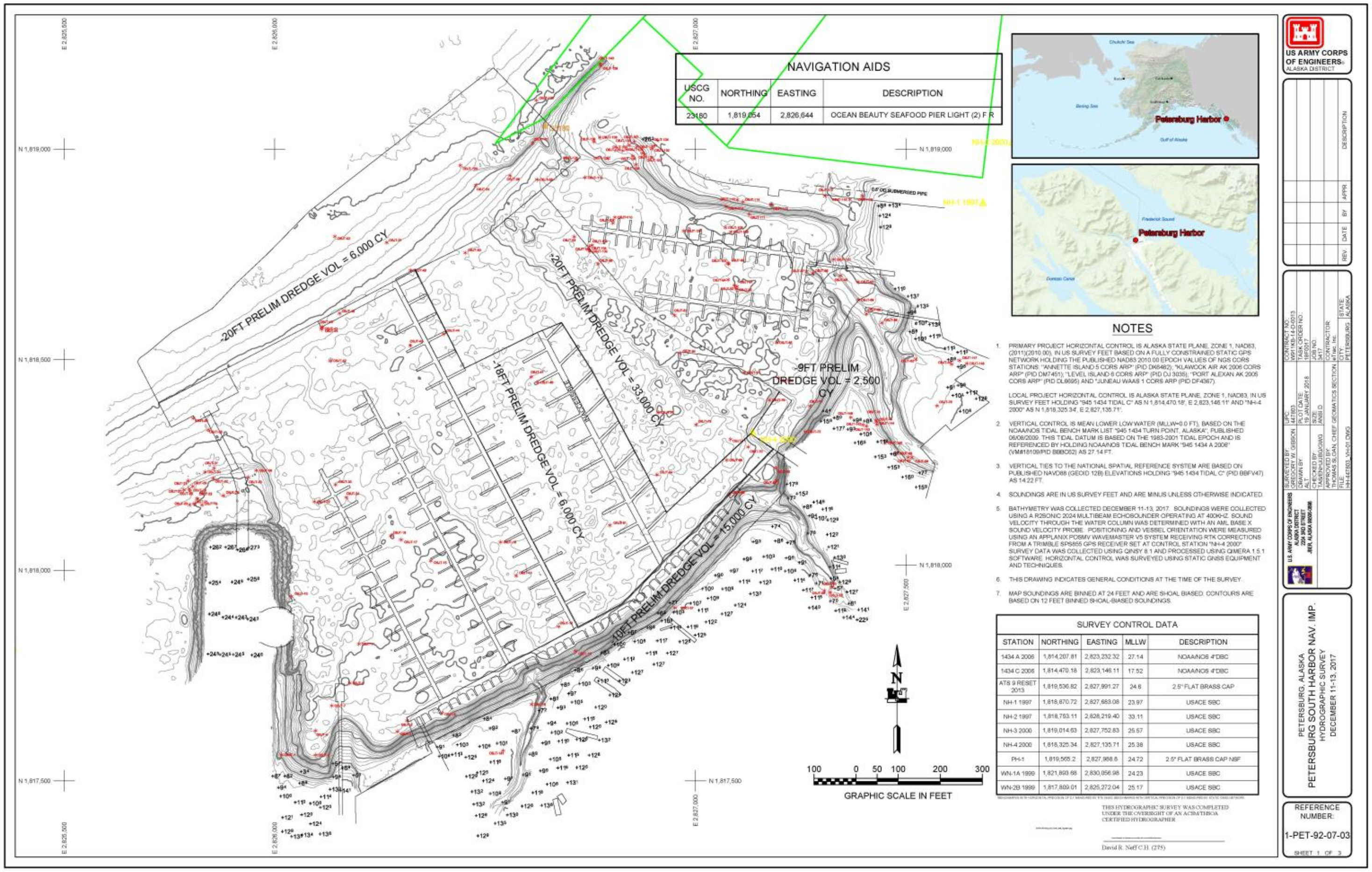


Figure 1. Petersburg South Harbor dredging project area



NAVIGATION AIDS			
USCG NO.	NORTHING	EASTING	DESCRIPTION
23180	1,819,054	2,826,644	OCEAN BEAUTY SEAFOOD PIER LIGHT (2) F R

