DEIS-APPENDIX 2

OCEAN DREDGED MATERIAL DISPOSAL SITE STUDY

NAVIGATION IMPROVEMENTS PROJECT

DELONG MOUNTAIN TERMINAL, ALASKA

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AUGUST 2005

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1. PURPOSE

The U.S. Army Corps of Engineers (Corps) prepared this appendix in cooperation with the U.S. Environmental Protection Agency (EPA) as part of the development of the draft Environmental Impact Statement (EIS) for the *DeLong Mountain Terminal Navigation Improvements* project. This appendix provides information about use or disposal alternatives for dredged material that would be generated by proposed construction and initial maintenance of the Trestle-Channel alternative for the DeLong Mountain Terminal (DMT) project. It also presents the evaluations needed to support the selection of a site for use during construction and initial maintenance dredging efforts. The project, if constructed, would include a dredged turning basin and 3.5-mile channel. The channel and turning basin would range from 250 feet wide at its seaward end up to about 1,600 feet wide near shore and would be maintained to a depth of –53 feet mean lower low water (MLLW). Initial excavation of the channel and turning basin and advance maintenance would generate approximately 6.2 million cubic yards of material. An additional 1.9 million cubic yards would be excavated during construction to create a sediment accumulation sump. Maintenance dredging would be expected to occur in years 5, 17, 33, and 49, with each effort removing between 1.1 and 1.2 million cubic yards of material from the sump.

At this time, there is no EPA-designated Ocean Dredged Material Disposal Site (ODMDS) in the Eastern Chukchi Sea. The nearest EPA-designated ODMDS is at Nome (Norton Sound) about 250 nautical miles south of Portsite. An evaluation of near-shore and upland disposal sites near Portsite failed to identify practical and environmentally acceptable alternatives for the use or disposal of the material proposed for dredging. Designation of an ODMDS by EPA would create a permanent site for the placement of dredged material from the DMT project and other unforeseen Federal and non-Federal projects in northwestern Alaska. EPA, however, requires Congressional authorization to establish that there is a need for an ODMDS for the DMT project. Establishing need is a necessary first step in designating an ODMDS; therefore, EPA will not proceed with disposal site designation unless Congress authorizes a DMT project. The Corps of Engineers conducted a site evaluation to select a disposal site for construction and initial maintenance of the Trestle-Channel alternative of the DMT navigation improvements project. This appendix presents the results of that evaluation, and provides an information base that could be used to designate a disposal site for long-term use by the DMT project and by other projects that might need a disposal site in the future.

2. STATUTORY AND REGULATORY REQUIREMENTS

The Marine Protection, Research and Sanctuaries Act (MPRSA) of 1972, as amended, also known as the Ocean Dumping Act, was passed because disposal of material into ocean waters can cause unacceptable adverse environmental effects. Under Title I of the MPRSA, the EPA and the Corps were assigned responsibility for developing and implementing regulatory programs to ensure that ocean disposal would not "... unreasonably degrade or endanger human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities."

The EPA administers and enforces the overall program for ocean disposal. Two sections of the MPRSA regulate ocean disposal. Section 102 of the MPRSA requires EPA to establish long-term disposal sites that may be used for multiple disposal actions involving a wide range of materials from multiple sources. In the absence of a designated ODMDS, the Corps can select a disposal site pursuant to Section 103 of the Act using the criteria used to designate a site under Section 102. With EPA concurrence, the selected site can be used for 5 years. Use of the site can be extended an additional 5 years if:

- No feasible disposal site has been designated;
- Use of the Corps-selected site is necessary to maintain navigation and interstate commerce; and
- EPA determines continued use of the site does not pose an unacceptable risk to human health, aquatic resources, or the environment.

For both section 102 and 103 disposal actions, the EPA and the Corps establish sediment testing and environmental criteria that are used to evaluate disposal actions before an ocean dredged material disposal permit can be granted. Under Section 103 the Corps, in coordination with EPA, evaluates actions to ensure compliance with those environmental criteria and issues permits to allow the transportation and disposal of dredged material at the ODMDS. For its own projects, the Corps does not administratively issue itself a permit. However, the Corps must meet the same environmental criteria before dredged material from Corps projects can be discharged into ocean waters.

The MPRSA Criteria (40 CFR, Part 228) states that site selection must be based on environmental studies of each site and on historical knowledge of the impact of dredged material disposal on areas similar to those sites in physical, chemical, and biological characteristics. General criteria (40 CFR 228.5) and specific factors (40 CFR 228.6) that must be considered during the site selection process are described and evaluated in this appendix.

Related federal statutes applicable to the ODMDS selection and designation process include the National Environmental Policy Act of 1969, as amended; the Coastal Zone Management Act of 1972, as amended; the National Historic Preservation Act; and the Endangered Species Act of 1973, as amended. Section 103(b), while encouraging use of EPA-designated sites where feasible, does provide for alternative site selection by the Corps when a suitable EPA-designated site is not available. The same evaluation criteria (40 CFR 228.5 -6) are used in the evaluation process that leads to site selection and the EPA must concur with the Corps' decision before the site can be used.

3. PROJECT SUMMARY AND BASIS OF NEED FOR OCEAN DISPOSAL

The existing DMT is at Portsite on the eastern shore of the Chukchi Sea, north of the Bering Strait and 90 miles north of the Arctic Circle (figure 1). It is approximately 17 miles southeast of Kivalina, 75 miles northwest of Kotzebue, and 550 miles northwest of Anchorage, Alaska. The site is not accessible by road. Air transport to the site is by charter to the Red Dog Mine. A 52-mile gravel road [DeLong Mt. Transportation System (DMTS) road] extends from the mine to Portsite and is used to transport ore concentrate from the mine to the port facilities for shipment.

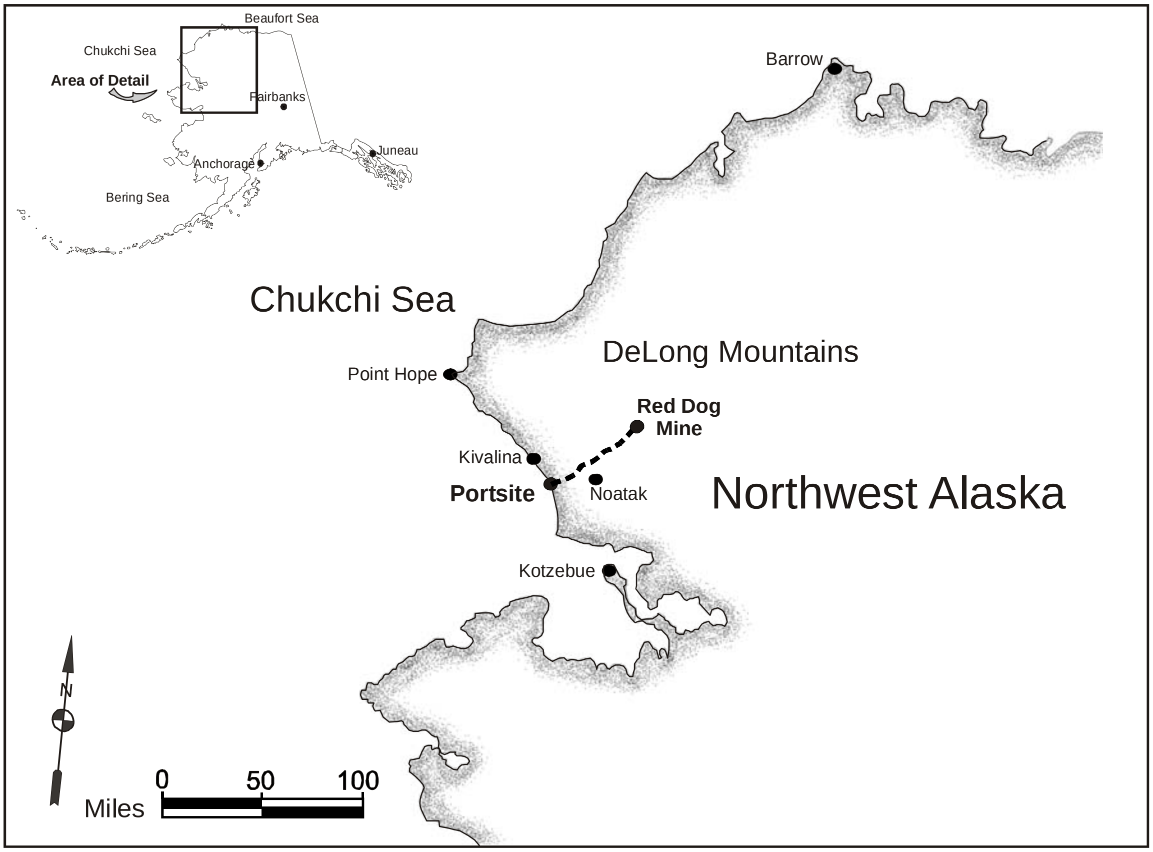

***Figure 1**: DMT and Portsite Location*

3.1 Site History and Existing Facilities and Use

The land in the Portsite area is mostly undeveloped wetland/tundra. The Portsite ore storage and loading facilities, the DeLong Mountain Transportation System (DMTS) road, and the community of Kivalina are the only major developments along the 160 miles of Chukchi Sea coastline between Kotzebue and Point Hope. Other minor developments consist of small hunting cabins scattered along the coast and clustered at Sheshalik, north of Kotzebue. They are primarily on privately owned Native allotments and used seasonally for subsistence hunting and fishing.

Construction of the 126-acre DMT facility at the coastal location locally known as "Portsite" and the 52-mile-long DMTS road connecting the DMT to the Red Dog Mine was completed in 1989 on land owned or leased by the NANA Regional Corporation, the U.S. Park Service, and the State of Alaska. All improvements and structures at the DMT are owned by the Alaska Industrial Development and Export Authority (AIDEA). An additional 64 acres of tideland are leased from the State of Alaska for the existing water and shore-based DMT facilities. Major area land ownership and uses in the vicinity of Portsite are shown in figure 2.

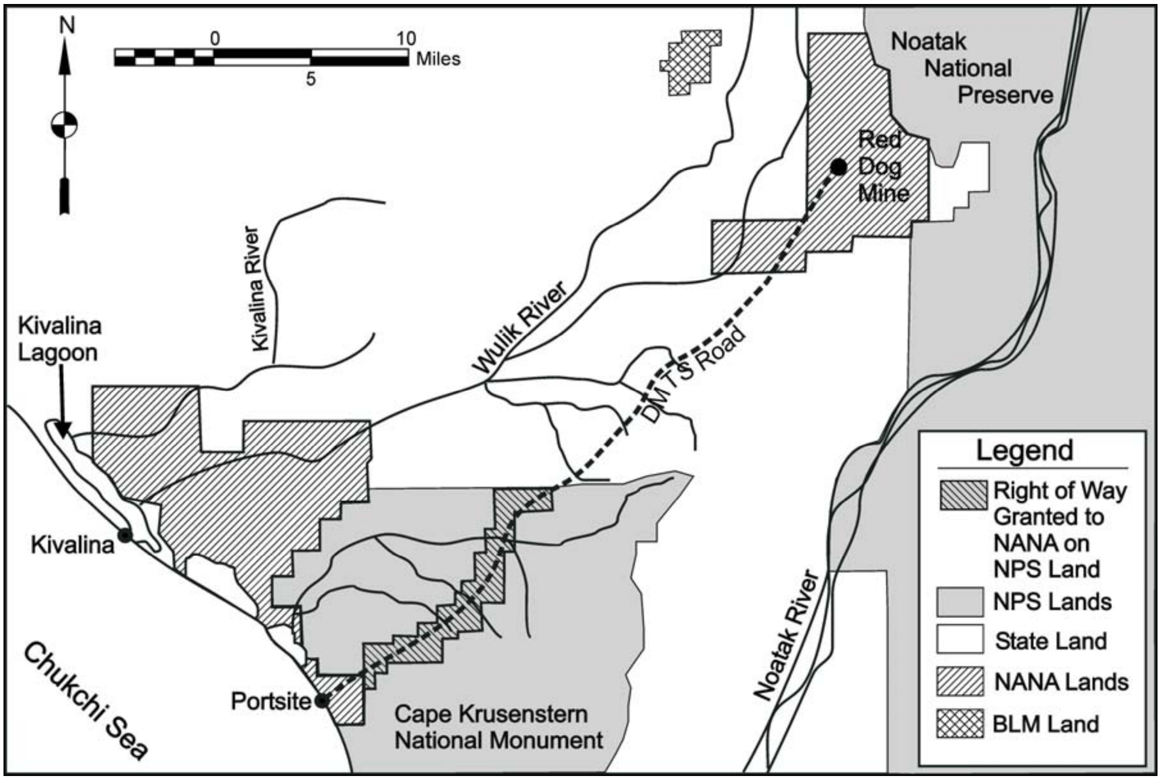

Figure 2: *Principal Ownership of Lands in the Vicinity of Portsite.*

About one-third of the DMTS road passes through Cape Krusenstern National Monument, which is administered by the National Park Service (NPS). The Cape Krusenstern National Monument is approximately 660,000 acres and is within the much larger 2.3-million-acre Cape Krusenstern National Historic Landmark.

The existing water-based facilities at the port include offshore moorage, a barge loading dock, a barge loader, a shallow-water barge dock, a conveyor and gallery from the surge bin to the barge loader, and manifolds and pipelines to transfer fuel from barges to onshore storage tanks. The existing upland facilities at the port include two concentrate storage buildings, the fuel tank farm, four electrical generators, maintenance shops, personnel accommodations complex, port office, construction camp facilities, sewage treatment plant, roads, materials handling systems, and materials storage areas. The existing port can accommodate ocean-going barges, including lightering barges, but is too shallow to allow direct loading of ocean-going bulk carriers.

3.2 Project Objectives

Ore concentrates are lightered from the existing port facilities to bulk carriers anchored 4 to 5 miles offshore. Lightering of the mineral concentrate to offshore bulk carriers and receiving goods at Portsite is time consuming and costly. Additionally, it increases the risk of barge and ship damage and limits the ports' capacity to ship ore concentrate.

The navigation improvements at Portsite were proposed to meet the following objectives:

- Allow safer and more efficient ore concentrate shipping

- Reduce the risk of barge and ship damage
- Reduce the risk of fuel and ore concentrate spillage
- Reduce regional fuel transportation costs
- Improve regional distribution of fuel
- Reduce the impacts of ore transfer activities to the environment and wildlife
- Be consistent with future regional development needs

3.3 Proposed Action

Several project alternatives designed to meet the project objectives are presented and evaluated in the draft Environmental Impact Statement (EIS). The draft EIS also identifies a tentatively recommended alternative based on evaluation of the project's economic benefits and the environmental impacts associated with its construction and operation.

The tentatively recommended plan would be a Federally authorized navigation project. The project sponsor would construct a new conveyor system, loader, and associated structures to move ore transfer facilities and bulk fuel receiving manifolds to a site about 1,500 feet offshore. The Federal government and the sponsor would jointly fund the dredging of a 3.5-mile channel and turning basin from the loading facility to deeper water to allow ocean-going bulk carriers and tankers to access the facilities for loading and unloading. The channel and turning basin would range from 250 feet wide at its seaward end up to about 1,600 feet wide near shore. They would be maintained to a depth of –53 feet mean lower low water (MLLW) to accommodate the large vessels that would use the new facilities.

Initial excavation of the channel and turning basin would generate approximately 6.2 million cubic yards of material. An additional 1.9 million cubic yards would be excavated during construction as required over-depth dredging for efficient maintenance to create a sediment accumulation sump. Maintenance dredging would be conducted 5, 17, 33, and 49 years after construction, with each effort removing between 1.1 and 1.2 million cubic yards of material from the channel and turning basin.

3.4 Physical Characteristics of the Proposed Dredge Material

The sea bottom at the DMT Portsite is gently sloping with large areas of sand/silt interspersed with sand areas and sand/gravel areas. Generally, the coarser gravel-sediment areas are near shore in water depths less than 35 feet. A summary of the data relevant to the project is provided below. A more thorough description of the data is provided in the draft EIS and draft Interim Feasibility Report, especially in its Geotechnical Appendix.

Surface sediment samples were collected along the proposed shipping channel and turning basin alignment and at locations farther off shore by Peratrovich, Nottingham and Drage, Inc. (PN&D) in 1998 and by the Corps in 2000. PN&D and Corps sample locations are shown in figures 3 and 4, respectively.

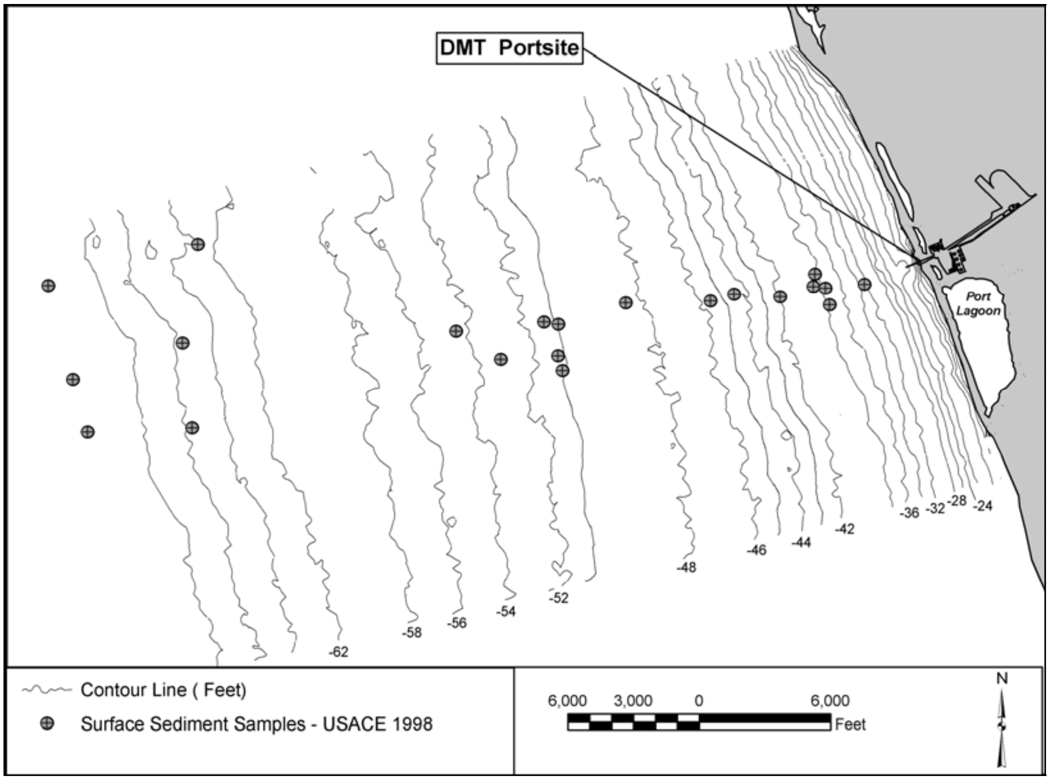

***Figure 3**: Surface sediment samples collected offshore of Portsite by Peratrovich, Nottingham and Drage, Inc. (PN&D) in 1998.*

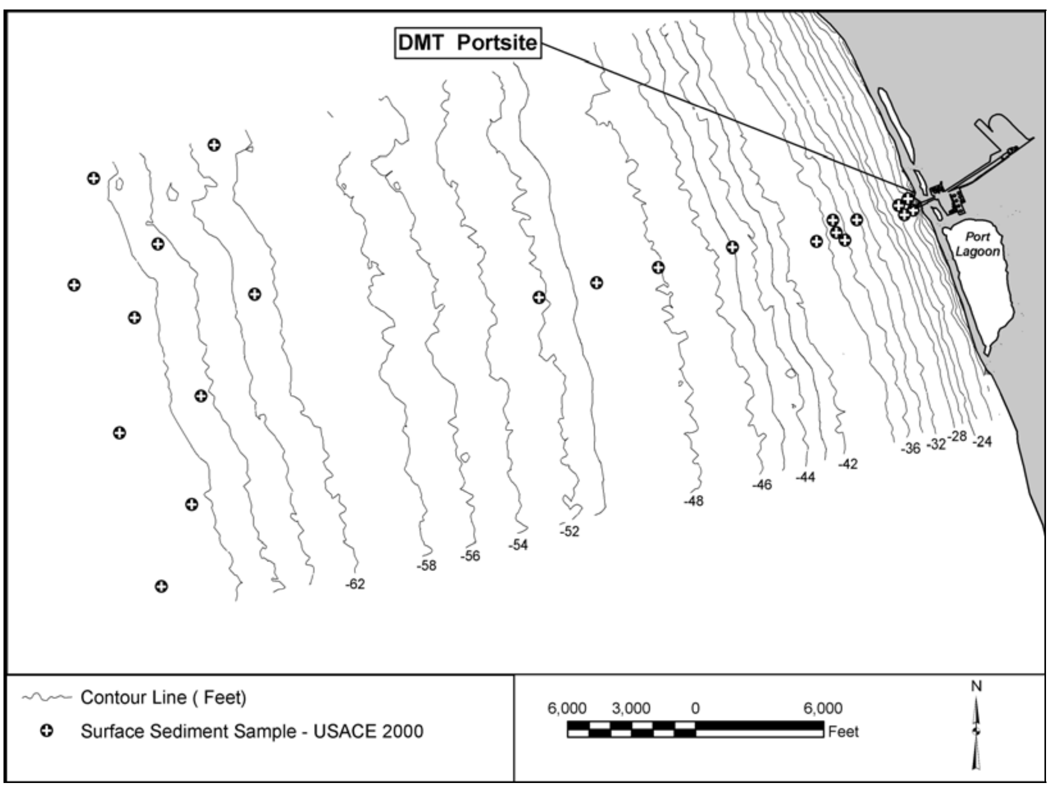

***Figure 4**: Surface sediment samples collected near Portsite by the U.S. Army Corps of Engineers (USACE) Alaska District in 2000.*

Sediment samples from near-shore surface sediments (at the barge loader in water depths of approximately 22 feet) contained well-graded sand and gravel mixtures with very little silt, while the potential turning basin alignment (water depths of 20 to 24 feet) contained variable mixtures of sand and silt. Samples collected from the upper-most layer of bottom material in water depths ranging from 65 to 70 feet generally contained a more uniform mix of silt and sand.

One sample was collected from the surface of the beach at Portsite during the Corps survey. It was classified as poorly graded gravel, with 82 percent sand and gravel by weight. Observations of sediment along the beach suggest that the median sediment grain diameter ranges between 0.5 and 20 mm. Generally, distribution of beach sediments was observed to be variable along the shore, with some areas of shoreline composed of gravel interspersed between areas composed primarily of coarse sand.

Subsurface samples from deeper in the bottom material off Portsite were collected and analyzed in 1998 and 2000. The samples from 1998 were collected using a drill rig and split spoon sampler operating from a vessel. The samples from 2000 were collected manually by divers. The locations of the samples collected in 1998 and 2000 are shown in figures 5 and 6, respectively.

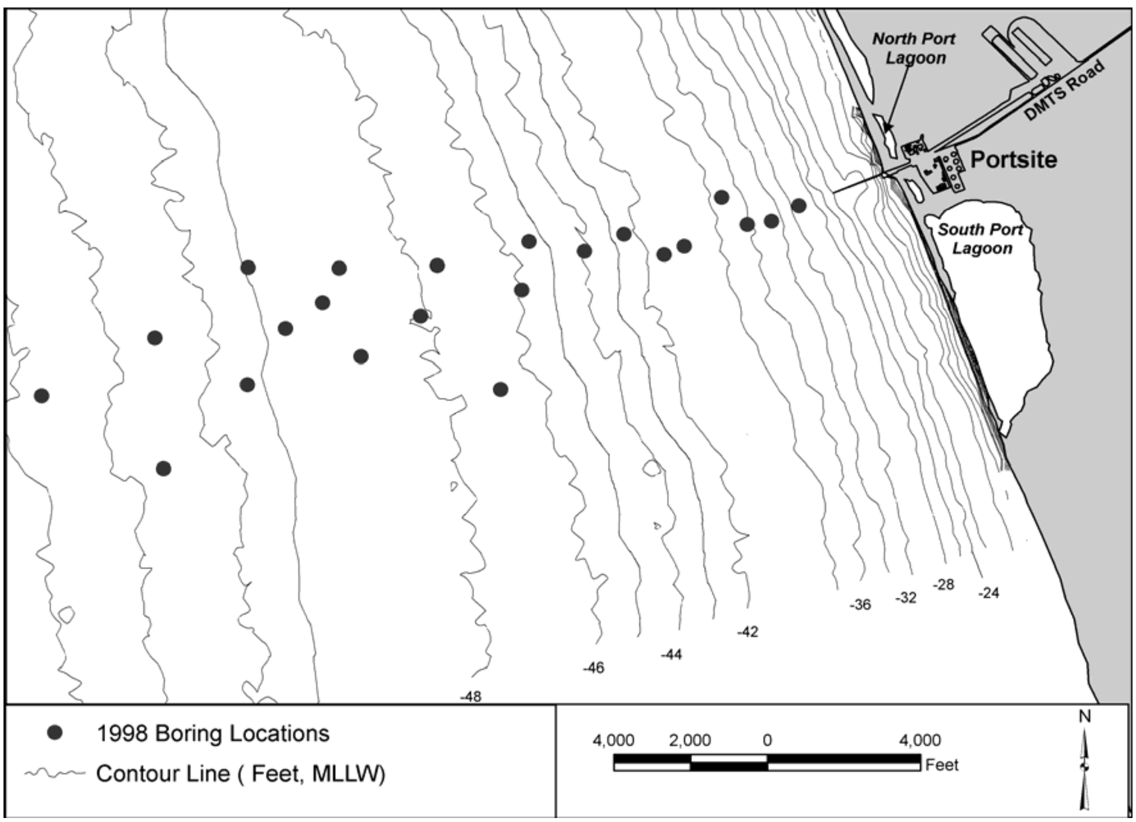

***Figure 5**: Boring locations for surface and subsurface sediment samples collected offshore of Portsite by Peratrovich, Nottingham and Drage, Inc. (PN&D) in 1998.*

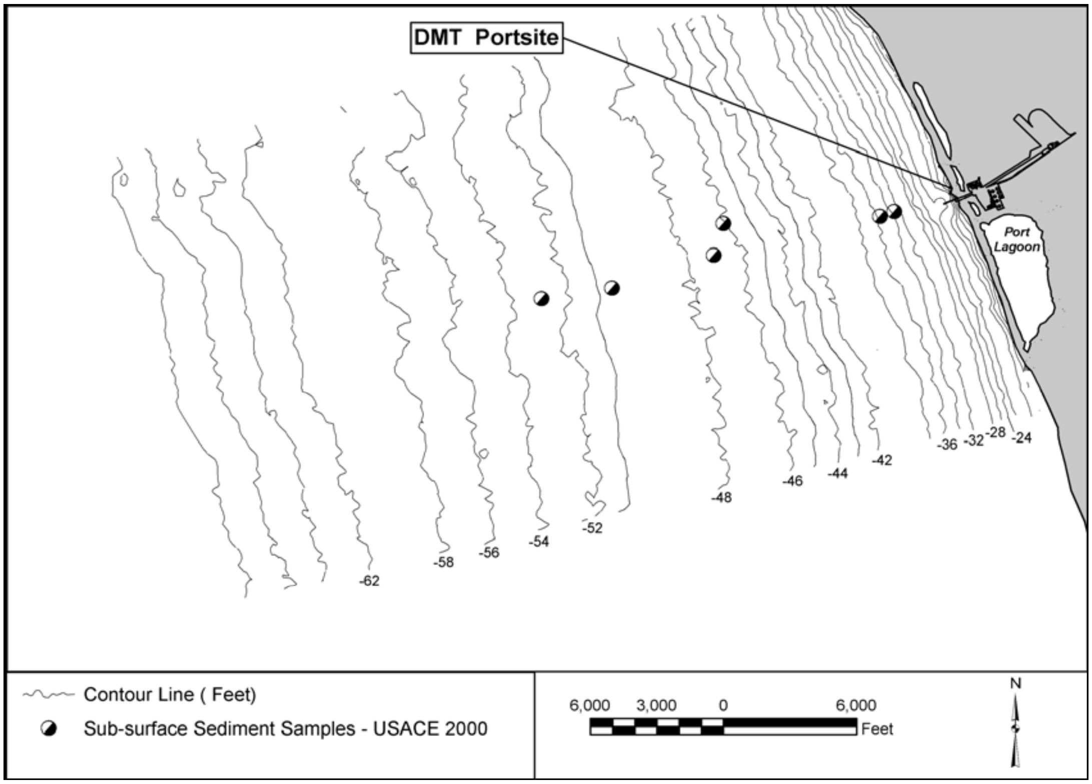

***Figure 6**: Diver-Collected Subsurface Samples Collected by PN&D in 2000*

The surface layer of bottom material generally consisted of fine-grained material that varied from firm to very hard consistency and sandy material that is typically of medium density. The collections indicate that subsurface bottom material typically consisted of compacted sandy and gravelly soils over deeper layers composed predominantly of silt and clay. Organic soil layers and lenses of peat were occasionally encountered. It was also noted in the survey that in sporadic locations deeper sand/gravel materials were exposed at the surface of the sea bottom. Geological evidence suggests that the sand/gravel materials might be alluvial deposits or remnant gravel beaches.

The subsurface sample results also support the results of a 1998 side-scan sonar survey (NW GEO Sciences 1999). That survey indicated the subsurface profile consisted of a layer of sand/silt/gravel/clay materials (from 10 to 25 feet thick) overlying a denser layer of sand/gravel (from 10 to 100 feet or more thick) with a basement material of sandstone bedrock. The earlier sonar survey and more recent core sample data also showed that the bedrock surface in the Portsite area varies from north to south and east to west. For instance, bedrock is found at about 39 feet below the seabed near the shore and at about 90 feet below the seabed in about 40 to 45 feet of water. Beyond this water depth, bedrock was not detected with the equipment used.