NOTES

1. PRIMARY PROJECT HORIZONTAL CONTROL IS ALASKA STATE PLANE, ZONE 1, NAD83, (2011)(2010.00), IN US SURVEY FEET BASED ON A FULLY CONSTRAINED STATIC GPS NETWORK HOLDING THE PUBLISHED NAD83 2010.00 EPOCH VALUES OF NGS CORS STATIONS: "ANNETTE ISLAND 5 CORS ARP" (PID DK6482); "KLAWOCK AIR AK 2006 CORS ARP" (PID DM7451); "LEVEL ISLAND 6 CORS ARP" (PID DJ 3035); "PORT ALEXAN AK 2005 CORS ARP" (PID DL6695) AND "JUNEAU WAAS 1 CORS ARP (PID DF4367).

   LOCAL PROJECT HORIZONTAL CONTROL IS ALASKA STATE PLANE, ZONE 1, NAD83, IN US SURVEY FEET HOLDING "945 1434 TIDAL C" AS N 1,814,470.18', E 2,823,146.11' AND "NH-4 2000" AS N 1,818,325.34', E 2,827,135.71'.
2. VERTICAL CONTROL IS MEAN LOWER LOW WATER (MLLW=0.0 FT), BASED ON THE NOAA/NOS TIDAL BENCH MARK LIST "945 1434 TURN POINT, ALASKA", PUBLISHED 06/08/2009. THIS TIDAL DATUM IS BASED ON THE 1983-2001 TIDAL EPOCH AND IS REFERENCED BY HOLDING NOAA/NOS TIDAL BENCH MARK "945 1434 A 2006" (VM#18109/PID BBBC62) AS 27.14 FT.
3. VERTICAL TIES TO THE NATIONAL SPATIAL REFERENCE SYSTEM ARE BASED ON PUBLISHED NAVD88 (GEOID 12B) ELEVATIONS HOLDING "945 1434 TIDAL C" (PID BBFV47) AS 14.22 FT.
4. SOUNDINGS ARE IN US SURVEY FEET AND ARE MINUS UNLESS OTHERWISE INDICATED.
5. BATHYMETRY WAS COLLECTED DECEMBER 11-13, 2017. SOUNDINGS WERE COLLECTED USING A R2SONIC 2024 MULTIBEAM ECHOSOUNDER OPERATING AT 400KHZ. SOUND VELOCITY THROUGH THE WATER COLUMN WAS DETERMINED WITH AN AML BASE X SOUND VELOCITY PROBE. POSITIONING AND VESSEL ORIENTATION WERE MEASURED USING AN APPLANIX POSMV WAVEMASTER V5 SYSTEM RECEIVING RTK CORRECTIONS FROM A TRIMBLE SPS855 GPS RECEIVER SET AT CONTROL STATION "NH-4 2000". SURVEY DATA WAS COLLECTED USING QINSY 8.1 AND PROCESSED USING QIMERA 1.5.1 SOFTWARE. HORIZONTAL CONTROL WAS SURVEYED USING STATIC GNSS EQUIPMENT AND TECHNIQUES.
6. THIS DRAWING INDICATES GENERAL CONDITIONS AT THE TIME OF THE SURVEY.
7. MAP SOUNDINGS ARE BINNED AT 24 FEET AND ARE SHOAL BIASED. CONTOURS ARE BASED ON 12 FEET BINNED SHOAL-BIASED SOUNDINGS.

SURVEY CONTROL DATA				
STATION	NORTHING	EASTING	MLLW	DESCRIPTION
1434 A 2006	1,814,207.81	2,823,232.32	27.14	NOAA/NOS 4"DBC
1434 C 2006	1,814,470.18	2,823,146.11	17.52	NOAA/NOS 4"DBC
ATS 9 RESET 2013	1,819,536.82	2,827,991.27	24.6	2.5" FLAT BRASS CAP
NH-1 1997	1,818,870.72	2,827,683.08	23.97	USACE SBC
NH-2 1997	1,818,753.11	2,828,219.40	33.11	USACE SBC
NH-3 2000	1,819,014.63	2,827,752.83	25.57	USACE SBC
NH-4 2000	1,818,325.34	2,827,135.71	25.38	USACE SBC
PH-1	1,819,565.2	2,827,988.6	24.72	2.5" FLAT BRASS CAP NSF
WN-1A 1999	1,821,893.68	2,830,056.98	24.23	USACE SBC
WN-2B 1999	1,817,809.01	2,825,272.04	25.17	USACE SBC