Overall, the relative compositions of gravel, sand, and fines that would be dredged for the channel and turning basin is estimated to be about 6 percent, 25 percent, and 69 percent, respectively. As a whole, the material is not suitable for use in construction because it contains such high proportions of fine particles. The fine particles decrease the soil's weight-bearing capacity and increase its susceptibility to movement during freeze/thaw cycles.

3.4 Chemical Characteristics of the Proposed Dredge Material

The surface and subsurface sediment samples were analyzed for general sediment chemistry and contaminants of concern. The results of the analytical testing are briefly summarized below. More detailed information is provided in the draft EIS, draft Feasibility report, and in the Geotechnical Appendix to the draft Feasibility Report.

Surface and subsurface sediment samples were analyzed for metals (arsenic, barium, cadmium, chromium, copper, lead, mercury, selenium, silver, and zinc), volatile and semi-volatile organic compounds, pesticides, polychlorinated biphenyls (PCB's), and total organic carbon. In the absence of more appropriate or applicable federal or state standards for the screening of sediment for ocean disposal, the analytical results for sediments were compared with the State of Washington Sediment Management Standards (SMS), the Puget Sound Dredged Disposal Analysis (PSDDA), and Lower Columbia River Management Area (LCRMA) guidance documents to evaluate ocean disposal options. For upland disposal and use alternatives, the results were screened against Alaska Department of Environmental Conservation (ADEC) Method 2 Cleanup Levels (CL) established for the Arctic Zone in Table B1 of 18 AAC 75. The ADEC CLs are not intended to be applied to ocean disposal options. They are normally applied to soil concentrations and are used here as indicators of how suitable the dredged material might be for on-land use or disposal.

No volatile organic compounds, semi-volatile organic compounds, pesticides, or polychlorinated biphenyls (PCB's) were present in the samples at concentrations approaching an associated screening level. However, some metals were reported in samples collected during both investigations at concentrations above ADEC cleanup levels. Tables 1and 2summarize the metals data associated with the samples collected in 1998 and 2000, respectively. Complete reports are available upon request.

Table 1

Metals Concentrations (mg/Kg) in Sediment Samples Collected in 1998.

Metal	Disposal Site	Background	Proposed Channel	PSDDA Standard	Washington MSQS	ADEC CL (Arctic Zone)
As	7.4-5.5	10.1-6.6	11.0-4.9	57	57	8
Ba	170-115	215-101	868-79.5	---	---	9600
Cd	<0.4-0.05	0.09-0.04	0.59-0.05	5.1	5.1	140
Cr	15.9-10.8	15.2-10.6	24.9-2.4	---	260	680
Cu	8.5-5.7	8.2-5.2	35.9-3.7	81	390	---
Pb	6.20-4.55	6.26-4.81	16.8-3.5	66	450	---
Hg	<0.15-<0.02	0.02-<0.02	<0.14-<0.02	0.21	0.41	26
Se	<8-<1	<1	8-<1	---	---	680
Ag	<0.8-0.03	<0.05	<0.78-0.04	1.2	6.1	680
Zn	49.0-32.5	50.4-38.8	83.4-14.6	160	410	41000

Note: When a number is preceded by "<", the number is the Method Reporting Limit, and the metal was not detected above this limit

Table B

Metals Concentrations (mg/Kg) in Sediment Samples Collected in 2000.

Metal	Disposal Site	Proposed Channel	Loading Cell	PSDDA Standard	Washington MSQS	ADEC CL (Arctic Zone)
As	10.0-3.5	10.0-6.6	9.8-5.5	57	57	8
Ba	270-150	390-220	390-140	---	---	9600
Cd	2.4-<1	2.5-1.9	2.3-<1	5.1	5.1	140
Cr	28-20	28-18	12-7.2	---	260	680
Cu	11.0-5.9	7.8-5.6	12-4.3	81	390	---
Pb	7.6-4.7	15-5.3	32-8.8	66	450	---
Hg	0.05 -<0.04	0.1-<0.04	<0.2	0.21	0.41	26
Se	<14	<14	<10	---	---	680
Ag	<2.9	<2.8	<2.1	1.2	6.1	680
Zn	78-41	64-48	240-29	160	410	41000

Note: When a number is preceded by "<", the number is the Method Reporting Limit, and the metal was not detected above this limit.

Arsenic was detected at concentrations above State of Alaska cleanup levels in some samples. Due to the wide range of results normally associated with the measurement of metals in soil and sediment samples, average concentrations are normally used to determine disposal options when areas of elevated concentrations cannot be reliably defined. In this case, elevated concentrations were reported in some of the samples collected from virtually all areas and depths. The average concentrations of all metals are below associated cleanup levels established for the Arctic Zone, where migration of contaminants to the groundwater is limited by the presence of continuous permafrost.

It is notable that the concentrations of arsenic, cadmium, lead, mercury, silver, and zinc show a trend of increasing concentrations near the existing loading cell. This trend could be interpreted as an indication that operations at the existing loading facilities may be measurably impacting the metals concentrations of the sediment near the existing facilities. However, background concentrations are naturally high and some of the highest concentrations were found in deep subsurface samples that would not have been affected by ore concentrate. This prevented any definitive conclusions about the precise impact of existing loading activities on the sediment proposed to be dredged.

To attempt to more closely define the impact of lost concentrate at the barge loader, surface sediment samples were collected from 26 locations near existing loading operations in June (prior to loading operations) and September (during loading operations) 2004. Sample locations are shown in figure 7. The samples were collected to attempt to determine if gradients in metal concentrations exist in surface sediments near the DMT or if a temporal relationship with the seasonal variability of loading operations could be identified.

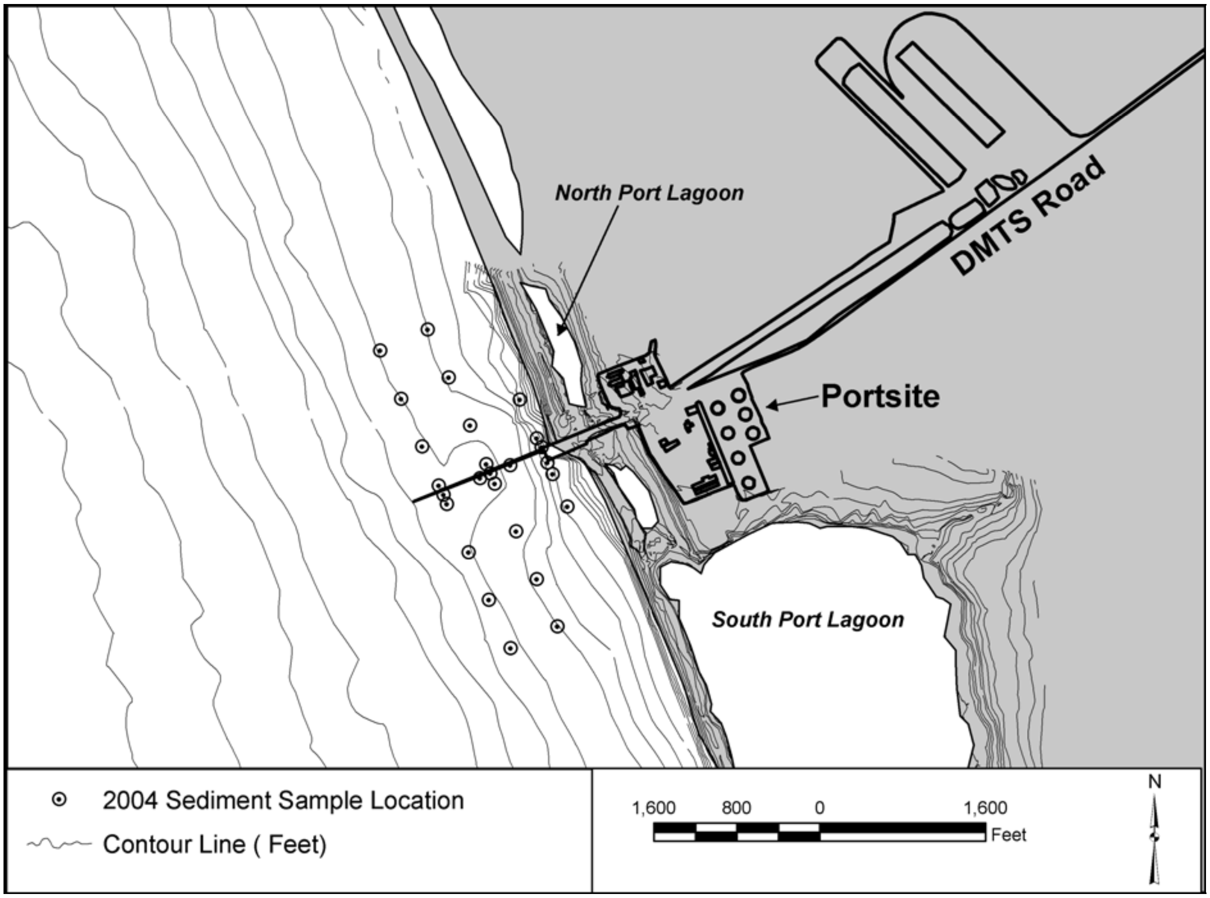

Figure 7. *Surface sediment samples collected at Portsite in 2004 (TCAK 2005).*

All the 2004 results were below PSDDA and MSQS screening criteria but also show a general increase in ore concentrate-related metal concentrations near the barge loader. Although some metal concentrations indicated variations that could be related to loading operations, no clear and consistent temporal relationships could be identified.

Based on the results of analysis and comparison of results to background levels and screening criteria, the material that would be dredged is not significantly contaminated or substantially different from the sediment at nearby coastal or offshore locations and is chemically suitable for upland and marine use and disposal alternatives. However, the material should not be placed in an upland disposal or construction site without careful consideration of risk potential to human and other receptors.

3.6 Basis for Determining the Need for an ODMDS

The basis for determining the need for ocean disposal is found in 40 CFR 227 subpart C (40 CFR 227.14-16). A need for ocean disposal is considered to have been demonstrated when a thorough evaluation of the factors listed in Section 227.15 has been made and when there exists no practicable improvements in technology or treatment, and there are no practicable alternative locations and methods of disposal or recycling available. Notwithstanding compliance with other subparts of the regulations (e.g., the criteria), ocean disposal may be denied or terminated on the basis of available alternatives and lack of need for the dumping.

40 CFR 227 subpart C requires that the need for ocean disposal be determined by the evaluation of the following factors:

- The degree of treatment useful and feasible for the waste to be dumped and whether or not the waste material has been or will be treated to this degree before dumping;
- Raw materials and manufacturing or other processes resulting in the waste, and whether or not these materials or processes are essential to the provision of the applicant's goods or services, or if other less polluting materials or processes could be used;
- The relative environmental risks, impact, and cost for ocean dumping as opposed to other feasible alternatives including but not limited to:
    - Incineration;
    - Additional biological, chemical, or physical treatment of intermediate or final waste streams;
    - Well injection;
    - Recycling of material for reuse;
    - Storage;
    - Spread of material over open ground;
    - Landfill.
- Irreversible or irretrievable consequences of the use of alternatives to ocean dumping.

A need for ocean disposal will be considered to have been demonstrated when a thorough evaluation of the factors listed above has been made and the District Engineer has determined that the following two conditions exist where applicable:

> (1) There are no practicable improvements that can be made in process, technology or in overall waste treatment to reduce the adverse impacts of the waste on the total environment;
>
> (2) There are no practicable alternative locations and methods of disposal or recycling available, including without limitation, storage until treatment facilities are completed, that have less adverse environmental impact or potential risk to other parts of the environment than ocean dumping.

The nature and location of the DMT project and the large volume and benign characteristics of the sediment proposed to be dredged limit the abilities of process technologies or waste treatment alternatives to reduce the adverse impacts of the dredged material disposal on the total environment. There is no practical process that could be applied to reduce the volume of the material or any treatment that could significantly reduce the adverse environmental impacts associated with placement of the material on top of existing resources.

Without practical process or treatment alternatives to significantly reduce adverse environmental impacts, the demonstration of the need for a ODMDS hinges primarily on the presence of practical alternative use and disposal sites and the evaluation of the adverse impacts and potential risk to other parts of the environment. A summary of relevant project information along with an evaluation of the practical alternatives is presented in the subsequent sections of this appendix. Additional details relevant to some subjects are provided in the draft EIS and/or other appendices.

3.7 Overview of Dredge Types

Construction of the proposed project would generate about 8.1 million cubic yards of material during the initial construction effort and between 1.1 million and 1.2 million cubic yards of material during each subsequent maintenance dredging effort. To assist in the evaluation of alternatives, a brief overview of the equipment that is generally used to dredge the material and transport it to use or disposal sites is provided below.

Three basic types of dredges exist: mechanical dredges, (which include clamshell), pipeline or suction dredges, and hopper dredges. Hopper dredges are self-propelled, seagoing vessels and are the only type of dredge that can work effectively in rough open water. Larger hopper dredges can work in sea swell conditions to about 10 feet. Hopper dredges are mobile, can move quickly to minimize interference with navigation traffic, and can adjust to rapidly changing weather and sea conditions. Pipeline and clamshell dredges are typically not self-propelled and cannot operate safely and effectively in waves greater than 3 to 4 feet. They also are unable to handle strong currents. Both pipeline and clamshell dredges employ spuds and/or anchors to station themselves in the work area and therefore cannot be as quickly moved to accommodate traffic or changing weather or sea conditions. The use of a specific dredge type does not necessarily dictate the use of a corresponding disposal method. However, efficiencies can usually be realized by matching the dredge type to an associated disposal method. For example, sediments removed by a pipeline dredge can be placed into a barge or at an upland dewatering or disposal site. However, the high water content required to pump the material complicates the associated barge transportation and ocean disposal issues and decreases overall efficiency of ocean disposal alternatives.

The Corps does not typically specify the equipment used to dredge its projects and therefore cannot guarantee that a particular method will be used. Site information can probably eliminate some dredging methods. The potential for dangerous sea conditions, short operational windows to conduct the dredging, and the rapidly changing meteorological conditions common at the site probably present too much schedule risk and danger to equipment for the use of pipeline or mechanical dredges for most of the dredging. Hopper dredges would most likely be used for most of the dredging because of they can work safely during adverse weather and sea conditions. Assumptions made for cost estimates indicate that clamshell dredges might be used for about 35 percent of the dredged volume and may work better for performing work in some areas under good conditions.

3.8 Logistical and Dredged Material Transportation Issues

Logistical considerations, the large volume and the physical and chemical characteristics of the proposed dredged material, and the sensitive nature of the area's upland environment present several significant problems relavent to all upland use and disposal site alternatives. The short working season and lack of existing infrastructure restrict access to potential disposal sites that are not near the coast or that are already developed, and limits the feasability of several inland alternatives. Few landforms near Portsite could contain 8.1 million cubic yards of material. If placed in a single 1-mile by 1-mile area, the material from the initial dredging effort would create an 8-foot lift. If the material were usable for construction purposes, the material could be used help create infrastructure. However, due to the high concentration of fine-grained particles, the material is not able to support structures and is susceptible to unacceptable amounts of expansion/contraction and instability during freeze-thaw cycles. Additionally, the fine-grained nature of the dredged material coupled with the high water content would make the material extremely difficult to move until it was thoroughly dewatered.

There are two general scenarios for the transportation of dredged material for upland disposal. A summary of the two scenarios follows:

1. <u>Transporting the material to a shore-based unloading facility in a scow or hopper dredge.</u>

The loaded scow or hopper dredge would be taken to an unloading facility (dock or a temporary barge landing area). The vessel would then be unloaded and the material either stockpiled near the facility or placed directly into trucks. Placing material from large vessels directly into trucks is not normally efficient because a large scow or hopper dredge can hold enough material to fill several hundred 15-cubic-yard trucks. In this case, the dredge would have to remain at the unloading facility a considerable amount of time, especially if the disposal area was far from the dock.

The loaded trucks would then be driven to the disposal site and the loads placed where heavy equipment would spread the material. The only road in the Portsite area is the DMTS road. New roads would be required to access staging and dewatering areas, stockpile locations, and disposal sites not along the existing road.

Once filled, the disposal site would be subject to erosion by wind and water until vegetation was established. Since water associated with the dredged material is saline, no upland vegetation would grow until the material was flushed of most of the salts. Topsoil could be used to cover the entire disposal site prior to revegetation. However, without a local source of topsoil, the acquisition and transportation of a sufficient amount would be difficult and expensive. The timing windows of the placement of the material would also be limited by the short growing season.

2. <u>Pumping the material through a pipeline to dewatering or disposal sites.</u>

Material would be discharged to an on-land, confined, dewatering and/or disposal cell. Depending on the equipment used and the distances and elevations involved, a series of booster pumps could be required.

A dewatering facility/disposal site usually consists of a berm around the disposal area with an adjustable weir at the downstream side. The dredged material (usually about 25 percent solids and 75 percent water) would be pumped to the containment cell where the solid material settles and the water canted off with the weir. The dewatering area is sized to ensure that the return water meets State water quality criteria. After the material was dried through evaporation, transpiration and absorption, it would be spread on site or loaded into trucks and transported to the final disposal site.

At the DMT site, dewatering and drying would be very slow. The water would not seep into the ground because of the presence of continuous permafrost, and the normal temperatures, relative humidity, and cloud cover at the site would limit evaporation and transpiration. If the dewatering facility was not the final disposal area, it is not known how much time would be required to remove enough water from the dredged material to place it in trucks for shipment to other disposal areas.

4. NON-OCEAN USE AND DISPOSAL ALTERNATIVES

An evaluation of the potential to utilize non-ocean disposal sites for the proposed dredged material is presented in Section 2.3.4. No suitable non-ocean disposal alternative was identified. A summary of the ocean disposal alternatives considered and the conclusions of the evaluations are presented below.

4.1 Evaluation of Non-Ocean Disposal Alternatives

In addition to the no-action alternative, initial screening of alternatives identified the following potential upland disposal and/or beneficial use alternatives for material dredged from the DMT project: (1) use of the material for the potential relocation of the village of Kivalina or other construction projects, (2) placement on the tundra, (3) placement in pits at Red Dog Mine, (4) placement in existing borrow pits developed to build the DMTS road, and (5) placement of the dredged material in one or more of several freshwater or saltwater lagoons near Portsite, including use to create freshwater wetland habitat in existing lagoon habitat.

The placement of the material on beaches near Portsite was also briefly considered, but was eliminated from detailed consideration because the dredged material would be physically incompatible with existing beach material and existing beach physical processes. The material also would cause a long-term source of silt that would affect water quality far down-current.

Although the environmental impacts would be significant, several non-ocean use and disposal alternatives were considered. A description and summary of the evaluation of each is presented below.

4.1.1 No Action

Under the no-action alternative, no navigation improvements would be constructed at any of the sites considered. Efficiencies in loading ore concentrate, fuel handling, and control of contaminants would not be realized with new facilities. Environmental and social impacts that might result from the construction and operation of new navigation facilities would be avoided. The no-action alternative would leave existing operations as they are now. Northwestern Alaska businesses and communities would not realize the benefits resulting from the improved facilities.

4.1.2 Fill for the Relocation of Kivalina or Other Projects

The possibility of using the dredged material as fill for the potential relocation of Kivalina and/or other construction projects was considered. However, the dredged material is not suitable as construction fill because of its physical characteristics. The high proportion of fine particulates makes it susceptible to freeze-thaw cycle expansion and contraction and reduces its weight-bearing capacity. Sorting the material to separate the sands and gravels from the fines was briefly considered. That potential was dismissed after considering the additional handling costs and environmental impacts associated with processing and storing all the material, treating the large volume of water needed to wash out the fines, and then disposing of the segregated fines.

4.1.3 Disposal on Tundra

The dredged material could be spread on the tundra near Portsite. However, most of the land surface is classified as wetlands. Even if covered with several inches of topsoil to facilitate revegetation, the salinity of surrounding wetlands would increase through leaching and runoff. More than 1,000 acres would be directly impacted and broader impacts to surrounding wetlands that are underlain by permafrost would be substantial.

4.1.4 Backfilling at Red Dog Mine

The dredged material could be used to backfill portions of the Red Dog Mine that have been worked and abandoned. Trucking the material to Red Dog Mine has all the logistical problems associated with upland disposal described previously, plus other logistic and safety issues.

Red Dog Mine is 52 miles from Portsite and is connected by a two-lane gravel road. The road is of sufficient width in most areas to allow trucks to pass cautiously, but drivers are required to keep in constant contact with each other to ensure safe driving conditions are maintained. It takes an ore truck about 1.5 to 2 hours one-way to drive the 52-mile road. It would take about 200,000 trips to dispose of the dredged material from the initial excavation using 50-cubic-yard dump trucks. The cost for disposal at Red Dog Mine, including a generic dewatering site close to Portsite and the transportation to the borrow pits by truck, would be about $253 million. The high cost of transportation and disposal combined with the associated safety and logistical problems make this alternative impractical, unsafe, and cost prohibitive.

4.1.5 Backfilling of Borrow Pits

The dredged material could be used to backfill the borrow sites created when the road was constructed between Red Dog Mine and Portsite. Several of these borrow pits are along the roadway and could be filled and contoured to blend in with the surrounding environment. The dredged material would be dewatered, trucked to the borrow pits, contoured, and vegetated with native plant species from the surrounding areas.

Trucking the material to the pits created from construction of the road from Red Dog Mine to Portsite has all the problems associated with the alternative to dispose of the material at Red Dog Mine. The cost for disposal at borrow pits, including a generic dewatering site close to Portsite and the transportation to the borrow pits by truck, would be about $174 million. The high cost of transportation and disposal combined with the associated safety, environmental, and logistical problems make this alternative impractical, unsafe, and cost prohibitive.

4.1.6 Lagoon Alternatives

The relative habitat value of most of the coastal lagoons in the Portsite area is high because of their diversity, productivity, and relative scarcity compared with the abundance of adjacent upland and marine environments. The filling of stable and productive lagoon habitat is not an acceptable alternative.

4.1.7 Creation of a Freshwater Wetland

The use of the dredged material to create a freshwater wetland in the existing Port Lagoon was evaluated. The 300-acre lagoon just south of Portsite is freshwater fed and is isolated from the Chukchi Sea for most of the year. Based on observations since the site was developed in the early 1980's, the small beach berm isolating the lagoon is apparently breached frequently enough to prevent the emergence of significant freshwater aquatic plants and animals but not often enough to maintain salinity levels to support marine or even brackish water biota.

This alternative would place dredged material in the lagoon and along the beach berm to ensure that seawater from the Chukchi Sea did not enter the lagoon. Either the berm would be hardened or the slope flattened to dissipate wave energy and prevent erosion. The lagoon could be contoured to allow a variety of water depths and could incorporate up to about one-half of the dredged material. The freshwater stream emptying into the lagoon would flush the salt from the dredged material in a few years. Native freshwater wetland species would naturally colonize shortly after construction. It is expected the lagoon would become productive freshwater wetland habitat and the amount of dredged material requiring disposal elsewhere would decrease. The cost would be about $68 million and would include disposal of the dredged material directly into the lagoon, contouring the material into a wetland marsh, and hardening the shoreline adjacent to the lagoon.

In spite of the apparent lower level of productivity and diversity observed at Port Lagoon, it provides valuable habitat, and recent observations indicate that it has remained freshwater for extended periods. This alternative was not given more detailed consideration because: (1) it would extensively modify a functioning natural system that is relatively uncommon in a global perspective; (2) the created habitat could be more valuable for waterfowl and other animals of particular concern, but would be similar to existing habitat that is not especially uncommon in the region; and (3) this trade-off between existing natural habitat values and values that might be achieved by active habitat modification was not supported by state and federal resource agencies. From a construction standpoint, this alternative was unattractive because it would leave about half the dredged material to go into another site.

4.2 Determination of Need for an ODMDS

The nature and location of the proposed project and the large volume of material that would be dredged limit the potential of process technologies or waste treatment alternatives to reduce adverse impacts of dredged material disposal on the environment. There is no practical process that could be applied to reduce the volume of the material or any treatment that could significantly reduce the adverse environmental impacts associated with on-land placement of dredged material. The options of incineration; additional biological, chemical, or physical treatment of the material; well injection; recycling of material for reuse; storage; and landfilling were initially considered but were rejected due to the nature and volume of the material proposed for dredging. A subsequent evaluation of the irreversible or irretrievable consequences associated with use and disposal alternatives to ocean disposal did not yield an acceptable alternative.

Initial evaluation of dredged material disposal requirements and alternatives led to the following determinations: (1) there are no options for practicable improvements in process technology or in overall waste treatment to reduce the adverse impacts of the waste (dredged material) on the total environment; (2) and there are no practicable alternative locations or methods of disposal or recycling available that would have less adverse environmental impact or potential risk to other parts of the environment. Therefore, ocean disposal alternatives were identified and evaluated.

5. OCEAN DISPOSAL ALTERNATIVES

5.1 Overview of Dredging and Ocean Discharge of Dredged Material

Bottom material offshore from Portsite is predominantly tightly compacted material that might be efficiently dredged in two ways: (1) with a cutter head dredge that can breakup the bottom material so it can be sucked into a barge or carried away in a pipeline, or (2) with a large, heavy, powerful hopper dredge or clamshell dredge that can efficiently penetrate and remove the bottom material. A contractor could elect to use a cutter head dredge, but is unlikely to do so because cutter head dredging entrains large percentages of water that make transportation of the material inefficient. In many places, this inherent inefficiency is overcome by pipelining dredged material to a disposal site. The pipelining option is not practical for the Trestle-Channel alternative because the wave environment is too severe to ensure the pipeline could be kept in operation. Cutter head dredges themselves are not designed to safely survive the storms that periodically occur in the southeastern Chukchi Sea, and there is no harbor where they could seek shelter. This is a further obstacle to the use of cutter head dredges.

Large hopper dredges can move material faster than other dredges that could work in the Chukchi Sea. Cost estimates assume one would be used to dredge the bulk of the material for the Trestle-Channel alternative. The estimates also assume more maneuverable clamshell dredges would be used to reach final dredging configurations and dredge in areas that required better maneuverability. Combining the two types of dredges appears to be the least costly method of performing the work.

The example hopper dredge used for estimating costs would have a 7,600 cubic yard hopper capable of transporting 4,500 cubic yards safely in typical Chukchi Sea conditions. This 4,500 cubic yards is estimated to consist of about 3,600 cubic yards of sediment plus the water that would be mixed with the dredged material. Loading to capacity at a loading rate of about 2,200 cubic yards per hour would take about 1.75 hours. Hopper dredges of this general configuration can travel about 9 mph, so a trip to a disposal site 5 miles away would take about 33 minutes each way. Allowing for acceleration, slowing, dumping material, and turning, a round trip to a disposal site and return to a stop to recommence dredging would take about 1.25 hours. The complete loading and dumping cycle would take about 3.0 hours. Analysis of maintenance requirements and potential weather delays in the Chukchi Sea indicates the dredge could be expected to work 24 hours a day for about 75 percent of the open water season (typically about 100 days in this part of the Chukchi Sea). This indicates an effective working time of about 75 days per season and a maximum of about 600 loading cycles per year, which would equal a maximum of about 2.1 million cubic yards dredged each year by a single hopper dredge. Cost estimates assumed that a total of about 5.1 million cubic yards would be excavated by hopper dredge, which would require about 2.5 construction seasons and about 1,500 loading cycles.

Clamshell dredges would excavate about 3 million cubic yards of material. Clamshell dredges would generally be used where more precision was necessary. Cost estimates assume that clamshell dredges would load dredged material onto barges or scows, which would be transported to the disposal site by tugs. The clamshell dredges would remain at the dredge site while the barge or scow was emptied. To keep the dredge working while the material was being transported and disposed of, two or three barges or scows would likely be used, depending on their capacity and the distance to the disposal site. Large barges or scows have a capacity of about 2,000 cubic yards. Clamshell dredges do not incorporate large quantities of water so it is assumed that approximately 2,000 cubic yards of material could be transported with each load and that the dredge would work continuously, weather permitting, for one or two seasons. Based on the total volume anticipated to be dredged by clamshell dredges and typical barge and scow volumes, approximately 1,500 round trips would be required to transport and dispose of the material.

5.1.1 Barge/Scow Discharge

Bucket or clamshell dredges would remove the bottom material at nearly its *in situ* density and place it on a barge or scow for transportation to the disposal area. Although several barges could be used so the dredging is essentially continuous, disposal would occur as a series of discrete discharges. Barges are designed with bottom doors or with a split-hull, and the contents may be emptied within seconds. Often materials dredged by clamshell remain in fairly large consolidated clumps and reach the bottom in this form. The dredged material would descend rapidly through the water column to the bottom, and only a small amount of material would remain suspended.

5.1.2 Hopper Dredge Discharge

The characteristics and operation of hopper dredges would result in a mixture of water and solids stored in the hopper for transport to the disposal site. At the disposal site, hopper doors in the bottom of the hull would be opened and the entire hopper contents would be emptied in a matter of minutes. The dredge would then return to the dredging site to reload. This procedure, conducted by two or three dredges working at the same time, would produce a series of discrete discharges at intervals of perhaps one to several hours. Dredged material released from the hopper dredges at the disposal site would fall through the water column as a well-defined jet of high-density fluid that might contain blocks of solid material. Ambient water would be entrained during descent. After it hit bottom, most of the dredged material would come to rest. Some material would enter the horizontally spreading plume formed by the impact and would be carried away from the impact point until the turbulence of the surge was sufficiently reduced to allow deposition of the dredged material.

Dredge hoppers and scows are commonly filled past their point of overflow to increase the load. The gain hopper or scow load and the characteristics of the associated overflow depend on the characteristics of the material being dredged, the equipment being used, and sea conditions. The load can be increased by overflow if the material dredged is coarse grained or forms clay balls, but safety concerns during adverse sea conditions can preclude loading past the point of overflow. Environmental considerations of overflow may be related to aesthetics, potential effects of water-column turbidity, potential effects of deposition of solids, or potential effects of sediment-associated contaminants (Palermo and Randall 1990).