THIS HYDROGRAPHIC SURVEY WAS COMPLETED UNDER THE OVERSIGHT OF AN ACSM/THSOA CERTIFIED HYDROGRAPHER

David R. Neff C.H. (275)

Figure 2. Bathymetry and preliminary dredge volumes

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 155
Seattle, WA 98101-3140

OFFICE OF
ENVIRONMENTAL REVIEW
AND ASSESSMENT

June 28, 2018

Mr. Matthew Ferguson
U.S. Army Corps of Engineers
Alaska District
P.O. Box 6898
Joint Base Elmendorf-Richardson, Alaska 99506-0898

Dear Mr. Ferguson:

The U.S. Environmental Protection Agency has reviewed the U.S. Army Corps of Engineers' May 14, 2018 Invitation to Participate in the Scoping Process for the South Harbor Dredging Environmental Assessment, Petersburg, Alaska. The EPA comments are provided pursuant to the National Environmental Policy Act, Council on Environmental Quality regulations (40 CFR Sections 1500-1508) and Section 309 of the Clean Air Act (EPA Region 10 Project Number 18-0014-COE).

The U.S. Army Corps of Engineers, in partnership with the City of Petersburg, proposes to deepen the South Harbor in Petersburg, Alaska, to improve navigability for fishing vessels. Sedimentation and isostatic rebound have resulted in shallow depths affecting efficient use of portions of the Harbor during low tides. The proposed dredging would increase the depth of the Harbor to minus 19.25' below mean lower low water, which would require the dredging and disposal of between 62,000 and 92,000 cubic yards of dredged material.

Purpose and need

We recommend the EA should include a clear and concise statement of the underlying purpose and need for the proposed action, consistent with the NEPA implementing regulations.[1] In presenting the purpose and need for the project, we recommend that the NEPA document convey not only the Corps' purpose, but also the broader public interest and need. The purpose and need, together with its goals and objectives, are important to setting up the analysis of alternatives. To generate a range of reasonable alternatives, we recommend that the purpose and need not be too tightly focused, nor too broadly stated.

Range of alternatives

The NEPA states that "all agencies of the Federal Government shall study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources."[2] We recommend that the EA include a range of reasonable alternatives that would meet the stated purpose and need for the project and that would be responsive to the issues identified during the scoping process. This is to ensure that the NEPA document provides the public and the decision makers with information that sharply defines the issues and identifies a clear basis for choice among alternatives as required by the NEPA. NEPA regulations

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[1] 40 CFR 1502.13

[2] NEPA, Section 102(2)(E); (42 USC Section 4332)

require all reasonable alternatives be considered, even if some of them could be outside the capability or the jurisdiction of the agency preparing the NEPA analysis for the proposed action.[3] The Corps' scoping invitation identifies the proposed dredging of South Harbor and placement of dredged material in the estuarine waters of Thomas Bay as a least cost option. If the material is unsuitable for in-water disposal, it would be disposed in a rock quarry, landfill, or similar location on Mitkof Island.

Thomas Bay, which lies approximately 20 air miles northeast of Petersburg, is surrounded by the Tongass National Forest where the Land Use Designation is primarily "Non-Development." While some logging has occurred in the Bay's southern drainages, it appears generally pristine, affording visitors a wilderness experience of hiking, kayaking, fish and wildlife, and use of a Forest Service cabin.[4] These factors give reason to anticipate that use of Thomas Bay for dredged material disposal may potentially be controversial. Additionally, the historic industrial uses in South Harbor (large fishing fleet and several seafood processors) and previous sediment analysis results indicating contamination in the sediments of Petersburg North Harbor, support the need for a complete sediment analysis to inform the Environmental Assessment.