Open-water disposal sites can be either predominantly nondispersive or predominantly dispersive. At predominantly nondispersive sites, most of the material remains at the disposal site following placement and may be placed to form mounds. At predominantly dispersive sites, material may be dispersed either during placement or eroded over time and transported away from the disposal site by currents and/or wave action.

5.1.3 Theoretical Discharge Description

The behavior of dredged material during disposal can be separated into three phases:

- Convective Decent Phase: the majority of the dredged material is transported to the bottom under the influence of gravity as a concentrated cloud of material;

- The Dynamic Collapse Phase: following impact with the bottom the vertical movement present during the convective decent phase is transferred to horizontal spreading of the material;

- The Passive Dispersion Phase: following loss of momentum from the disposal operation, ambient currents and turbulence determine the transport and spread of material.

During convective decent phase, water is entrained into the disposal cloud, resulting in a gradual decrease in the concentration and density of the discharged material. This entrainment of water along with residual dispersal of sediment washing out of the disposal vessel results in some portion of the dredged material remaining in suspension throughout the water column after disposal. Since these suspended sediments are not transported as part of the dredged material plume, the ultimate fate of this material depends primarily on its settling rate and the ambient currents in the area (SAIC 1987).

The second phase of transport occurs when the cloud begins a dynamic vertical collapse, characterized by horizontal spreading upon contact with the bottom (Clarke et al. 1971). The material flattens out and is similar to the base surge cloud in a detonation-type event as the dredged material plume assumes a horizontal circular shape with a small vertical dimension (COE 1976).

During the last phase, passive dispersion, particles settle and can be advected and dispersed by bottom currents and turbulence caused by disposal. The concerns of dredged material disposal are that disposed materials will impact the disposal environment, including the water column, bottom sediment, and biological resources.

5.2 Disposal Site Selection Process

The disposal of waste material in the ocean, under 40 CFR 228, is permitted only at sites or in areas selected to minimize the intererence of disposal acticvities with other activities in the marine environment. The criteria and requirements for selecting and designating ODMDSs are outlined in 40 CFR Part 228.

The process followed by the Corps for the selection of an ocean disposal site for the DMT project complies with the requirements of 40 CFR, Part 228. When the need for ocean disposal has been established, the process of site selection begins with the identification of the broadest economically and operationally feasible area of consideration for potential disposal sites. A step by step evaluation process is then conducted to eliminate unsuitable sites and areas and identify candidate sites where unacceptable impacts can be avoided. The general and specific site criteria found in 40 CFR, Part, 228.5, and 228.6 are used to narrow the list of candidate sites until a final site or sites are selected. The site selection process is structured into three phases as presented in figure 8.

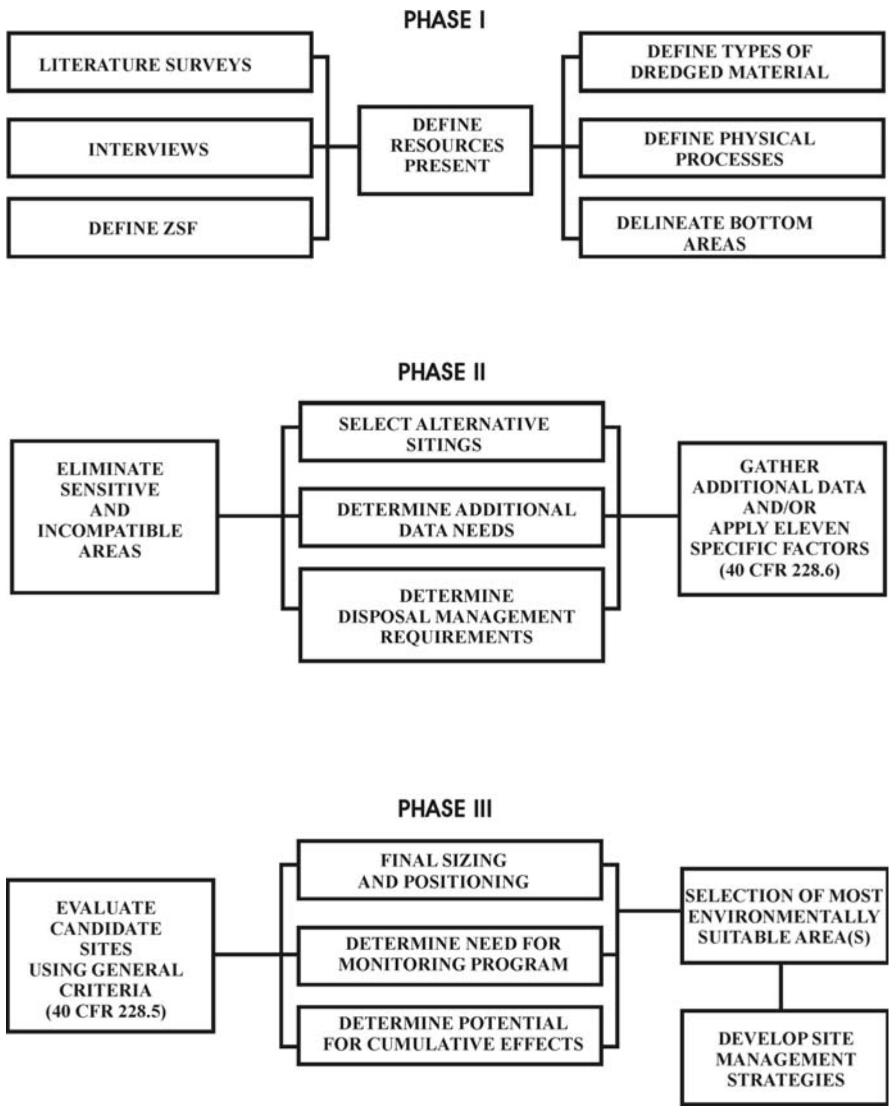

Figure 8*: Site Selection Process*

During phase I, the general area being considered for dredged material disposal is defined, and information and data necessary to characterize critical resources, uses, and the physical and environmental process that could be impacted by disposal activities is compiled. The overall size and boundaries of the Zone of Siting Feasibility (ZSF) for an ODMDS are determined by the consideration of a number of environmental, social, navigational, oceanographic, and project-specific factors. The project-specific factors that typically influence the ZSF boundaries include: available dredging equipment, energy use, costs and schedule constraints, and safety.

During Phase II, sensitive and incompatible areas are eliminated, and additional data needs and candidate sites are identified.

During Phase III, candidate sites are compared and evaluated, a proposed site is selected, and management strategies are developed. Although site management issues and strategies are considered during the site selection process, formal site management plans are not required for sites used under Section 103 authorization. If the tentatively recommended alternative was constructed, it is anticipated that the ODMDS would receive dredged material from initial construction and the first maintenance dredging effort under Section 103 authority. However, a formally designated ODMDS will be required for subsequent maintenance dredging efforts. EPA is responsible for the formal designation process and would select and designate a site to meet future maintenance dredging requirements.

5.3 Establishing the ZSF for Potential ODMDSs

The Zone of Siting Feasibility (ZSF) for ocean disposal alternatives is illustrated in figure 9 and is described below.

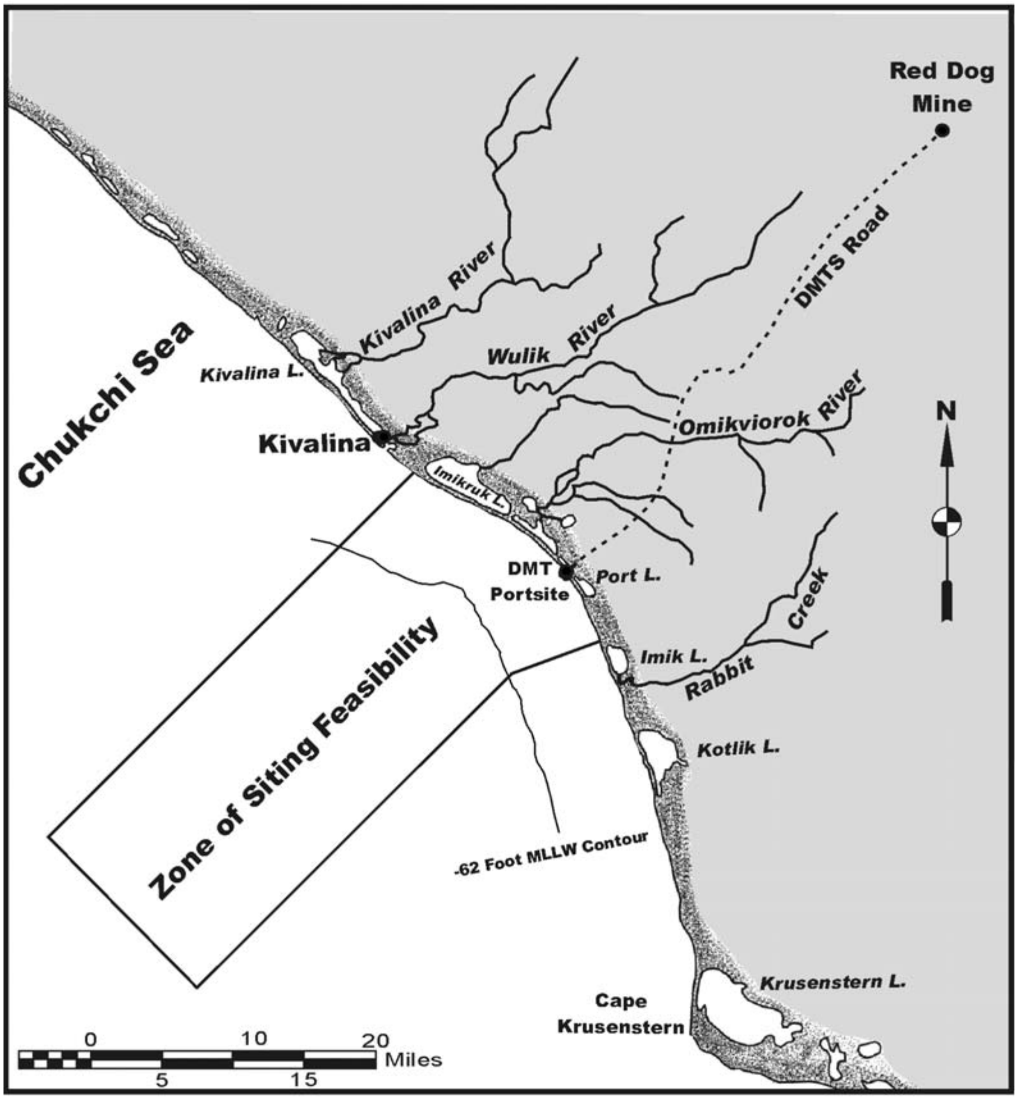

Figure 9: *Zone of Siting Feasibility for Ocean Disposal Alternatives*

The ZSF is confined to the north and south by the coastal community of Kivalina and the mouth of Rabbit Creek, respectively. Kivalina is the closest community to Portsite. It is closely tied to the Chukchi Sea through subsistence, recreational, and social connections. The community has expressed significant reservations about actions that would dispose of dredged material or significantly increase marine traffic near Kivalina. Based on the similarities of the resources and habitats near Portsite and the areas near and north of Kivalina, it would be difficult to justify any transportation or disposal action that might impact any resource or access to resources near Kivalina. South of Portsite, traditional knowledge indicates that biological diversity and abundance is higher offshore from the mouth of Rabbit Creek than adjacent areas to the north or south. Biological surveys in support of the DeLong Mountain Terminal Navigation Improvements draft EIS and other biological investigations support the conclusions from regional traditional knowledge.

The near-shore limit of the ZSF is defined by the minimum depth that would avoid impacts to navigation, or wave, current, and sediment transport dynamics. Based on wave-impact study results, a minimum water depth of -60 feet MLLW is required to avoid undesirable impacts to wave, current, and sediment transport dynamics. That depth was determined by running the ST WAVE numerical model that indicated that there was no effect if the bottom elevation was lower than -60 feet MLLW. This depth would also avoid the creation of navigation hazards and minimize the potential for effects on ice and for ice to redistribute the material. Based on anticipated deposition and dispersion of the proposed dredged material, it was determined that the minimum depth of an ODMDS should be –62 MLLW.

The seaward limits of the ZSF are more difficult to define. Marine wildlife would be impacted by the additional vessel traffic and possibly by the noise it generates. Longer transport distances would increase the area impacted by noise and activity and increase the duration of noise and activity. All other factors being equal, adverse water quality impacts would increase with water depth because of greater dispersion of the dredged material caused by a longer fall through the water column. In general, the farther the material is transported offshore for disposal, the greater the transportation-related adverse impacts to marine wildlife, and water quality impacts from disposal. The seaward boundary is also limited by the distance that dredged material can be economically transported. Increasing the distance to the disposal site would extend vessel running times for each disposal action, and increase fuel consumption and potential for accidents. As the distance increases, the economic feasibility of the project decreases due to cost and schedule impacts. Those impacts would eventually require additional dredge and/or barging capabilities or additional years of dredging. Adding additional equipment or extending dredging to additional seasons would add to construction costs and delay project economic benefits. Eventually, the project would become economically infeasible.

A summary of the activities performed for the development of the draft EIS and this ODMDS study, the data collected, and the results of the evaluation of the candidate sites is presented below. More detailed information about most subjects can be found in the draft EIS, and its other appendices. Together, the draft EIS and its appendices provide sufficient information to determine compliance with the Coastal Zone Management Act, the Endangered Species Act, the National Environmental Policy Act, and the National Historic Preservation Act of 1966, as amended, with regard to transportation of dredged material to and disposal at an ODMDS.

5.4 Biological Resources within the ZSF

5.4.1 Marine Vegetation and Algae

The Chukchi Sea does not have the large assemblages of kelps and other large, multicellular attached algae, although they are found in small areas of the Arctic Ocean off the Alaska coast. Potential disposal sites near Portsite do not support this unique habitat, and there are no known assemblages of this type within several hundred miles of Portsite. Kelps and other large multicellular algae may be rare in the Arctic because the growing season is short, the water is comparatively turbid, and /or the bottom is generally too soft for larger algae to attach. Near-shore freezing and ice gouging also may keep attached algae from colonizing along the shore.

Single-cell algae are the principal source of primary productivity in the Chukchi Sea. Two groups, diatoms and dinoflagellates, are reported to be the major producers. These microscopic algae can be floating or suspended in the water (phytoplankton), or attached to either the bottom sediments (benthic) or the underside of ice.

Areas of especially high primary productivity in the northern Bering and Chukchi Seas are defined in the DMT draft EIS. Those areas are well outside the potential disposal areas. Primary productivity in the southeastern Chukchi Sea in the general Portsite area is about one-quarter to one-third that of the western Chukchi Sea.

5.4.2 Marine Invertebrates

Marine invertebrates in the Portsite vicinity and the Chukchi Sea are discussed in Section 3.5 of the Draft EIS. They consist of four main types:

- Those floating or weakly swimming in the water column. The smaller forms often are referred to as zooplankton, which include organisms that remain in the water column throughout their life cycle, such as copepods, and the larvae of many larger sedentary and bottom dwelling invertebrates.
- Those swimming in the water column such as amphipods, including some species of shrimp and krill. These larger, actively swimming invertebrates also may dwell on the bottom. They are not commonly harvested for human food, but are essential in the diets of many fish, some seals, and baleen whales (notably gray and bowhead whales).
- Those living on the bottom sediment and other substrates, including starfish, crabs, sponges, barnacles, snails, and whelks. King crabs are harvested in a few places for personal use, and there is a small commercial harvest near Kotzebue.
- Those living in the bottom sediments, such as clams, and worms. Many fish and invertebrates eat these benthic invertebrates. They are particularly important to walrus, which feed largely on clams and to gray whales, which filter amphipods, worms, and other organisms from soft bottom material

The types, diversity, and abundance of the marine invertebrates living in the eastern Chukchi Sea have been defined by a number of marine invertebrate surveys completed over the past 35 years. The surveys most appropriate to describing the existing biological environment near Portsite are briefly discussed below. Three major surveys (Sparks and Pereyra 1966; Wolotira et al. 1977;

and Fair and Nelson, 1999) were conducted as part of regional efforts to characterize marine resource for potential commercial fisheries and/or industrial development. The areas they sampled near Portsite are illustrated in figure 10. The principal species they collected in trawl collections are compiled in table 3, which is keyed to the survey sites in figure 10. The figure identifies alternative disposal sites and the tables include marine fish that are identified and discussed in subsequent sections.

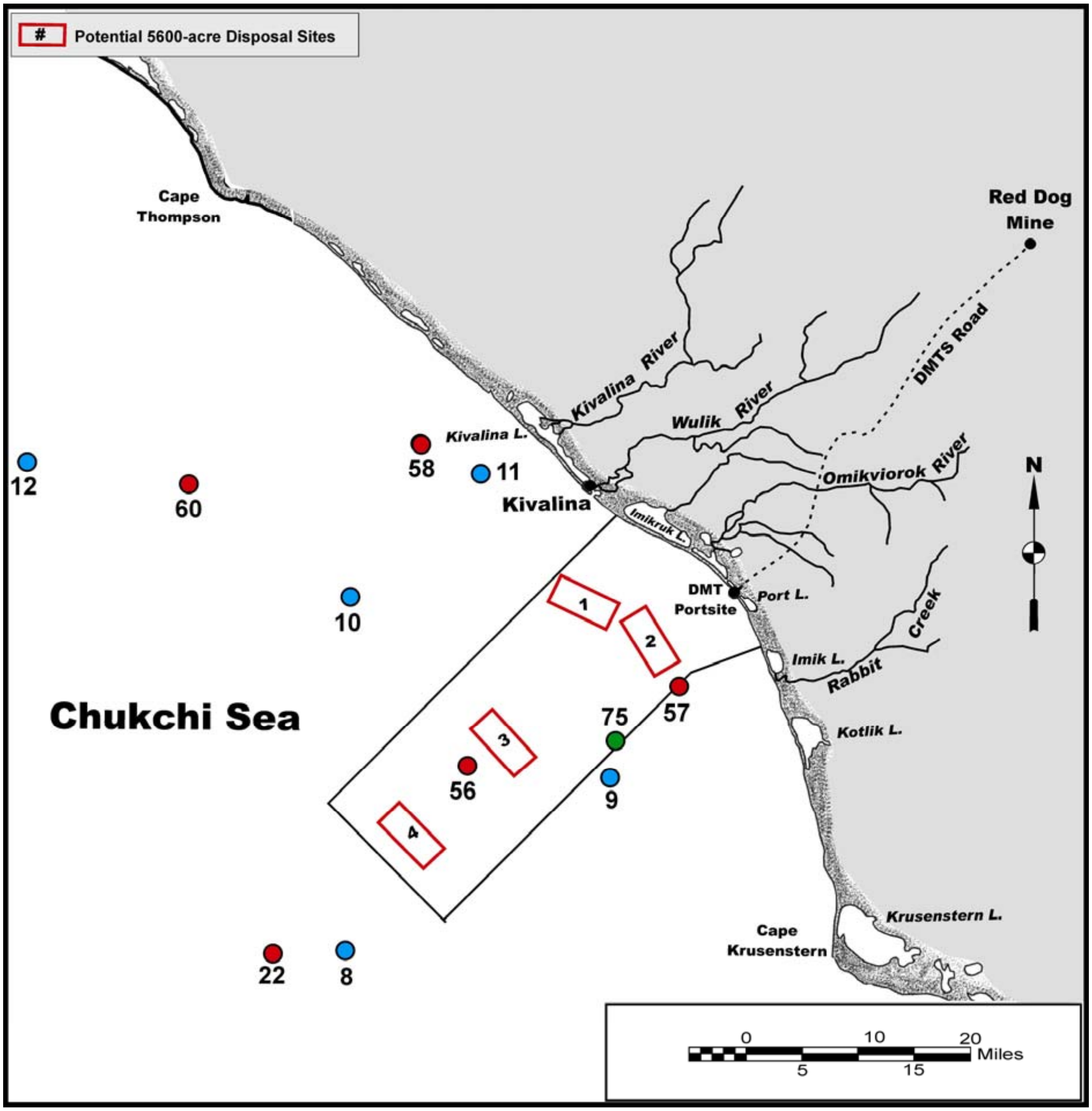

Figure 10. Survey stations trawled during three major fisheries surveys (Sparks and Pereyra 1966; Wolotira et al. 1977; and Fair and Nelson, 1999), and their proximity to potential offshore disposal sites (1-4).

Table 3. Estimated catch of principal species in kilograms per kilometer at stations surveyed in the vicinity of Portsite between 1959 and 1998.

Station Number [a]	**11**	**58**	**57**	**9**	**22**	**8**	**10**	**56**	**60**	**12**
Depth (feet)	**60**	**60**	**60**	**84**	**96**	**96**	**114**	**108**	**120**	**138**
Distance Offshore (miles)	**4**	**5**	**7**	**13**	**38**	**34**	**17**	**18**	**30**	**45**
Sea stars	**0.1-0.4**	**9-26**	**9-26**	**0.1-0.4**	**26-43**			**67-110**	**43-67**	**0.5-2.0**
Basket stars	**26-50**			**0.3-14**			**26-50**			**50+**
Clams					**0.02-0.04**		**0.2-0.7**	**0.12-0.47**	**0.04-0.12**	**0.2-0.7**
Snails					**0.02-0.24**		**0.01-0.05**			**0.06-0.25**
Amphipods							**0.1-0.5**			
Crabs	**5.05-10.0**	**3.02-18.22**	**2.05-3.02**	**1.3-5.0**	**0.03-0.04**	**0.05-0.25**	**10.0+**	**0.01-9.0**	**28-75**	**1.3-5.0**
Green urchin		**9.5-20.7**	**0.01-2.8**		**0.01-2.8**			**0.01-2.8**	**0.01-2.8**	
Barnacles	**0.3-0.5**			**0.07-0.27**			**0.27-0.54**			
Tunicates	**8.2-16.2**	**14-30**	**0.1-2**	**8.2-16.2**	**0.01-2**	**0.1-0.4**	**16.2+**	**7-14**	**14-30**	**0.1-0.4**
Shrimp		**1.66-3.37**	**1.66-3.37**		**0.03-0.31**	**0.003-0.014**		**0.31-0.78**	**0.78-1.66**	
Cod		**2.7-8.0**	**2.7-8.0**					**0.1-1.2**	**0**	
Sculpin		**3.4-9.4**	**0.5-1.7**					**0.5-1.7**	**0.5-1.7**	
Flatfish			**1.5-3.8**					**0.01-1.5**	**0.01-1.5**	
Forage fish		**0.38-0.68**	**0.01-0.18**			**12**	**1.3**	**0.4-0.75**	**0.01-0.18**	**0.4**
Total Catch [b]		**73-115**	**9-43**		**9-43**			**116-185**	**116-185**	
Total Fish catch [b]		**6-11**	**6-11**		**1-5**			**1-5**	**1-5**	
Total invertebrate catch [b]		**65-112**	**9-35**		**36-64**			**113-163**	**113-163**	

a. Station locations are shown in Figure 11.
b. Total catches reported by Fair and Nelson (1998).
+. No upper limit was reported. Catch was greater than accompanying value.

Sparks and Pereyra 1966. This trawl survey covered part of the eastern Chukchi Sea, approximately 2 miles off shore. Conducted in 1959 as part of Project Chariot, the survey found the same invertebrates that later surveys collected near Portsite and elsewhere in the region. Some of the more common invertebrate groups found in the survey are shown in table 4. Collectively, the groups shown in this table accounted for about 95 percent of the samples.

Table 4. The common marine invertebrate groups found in the Eastern Chukchi Sea in 1959.

Invertebrate Group	Where Found
Worms	Silty substrate
Mysid shrimp	Near shore brackish areas
Clams	Muddy areas
Sea stars	Areas with higher densities of bivalve mollusks
Isopods	Cosmopolitan
Sea cucumbers	Silty substrate
Brittle stars	Silty substrate
Sand fleas (Amphipods)	Cosmopolitan
Snails and whelks	Wide spread, particularly in areas of high bivalve density
Bryozoans (colony organisms)	Cosmopolitan
Sponges	Near shore areas less than 20 fathoms
Shrimp	Cosmopolitan
Crabs	Cosmopolitan

Source: Sparks and Pereyra 1959.

The conclusions reached by Sparks and Pereyra from their survey included: (1) There are probably no commercial quantities of economically important invertebrate species in the area they surveyed; (2) the type and consistency of the bottom substrate greatly influences the distribution and abundance of benthic (bottom-dwelling) invertebrates in the area; and (3) ice scouring of near shore areas greatly reduces the possibility of invertebrates becoming permanently established at water depths of less than 20 to 30 feet.

Wolotira et al. (1977). This trawl survey was conducted in 1976 as part of National Marine Fisheries Service's Outer Continental Shelf Environmental Assessment Program (OCEAP) surveys in the Bering and Chukchi seas. The survey sampled 242 bottom stations in the eastern Bering Sea north of Saint Lawrence Island, and in the eastern Chukchi Sea north to Point Hope and west to the boundary established by the 1958 International Convention of the Continental Shelf. It included stations offshore of the Portsite. The survey focused on fish and invertebrates with potential economic importance and on sea stars and their relatives (echinoderms) because of their extremely high abundance relative to other invertebrates in the survey area.

Sea stars were the major invertebrate in the eastern Chukchi and eastern Bering seas areas surveyed, and accounted for 65 percent of the catch. Among the more common marine invertebrates of economic importance found in the study area were Crangonid shrimp that live in the substrate, cockles and clams, whelks (marine snails), and crabs including small numbers of king crab. None of these invertebrates were found in commercial quantities.

Fair and Nelson (1999). Fair and Nelson (1999) conducted the most recent comprehensive fish and invertebrate survey of the southeast Chukchi Sea and accounted for 52 species of fish in 12 families. The stations surveyed were mostly the same as those surveyed during previous surveys, and included several near Portsite. They found relatively little diversity of fish species with cod (mostly saffron cod), pleuronectid flatfish (mostly Alaska plaice and yellowfin sole), and sculpin (mostly shorthorn sculpin), which collectively accounted for over 88% of the species caught. Smelt, herring, poachers, sandlance, eelpouts, snailfish, pricklebacks, and greenlings made up the remaining 12 percent of species caught. The highest catch in kilograms per kilometer trawled (CPUE) of saffron cod and flatfish was in the strait of Kotzebue Sound and near Cape Prince of Wales. Catches of sculpin were highest in deeper water between Cape Prince of Wales and Point Hope. Rainbow smelt, a nearshore anadromous species of little importance, dominated the remaining 12 percent of species.

Fair and Nelson identified 71 invertebrate taxa representing 9 phyla. Mollusca (clams and snails) had the greatest diversity followed by Arthropoda (crabs), Echinodermata (sea stars, basket stars, and urchins), Cnidaria (hydras and jellyfish), Annelida (worms), Bryozoa (bryozoans), Chordata (sea squirts), Phoronida (horseshoe worms), and Porifera (sponges). The highest catches of invertebrates were in deeper waters. In order of abundance (CPUE), sea stars or starfish was the most abundant, followed by the spider crab (sub-legal size *Chionoecetes opilio*), tunicates, green urchin, and sponges. Clams were more abundant in deeper water offshore, but no calms were found along shore north and south of the proposed disposal site.

Shrimp, and especially bottom dwelling Crangonid shrimp, are widely distributed in southeast Chukchi Sea and were caught at all but one station trawled by Fair and Nelson. Higher shrimp CPUE was generally found in nearshore waters between Cape Krusenstern and Point Hope.

Fair and Nelson (1999) surveyed the same general locations as Sparks and Pereyra (1966) and Wolotira et al. (1977), that included three stations near Portsite: one (station 58) north offshore of Kivalina, one (station 57) south offshore of Rabbit Creek, and one (station 56) about 4 miles directly offshore of Portsite. With exception of saffron cod, helmet crab, and shrimp, the relative abundance (CPUE in kg/km trawled) of fish and invertebrate species present increased with distance from shore. None of the nearshore species were particularly abundant (CPUE range 0-9.22 kg/km), but they are expected to be present nearshore in varying abundance year around.

Blaylock and Erickson (1983 Red Dog Port Baseline Survey). This survey was part of baseline research for the Red Dog Mine EIS, which included the Portsite area. The survey area included approximately a 50-mile length of the coastline between Tasikpak Lagoon, which is north of Kivalina, to Kotlik Lagoon, south of Portsite, and extended from shore out to waters about 50 feet deep. Five transects were sampled and sampling methods included diving, bottom coring, trawling, and dragging a sled on the bottom to collect invertebrates. The five transects sampled ranged from about 32 miles northwest of Portsite to about 12 miles southeast of Portsite. Three of the survey transects are of special interest because they were close to Portsite. One transect was surveyed about 2 miles northwest of Portsite, a second one was directly at Portsite, and a third about 4 miles south of Portsite.

The most common marine invertebrates reported at the three transects are in Table 5.

Table 5. Marine Invertebrates Found in Portsite Area in 1983.

Location of Transect Relative to Portsite	Common Invertebrates (Listed in descending order found)
Two Miles North	Amphipods, Brittle Stars, Sea Stars, Mysid Shrimp, Cumaceans (crustacean), Worms, Crabs, Bryozoans (colony organism), Shrimp.
At Portsite	Worms, Amphipods, Shrimp, Mysid Shrimp, Crangon Shrimp, Brittle Stars, Sea Stars, Tunicates (colony organism), Clams, Crabs.
Four Miles South of Portsite	Worms, Amphipods, Sea Stars, Brittle Stars, Shrimp, Crangon Shrimp, Mysid Shrimp, Isopods, Cumaceans (crustacean), Crabs.

Source: Blaylock and Erikson 1983.

Worms and amphipods were frequently the most numerous invertebrate collected. Brittle stars and sea stars were abundant and three varieties of shrimp were common. Helmet crab (Telemessus) was the only crab species caught by trawling. Apparently no crab pots were placed during this survey. Red king crab, although possibly present in the area, were not caught.