We recommend consideration of additional alternatives, such as:

- If the dredged material is unsuitable for in-water disposal, we recommend that the Corps identify specific location alternatives for upland disposal. Each potential upland site would also need to be evaluated for applicable regulatory compliance, as well as for potential effects to human health and the environment.
- If the dredged material is of suitable quality for in-water disposal, we recommend that the Corps:
  - Consider beneficial uses for the dredged material. We do not recommend using the dredged material for intertidal fill, such as, for a boat storage area.
  - Identify other potential in-water disposal sites in inland waters under Section 404 Clean Water Act. We recommend that the NEPA analysis demonstrate compliance with the CWA Section 404(b)(1) Guidelines and identify the Least Environmentally Damaging Practicable Alternative (LEDPA).
  - Identify disposal sites in ocean waters under the Marine Protection, Research, and Sanctuaries Act, Section 103, that may have fewer impacts than those to the Thomas Bay estuary. The Corps is given authority under Section 103 of the Marine Protection, Research, and Sanctuaries Act (33 U.S.C 1413) to select a disposal site for a specific project with limited duration when other alternatives are not available. The Corps would apply the criteria and factors as set forth in Section 102(c) of the statute for evaluating the suitability of the disposal site. While this approach requires concurrence by EPA on the selection and use of the site, EPA would not conduct rulemaking or develop a site management and monitoring plan.

Subjects for analysis in the EA

Resources identified by the Corps as potentially affected by the project include migratory birds, fish, marine mammals, recreation, socioeconomics, land use, and water quality. Humpback whales and Steller sea lions, which are listed under the Endangered Species Act, are known to occur in the project

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[3] 40 CFR 1502.14

[4] https://www.fs.usda.gov/detail/tongass/landmanagement/?cid=stelprd3801708

vicinity. Herring, which spawn in nearby Scow Bay, may be present in South Harbor at various times throughout the year. Hammer Slough, an anadromous fish stream, may contain coho and pink salmon and Dolly Varden.

We agree that these subjects are appropriate for the NEPA analysis. We recommend that the Corps identify and characterize the stressors that would affect each of these resources, i.e., the nature, number, frequency, duration, severity, and specific manner in which the stressors would affect the project area ecosystems, habitats, species, and human communities. We offer further comment on several of these and additional related subjects for analysis below.

Sediment characterization: The Corps states that the area to be dredged in South Harbor consists of consolidated clay material underlying sand with silt epipedon. The Corps collected sediment samples from 12 dredged material management units and provided preliminary results to EPA. The information provided is insufficient to make a determination of the suitability of in-water placement or disposal of the dredged material. We recommend that the Corps provide the following additional information related to the evaluation of the dredged material to inform the range of alternatives for the final disposition of this material:

- Include the Sampling Analysis Plan;
- Identify what standards are being used for comparison of the chemical analysis results;
- Provide a full sedimentation characterization report, including PAH results, and analysis of the physical characteristics of the dredged material;
- Clearly describe the sediment sample matrix that was analyzed; and
- Provide an analysis of the potential for debris, anthropogenic or non-anthropogenic, that may be found in the dredged material and the proposed method for ensuring that debris is not disposed in-water.

We recommend that the EA also discuss the anticipated number, frequency, and volume of dredging operations and dredged material disposal events at the proposed disposal site(s). Factoring in the effects of changing climate on the rate and volumes of sediment delivered to South Harbor and other potential locations that may require dredging, which can affect the reasonably foreseeable frequency and volume of dredging events, would be useful to inform the analysis of effects for each alternative, including the cumulative effects.

Once the Corps has assembled the above information, we encourage the Corps to have early and ongoing coordination with EPA, USFWS, NMFS, and the State of Alaska regarding sediment characterization and disposal site selection processes. We would appreciate receiving the draft EA for review, the Public Notice for proposed disposal in inland waters, or the MPRSA Section 103 proposal for disposal in ocean waters. The input by these agencies early in the process would avoid unnecessary delays and inefficient use of government resources as the Corps moves forward with their project.