RWJ (2000 Portsite EIS Survey). Surveys for marine invertebrates were conducted off Portsite during the spring and summer of 2000 as part of the environmental studies conducted in preparation for this draft EIS. These surveys, which included collecting invertebrates and plankton living in the water column, on the surface of bottom, and in the bottom sediments, are briefly described below. Collecting methods used baited pots for crabs and shrimp, a trawl for collecting fish and invertebrates living on or near the bottom (benthic fish and invertebrates), plankton net for sampling zooplankton, and a dredge for collecting worms and other invertebrates living in the mud and sand on the bottom. The locations of surveys reported in the RWJ report are illustrated in figure 11. Principal organisms collected in trawl samples, which represent the broadest and most effective open-water collection technique for marine organisms of particular interest, are presented in table 6.

Pot Surveys. The pot surveys during spring used baited shrimp and crab pots fished through holes cut in the ice. Crab and shrimp pots were set at 11 stations: six north, four south, and one about 1.1 miles straight off shore from the DMT. Distances from Portsite ranged from about 2.1 miles for pots set north of Portsite to about 1.9 miles for pots set south of Portsite. Most pots were set in water 34 feet deep from 0.53 mile to 0.75 mile off shore, but the pots set 1.1 miles straight out from the Portsite were set in water 41 feet deep.

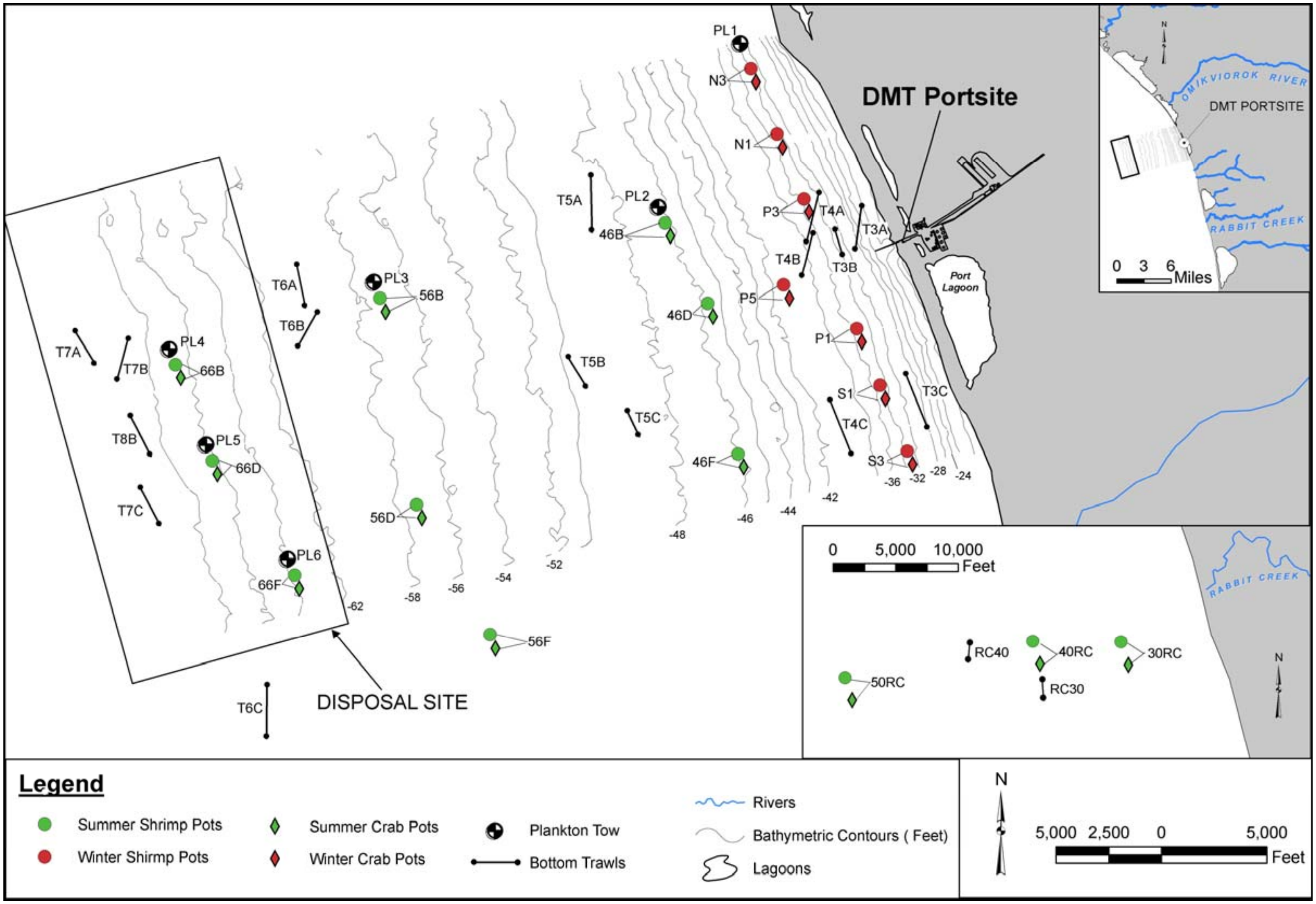

Figure 11. Trawl, invertebrate, and plankton surveys location at Portsite as reported by RWJ Consultants, Inc. (RWJ 1999, 2001).

Table 6. Ranking by wet weight (in g/m^2) of the top 15 taxa (by overall weight) for trawl samples collected offshore of the DeLong Mountain Terminal in summer 2000 (Table 5, RWJ 2001).

Common Name or Taxa	Scientific Name	RC30	RC40	T3A	T3B	T4A	T4B	T5A	T5B	
Seastar	*Asterias amurensis*	0.699	1.890	0.693	1.464	2.182	3.097	0.000	3.810	
Seastar	*Evasterias echinosoma*		0.203		0.682		0.641	0.000	1.249	
Helmet crab	*Telmessus cheiragonus*	0.797	0.129	0.247		0.163	0.199	0.105	0.156	
Blacktip seastar	*Lethasterias nanimensis*	0.315	0.370		0.510	0.258	0.207		0.356	
Shrimp	Crangonidae		0.190	0.098	0.063	0.183	0.244	0.000	0.475	
Shrimp	Caridea	0.555	1.212					0.000		
Saffron cod	*Eleginus gracilis*	0.543	0.167	0.689		0.011	0.023	0.036		
Yellowfin sole	*Pleuronectes asper*	0.093	0.256	0.046	0.104	0.033	0.050	0.014	0.131	
Basket star	*Gorgonocephalus caryi*						0.003		0.012	
Seastar	*Leptasterias polaris acervata*	0.165	0.033		0.057	0.027	0.304	0.000	0.069	
Sculpured shrimp	*Sclerocrangon boreas*	0.455			0.042					
Northern sculpin	*Icelinus borealis*	0.028	0.037	0.018	0.031		0.053	0.008	0.032	
Snake prickleback	*Lumpenus sagitta*	0.061	0.211	0.039	0.016	0.038	0.055	0.053	0.008	
Alaska plaice	*Pleuronectes quadrituberculatus*					0.035			0.061	
Starry flounder	*Platichthys stellatus*			0.022	0.076					
		T5C	T6A	T6B	T6C	T7A	T7B	T7C	T8B	Average
Seastar	*Asterias amurensis*	3.044	2.912	2.659	1.833	1.393	2.163	2.729	2.194	2.048
Seastar	*Evasterias echinosoma*	0.861		1.038	0.670	0.147	0.970	0.132	0.334	0.433
Helmet crab	*Telmessus cheiragonus*	0.427	0.219	0.194	0.041	0.294	0.038	0.205	0.053	0.204
Blacktip seastar	*Lethasterias nanimensis*	0.769	0.055	0.163	0.027	0.081		0.089		0.200
Shrimp	Crangonidae	0.484	0.153	0.106	0.127	0.168	0.210	0.191	0.206	0.181
Shrimp	Caridea		0.213		0.175	0.222		0.260	0.216	0.178
Saffron cod	*Eleginus gracilis*	0.028	0.011	0.002	0.008	0.002	0.050	0.007	0.010	0.099
Yellowfin sole	*Pleuronectes asper*	0.090	0.075	0.082	0.061	0.036	0.170	0.114	0.118	0.092
Basket star	*Gorgonocephalus caryi*			0.048	0.004	0.349	0.296	0.359	0.344	0.088
Seastar	*Leptasterias polaris acervata*	0.094					0.016		0.076	0.053
Sculptured shrimp	*Sclerocrangon boreas*			0.149			0.113			0.047
Northern sculpin	*Icelinus borealis*	0.002	0.030	0.004	0.047	0.093	0.079	0.063	0.134	0.041
Snake prickleback	*Lumpenus sagitta*	0.050	0.014		0.014	0.010	0.007	0.007	0.016	0.037
Alaska plaice	*Pleuronectes quadrituberculatus*		0.022		0.055	0.066	0.056	0.025	0.068	0.024
Starry flounder	*Platichthys stellatus*				0.036	0.031	0.090	0.098		0.022

The pots fished during summer were set in water from 44 to 66 feet deep between 1.7 and 6.6 miles off shore from Portsite. Nine stations were sampled during the summer. Another three stations from 1.5 to 5.7 miles off shore from Rabbit Creek, about 10 miles south of Portsite, were also sampled with baited pots during the summer. Marine invertebrates caught during the spring and summer pot surveys are listed below, in descending order of abundance:

1. Sea Star
2. Helmet Crab
3. King Crab
4. Lyre Crab
5. Shrimp
6. Jellyfish
7. Brittle Star

Trawl Survey. Eighteen stations were surveyed by dragging a 16-foot-wide trawl on the bottom for approximately 10 minutes at each station. The trawl stations ranged from about 24 feet deep at 0.3 mile off shore, to 70 feet deep 7.3 miles off shore. Two additional stations were trawled about 2.8 and 3.8 miles off shore from Rabbit Creek, about 10 miles south of Portsite. The marine invertebrates caught in the trawl survey were predominantly shrimp (3 varieties), followed by sea star (2 varieties), and helmet crab.

Plankton Survey. Plankton samples were collected through the ice in the spring and from a vessel during the summer. Very few planktonic invertebrates were collected through the ice during the spring, but in the summer the larvae and pre-settle juveniles from many invertebrates were collected. Larvae included jellyfish, amphipods, copepods, and arrow worms. The most prevalent zooplankton larvae collected were copepods, followed by larvae of sand dollars, sea urchins, and jellyfish. No king crab larvae were collected during the spring or summer sampling period.

Bottom Sediment Survey. Samples of sediment-dwelling invertebrates (infauna) were taken from a 5,600-acre offshore area that could be used for disposal if a navigation channel was dredged at Portsite. Sampling stations were stratified at 2-foot-depth increments between 63 to 71-foot depth contours, and randomly distributed within the potential disposal area. Marine worms of four families were the dominant (in numbers) invertebrate in the samples, and amphipods were second in order of abundance. A high degree of similarity was exhibited in the density of organisms between the stations sampled.

5.4.3 Fish

5.4.3.1 Marine Fish

Twenty species of marine fish were caught during the 1982 Dames and Moore, Inc. surveys with considerable overlap in species between gear types (Table 7). Starry flounder, Arctic flounder, rainbow smelt, and saffron cod dominated the near-shore collections. Saffron cod, starry flounder, Pacific herring, Atka mackerel, yellowfin sole, and Alaska plaice were most abundant in the offshore collections.

Table 7

Numbers and percent occurrence of marine fish species collected during summer 1982 by various gear types (source: Dames and Moore 1983)

Species	Beach Seine (approx %)	Fyke Net (approx %)	Trawl (approx %)
Starry Flounder - *Platichthys stellatus*	7(15)	7(6)	14(3)
Arctic Flounder - *Liopsetta glacialis*	2(4)	1(1)	17(4)
Yellowfin sole - *Limanda aspera*			94(204)
Longhead dab - *Limanda proboscidea*			16(4)
Alaska plaice – *Pleuronectes quadrituberculatus*			87(19)
Sand lance - *Ammodytes hexapterus*			3(1)
Rainbow smelt - *Osmerus mordax dentex*	2(4)	4(3)	10(2)
Pacific herring - *Clupea harengus pallasi*	5(11)	8(7)	
Saffron cod - *Eleginus gracilis*	24(52)	77(65)	143(31)
Tubenose poacher - *Pallasina barbata*			11(2)
Sturgeon poacher - *Agonus acipenserinus*			9(2)
Atka mackerel - *Pleurogrammus monopterygius*		19(16)	9(2)
Fourhorn sculpin - *Myoxocephalus quadricornis*			6(1)
Slender eelblenny - *Lumpenus fabricii*			20(4)
Arctic shanny - *Stichaeus punctatus*			21(5)
Bering poacher - *Occella dodecaedron*			1(1)
Surf smelt - *Hypomesus pretiosus*	2(4)		
Larval smelt - Family Osmeridae	4(9)		
Ringtail snailfish - *Liparis rutteri*			1(1)
Nine-spine stickleback - *Pungitius pungitius*		1(1)	
	46(100%)	118(100%)	462(100%)

Marine fish also were collected in the marine waters off the Portsite and in the surrounding area in 2000 (RWJ 2001). Marine fish species diversity and abundance was not particularly high off Portsite during the survey and was similar to that in collections from nearby waters. Marine fish caught in the 2000 collections were predominantly yellowfin sole, northern sculpin, saffron cod, snake prickleback, sturgeon poacher, Arctic staghorn sculpin, and longhead dab. More information about those collections and collections by others is presented in Section 3.5.3.1 of the DMT draft EIS.

Species in the near-shore collections, particularly saffron cod, are caught through the ice for personal use. There is no commercial fishery in the southeastern Chukchi Sea for any of the species collected near Portsite. Most or all of the species collected near Portsite are eaten by other fish, beluga whales, and/or seals. All the species collected are widely distributed and common in the Chukchi Sea. No critical habitats or areas of special importance for any of the species has been identified in the southeastern Chukchi Sea, although marine fish biomass is reported to be unusually high south of Portsite near Cape Krusenstern. During collections near Portsite, two of the most abundant fish in summer collections were saffron cod and yellowfin sole. Both were most abundant in waters less than 40 feet deep. The various sculpin species of the area were more broadly distributed.

5.4.3.2 Anadromous Fish

The principal anadromous species in the Portsite area are five species of Pacific salmon and Dolly Varden char. Other anadromous or semi-anadromous species in the area include smelts, whitefishes, and ciscoes. Many of these species are not truly anadromous, but can winter in salt or brackish water and then “run” in rivers the same as salmon and char. Dolly Varden run the Wulik River in large numbers while salmon return in smaller numbers. Whitefishes and smelts are present in the Portsite area.

The Dames and Moore, Inc. (1982) surveys documented six species of anadromous fishes including pink salmon, chum salmon, Arctic char (or Dolly Varden), Arctic cisco (or Bering cisco), and humpback whitefish. Overall abundance of anadromous fish was low with only 110 caught in 46 seine hauls along the southeastern Chukchi Sea coast. Pink salmon and Arctic cisco were the most numerous species caught, with 46 and 51 fish, respectively. The other anadromous species were caught only infrequently near Portsite and from nearby inshore waters.