Disposal site characterization: We recommend that the Corps provide information about the proposed disposal location(s) including: bathymetry, substrate type, benthic fish and invertebrate communities, quality and quantity and potential capacity of habitat and species use of the area to be dredged, and of the disposal site(s). A discussion of potential impacts to important recreational and commercial species and their habitat would also inform the analysis. Data collection methods to gather this information pre- and post- dredging could include multibeam bathymetric surveys and underwater video imagery surveys. The deeper material to be dredged might be extracted in a consolidated form that, once disposed on the seafloor, could create structure that would change the habitat function of the affected area and provide for a different type of epibenthic ecological community. We recommend that the Corps assess this type of change to the seafloor at the disposal area(s) and implications for recreationally and commercially important species.

Transport of dredged material: The means for and effects of transporting dredged material from South Harbor to the disposal site is also recommended for analysis in the EA. This would include the number, timing, frequency, and duration of transport and disposal events, the type of transport vessel (e.g., a towed barge, discharge from a barge), fuel use, air emissions, and the potential for collisions with wildlife (e.g., marine mammals) or with other boat traffic.

Human uses of potential dredged material disposal sites: To evaluate the potential effects on human health and the environment from dredged material disposal, we recommend the EA also describe the human uses of the proposed disposal sites. For example, the assessment for Thomas Bay would address: subsistence uses, recreational fishing, commercial fishing, recreational and/or commercial crabbing, recreational boating, commercial tourism, and non-water based activities that may be affected by disposal activities, such as, hiking, camping, and wildlife viewing.

Threatened and endangered species: Identification of any endangered, threatened, and candidate species listed under the Endangered Species Act, and any state-listed or other sensitive species within the proposed project area is important to the NEPA analysis. We recommend that the EA also describe the critical habitat for these species, identify any impacts the proposed project would have on these species and their critical habitat, and how the Corps would meet all ESA requirements.

Habitat: Because the proposed project may have impacts on fish and marine mammal habitat, we recommend that the EA describe the current quality and potential capacity of habitat, its use by fish and marine mammals in and near the anticipated project area, and identify known fish and marine mammal corridors, migration routes, and areas of seasonal congregation. The analysis would also include an evaluation of the direct and indirect effects on fish and marine mammals from activities proposed under each alternative including, but not limited to, underwater noise effects. Updated technical guidance for assessing acoustic impacts is available from NOAA Fisheries.[5]

Indirect and cumulative effects: Cumulative impacts result when the effects of an action are added to other effects on a resource in an appropriately specified geographic area and within an appropriately specified timeframe. It is the combination of these effects, and any resulting environmental degradation, that are the intended focus of cumulative impact analysis. While impacts can be differentiated by direct, indirect, and cumulative, the concept of cumulative impacts takes into account all relevant disturbances because cumulative impacts result from compounding the effects of all actions over time. The cumulative impacts of an action can be viewed as the total effects on a resource, ecosystem, or human community of the proposed action *and* all other activities affecting the resource. We recommend that the cumulative impacts analysis:

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[5] http://www.nmfs.noaa.gov/pr/acoustics/Acoustic%20Guidance%20Files/opr-55_acoustic_guidance_tech_memo.pdf

- Characterize the resources, ecosystems and communities in terms of their response to change and capacity to withstand stresses;
- Focus on resources that are "at risk" or have the potential to be significantly impacted by the proposed project;
- Delineate and explain the reasoning behind the geographic boundary decision, using natural ecological boundaries to the extent possible. For example, for cumulative aquatic resource impacts, a natural boundary such as a watershed or sub-watershed could be identified for the spatial scope, although an analysis at multiple geographic scales may also be appropriate;
- Include a determination and explanation for the temporal scope of the analyses; and
- Use trend data, where available, to establish a baseline for the affected resources, to project a reasonably foreseeable cumulative baseline for the affected resources, and to predict the environmental effects of the project when added to this baseline.

NEPA mitigation and monitoring: The Council on Environmental Quality's January 14, 2011 guidance on the Appropriate Use of Mitigation and Monitoring addresses establishing, implementing, and monitoring mitigation commitments made during the NEPA process.[6]

Key concepts include:
- Ensuring that mitigation commitments are implemented;
- Monitoring the effectiveness of mitigation commitments;
- Remedying failed mitigation; and
- Involving the public in mitigation planning.

The EIS should include a discussion of how the mitigation measures would be implemented and monitored, such as, identification of the responsible parties, performance objectives, and enforcement clauses to ensure the commitments are stipulated through agency permits or other agreements.

Consultation and Coordination with Tribal Governments: Executive Order 13175, Consultation and Coordination with Indian Tribal Governments,[7] was issued to establish regular and meaningful consultation and collaboration with tribal officials in the development of federal policies that have tribal implications, and to strengthen the United States government-to-government relationships with Indian tribes. We recommend that the NEPA document describe the process and outcomes of the government-to-government consultations between the Corps of Engineers and tribal governments, including the major issues raised, and how those issues were addressed in the NEPA analysis.

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[6] CEQ, Memorandum for Heads of Federal Departments and Agencies, Subject: Appropriate Use of Mitigation and Monitoring and Clarifying the Appropriate Use of Mitigated Findings of No Significant Impact, January 14, 2011.
http://ceq.hss.doe.gov/current_developments/docs/Mitigation_and_Monitoring_Guidance_14Jan2011.pdf

[7] Consultation and Coordination with Indian Tribal Governments, Executive Order 13175, Fed. Reg. 67249, November 9, 2000.

We appreciate the opportunity to provide scoping comments. If you have questions about our comments, please contact me at (206) 553-2966 or at somers.elaine@epa.gov. or contact Bridgette Lohrman at (503) 326-4006 or at lohrman.bridgette@epa.gov.

Sincerely,

Elaine

Elaine L. Somers
Environmental Review and Sediment Management Unit

From: Megan O"Neil
To: Ferguson, Matthew W CIV USARMY CEPOA (US)
Subject: [Non-DoD Source] Re: Frederick Sound disposal area (UNCLASSIFIED)
Date: Tuesday, July 24, 2018 11:10:15 AM

Hello Matt,

First of all, thank you, were are very happy that our South Harbor is getting dredge! We have had several of our large boats get stuck on bottom entering and leaving the harbor at low tide in the last several years. And during some low tides, they can¹t make it to the crane dock.

We reviewed the map you provided and our members believe this is a good choice for a dump site again. The area is black mud already with no crab or fish there. This is not a place any of our fleet go to fish and won¹t disrupt any of our fisheries.

Thank you for your work and including us,

Megan O¹Neil
Petersburg Vessel Owner¹s Association
PO Box 232
Petersburg, AK 99833
907.772.9323
pvoa@gci.net
Blockedwww.pvoaonline.org

This email and its attachments are confidential and are intended solely for the use of Petersburg Vessel Owner¹s Association paid membership to whom it is addressed. If you are not the intended recipient of this email and its attachments, you should not disseminate, distribute, or copy this email. Please contact the sender if you have received this email in error.

On 7/19/18, 1:48 PM, "Ferguson, Matthew W CIV USARMY CEPOA (US)" <Matthew.W.Ferguson@usace.army.mil> wrote:

>CLASSIFICATION: UNCLASSIFIED
>
>Hi Megan,
>
>I'm working on the proposed South Harbor dredging project and will be
>performing a site selection analysis for the disposal of dredged material
>generated by the project. As I'm sure you're aware, there is a disposal
>area marked on the chart about 2 miles northeast of Petersburg. Due to a
>regulatory nuance, that area is not currently authorized for the disposal
>of dredged material. In order to reauthorize it, the US Army Corps of
>Engineers has to perform a study and determine that placement dredged
>material in the area would not be contrary to the public interest and
>receive concurrence from the US EPA.
>
>I am interested in any information you have regarding the use of that
>site for the disposal of dredged sediments, or anything else. Part of the

>site selection criteria is making use of a historically used area, so
>knowing its history could really strengthen our argument. I can prepare a
>solicitation notice for you to circulate to your members if that would be
>helpful. I've attached a map showing the disposal area and some of the
>locations within the area that I've tentatively identified for sampling
>via pot fishing and video. It would be good to know if anyone has
>experience with fishing in that area as well. I would ask where someone
>would go to NOT catch fish.
>
>Thanks,
>
>Matt Ferguson, Biologist
>USACE-AK District Environmental
>907-753-2711
>
>
>
>CLASSIFICATION: UNCLASSIFIED