Streams closest to Portsite, specifically the Omikviorok River (Ipiavik Lagoon), Agarak Creek, and Rabbit Creek have small runs of anadromous fish including char, pink salmon, and chum salmon (Dames and Moore 1983). The nearby Wulik, Kivalina, and Noatak Rivers have large runs of Dolly Varden and varying returns of Pacific salmon. The anadromous fish that run the Wulik River are described below.

Dolly Varden. The anadromous Dolly Varden is the principal fish species in the Wulik River drainage. They deserve additional discussion because they move past Portsite during their time in saltwater and because they are important to the local subsistence economy. Many researchers consider anadromous Dolly Varden to be a coastal ranging species, but Dolly Varden can range considerable distances. Fish tagged in the Wulik River have been recaptured at distant locations including Point Hope, St. Lawrence Island, and Norton Sound. Dolly Varden are sometimes seen schooling along the beach near Portsite, but they are seldom harvested from marine waters in the area. Anadromous Dolly Varden overwinter and spawn in freshwater. Overwintering fish descend to saltwater in June, while spawning fish stay in the river and spawn the following fall. Aerial counts of overwintering Dolly Varden in the Wulik River have been conducted intermittently since 1968, with counts ranging from a high of 297,257 in 1969, to a low of 5,590 in 1986. This wide range in census results may have been caused by stream conditions or other environmental factors, but, probably resulted, in part, from variations in site conditions that affected fish counts. Overwintering areas in the Wulik River (DeCicco 1996) are illustrated in figure 12. Tagging studies show that the population of Dolly Varden overwintering in the Wulik River spawn in several nearby rivers including the Noatak, Kivalina, Wulik, Kobuk and Pilgrim rivers.

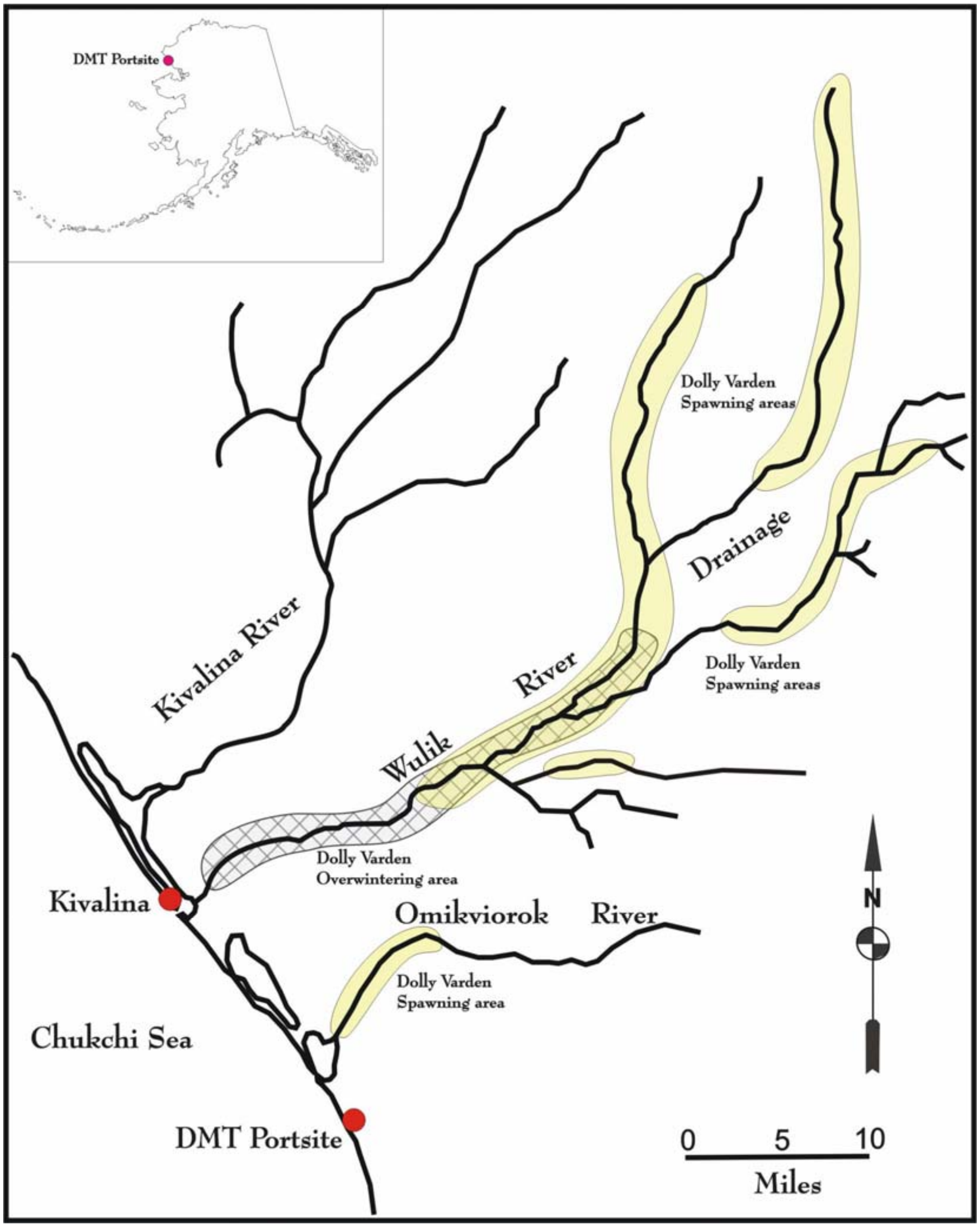

Figure 12: *The general overwintering and spawning areas for anadromous Dolly Varden in the Wulik River and Omikviorok River drainages (adapted from EPA-DI, 1984, and DeCicco 1996).*

Pacific Salmon. Kivalina and Ipiavik lagoons near Portsite have runs of anadromous salmon (Dames and Moore 1983, Blaylock and Houghton 1983). As adults, Pacific salmon use the lagoons for passage to upriver spawning grounds. As juveniles, they use the lagoons as passages to the sea where they acclimate to salt water before the marine transition. Juvenile Chinook and coho salmon also sometimes use the lagoons for wintering or rearing before migrating to sea. Other than the occasional stray, Pacific salmon are not found in Agarak or Rabbit Creeks south of Portsite (W. Goodwin personal communication).

The most abundant species of Pacific salmon in the Kivalina and Ipiavik lagoons is pink salmon (Dames and Moore 1983), but other North American species of Pacific salmon, particularly chum salmon, are known to spawn in the Wulik River drainage as far upstream as lower Ikalukrok Creek (EPA-DI 1984, Scannell et al. 2000). Pink and chum salmon fry migrate to sea in large schools almost immediately after emergence and spend little time in freshwater. Chinook, coho, and sockeye salmon sometimes spend from 1 to 3 years in fresh water, and then migrate to sea as smolt similar in size to Dolly Varden smolt. All Pacific salmon gain most of their size and weight feeding at sea before returning to spawn, but unlike Dolly Varden that overwinter in freshwater, Pacific salmon deteriorate rapidly after entering freshwater and die soon after spawning.

Whitefish. Whitefish are also present in the Wulik River drainage. Species of whitefish in the Portsite area include least cisco, Bering cisco, round whitefish, broad whitefish, and humpback whitefish (Morrow 1980). Whitefish are relatively abundant in Kivalina Lagoon and the lower Wulik River.

Smelt. There are at least three species of anadromous smelt in Alaska: longfin smelt, rainbow smelt, and eulachon. These smelt enter freshwater in early spring to spawn in the lower reaches of rivers and even in brackish lagoons. Rainbow smelt are found in Kivalina and Ipiavik lagoons.

There is a small, local chum salmon fishery based in Kotzebue. No other anadromous fish are harvested commercially in U.S. waters of the Chukchi Sea and there is no commercial harvest near Portsite. Most of the anadromous fish species in the region are harvested for personal use, primarily from the streams, coastal lagoons, and estuaries. There is no personal use harvest of anadromous fish at or within several miles of Portsite. Anadromous fish are eaten by other fish, beluga whales, and seals. They also are critical to stream ecology because they are sources of organic material that form the foundation of food webs in those systems.

There are no identified marine critical habitats for anadromous fish in the Chukchi Sea. Many anadromous fish require or at least benefit from estuarine habitat where they can become physiologically prepared to enter or leave salt water. Juveniles of most anadromous species may remain near shore for a period when they first enter salt water, so near-shore habitat along the coast may warrant particular attention to minimize activities that might adversely affect those juveniles. Smelt were occasionally collected in the ZSF, but other anadromous fish were absent or rare in ZSF collections.

5.4.4 Marine Mammals

The marine mammals with ranges or migration patterns within the general Portsite area are summarized in Table 8. Although included in the table, the Pacific right whale, narwhal, sei whale, little piked whale, finback whale, orca whale, harbor porpoise, minke whale, fur seal, ribbon seal, and spotted seal are rarely or never observed in the Portsite area.

Table 8

Whales and Porpoises	Seals and Walrus	Bear
Minke whale	Bearded seal	Polar bear
Sei whale	Ringed seal	
Little piked whale	Ribbon seal	
Humpback whale	Spotted seal	
Bowhead whale	Fur seal	
Finback whale	Pacific walrus	
Right whale		
Gray whale		
Beluga whale		
Orca whale		
Harbor porpoise		
Narwhal		

Several marine mammals were identified as important during the EIS scoping process or as likely to be in areas that might be directly affected by the expansion of the Portsite loading facilities. These species are bearded seal, beluga whale, bowhead whale, Pacific walrus, polar bear, ringed seal, and gray whale. Information about the distribution, life history, and major environmental influences on these species is presented in the DMT draft EIS (Section 3.5.4.1) and is summarized below.

Bearded Seal. Most of the eastern Chukchi Sea bearded seal population follows sea ice and their local density changes with the ice conditions, although a few may be present at anytime of the year. Most bearded seals arrive near Kivalina and Portsite with the advancing ice pack in late fall, move south with the ice, reappear as the edge of the ice pack moves north in spring, and then leave with the retreating ice pack in early summer. During intensive surveys from the DMT loader at Portsite in 2000, a few bearded seals were seen in mid April, but it was late May before numbers grew appreciably. Numbers peaked in mid June. This timing is typical of bearded seal northward migration in the eastern Chukchi Sea.

Bearded seals typically remain several miles off shore, at or beyond the zone where pack ice meets shorefast ice, but they may move or be carried closer as the icepack breaks up in June. In the 2000 survey, bearded seals were not observed within 1 mile of Portsite until mid June and were typically 3 or more miles offshore during the spring migration. Observations from the DMT loader platform and aerial surveys during the same period in 2000 did not distinguish any difference between abundance or distribution of bearded seal offshore from Portsite or offshore farther north or south. The aerial survey did show that bearded seals typically were sparsely distributed on ice within 3 miles from shore and that abundance was greater along transects 5 to 25 miles off shore all along the coast.

Bearded seals feed on shrimp, crabs, other invertebrates and fish (DMT draft EIS, Section 3.5.4.1). Their diet changes seasonally, presumably in response to changes in food availability. The most important habitat to bearded seals in the eastern Chukchi Sea seems to be associated faults, fractures, and leads in the southern edge of the Arctic ice pack, rather than any particular locations over the sea bottom. No areas of the southeastern Chukchi Sea have been identified as critical habitat for bearded seals, but areas where leads form in the ice pack each spring may have particular value if they are in deep enough water. Hunters from Kivalina also noted that the marine waters off Rabbit Creek, south of Portsite, may be unusually valuable habitat for bearded seals during the spring migration.

Beluga Whales. Beluga whales are Arctic and subarctic in range. Five distinct stocks of beluga whales have been identified in Alaska waters (Hill and DeMaster 1999). Two of the five stocks in Alaska waters – the Beaufort Sea stock and the Eastern Chukchi Sea stock – travel north through the central and eastern Chukchi Sea during their spring and fall migrations. They summer in the Beaufort Sea and northward into the Arctic ice pack, although they sometimes are seen in the eastern Chukchi Sea during the summer.

Belugas eat a variety of fish and invertebrates, indicating that they adapt to local and seasonal food availability. Areas where belugas preferentially gather to feed, birth, nurse their young, and shed skin or molt may be of special importance to belugas. Belugas are known to gather seasonally in parts of Kotzebue Sound to calve and molt, in Kasegaluk Lagoon near Point Lay to calve and nurse, and in other locations near Point Lay and Icy Cape where they feed in the summer. The leads through the Arctic ice pack that belugas follow in the spring are important in beluga northward migration, but are variable in location. There are no sites or areas of identified special importance in the Portsite area or along the adjacent coastline between Kotzebue Sound, more than 50 miles south of Portsite, and Point Hope, more than 70 miles north of Portsite.

Bowhead Whales. An estimated 50,000 bowhead whales once ranged over Arctic seas in two main stocks: the eastern and western Arctic stocks, with more than 30,000 in the eastern stock.

The Bering Sea and Chukchi Sea stock, which once numbered about 18,000 whales, was greatly reduced during the late 1800 and early 1900's (Carroll 1994, Fraker 1984), and is likely extinct because bowheads no longer summer in the Bering and Chukchi seas. The current stock, the western Arctic stock (Hill and DeMaster 1999), summers in the eastern Beaufort Sea and winters in the Bering Sea, and has a minimum population of about 7,738 whales. The western Arctic stock of bowhead whales increased at an estimated rate of 3.2 percent during a 1978-1993 survey period.

Bowhead whales winter in the Bering Sea south of Saint Lawrence Island and in the Gulf of Anadyr, and begin to migrate north through the Bering Strait along leads in early spring. The majority of the population migrates offshore, out of the range of subsistence hunters, but some bowheads follow leads that form comparatively close inshore, including those that sometimes form near Portsite. The spring and fall migration of bowhead whales in the eastern Chukchi Sea is well outside the July through September shipping season at Portsite.

Summer feeding grounds in the Beaufort Sea and wintering grounds in the Bering Sea are habitat of particular importance to bowhead whales. Whale hunters on the coast of the Chukchi and Beaufort Seas north of Portsite consider the spring migratory pathways through the offshore icepack to be habitat of particular importance and worry that offshore activities might affect bowhead migration and habitat use farther north.

Walrus. A 1990 population estimate for the Pacific walrus was 201,000 animals, but recent calf-to-cow ratios suggest the population is in decline (Kelly and Taras 2000).

Most Pacific walrus spend the winter in the Bering Sea then migrate north with the receding ice pack in the spring. They generally migrate far offshore from Portsite, but in some years, currents and wind can bring drifting ice and their migration route closer to shore. In the fall, walrus migrate south through the Bering Strait along the edge of the advancing ice pack.

Critical and important habitat for Pacific walrus is predominantly associated with the relatively few land masses used as haulouts and the principal feeding areas. In the Chukchi Sea, rich benthic habitat offshore from the Siberian coast is the only identified habitat of particular importance. There are no walrus habitats of special importance in the southeastern Chukchi Sea. The ZSF is not used by walrus except that they may occasionally pass through the western waters of the ZSF during spring migrations.

Polar Bear. Polar bears are more abundant near coastlines and the southern edges of sea ice than on the central Arctic ice pack. During winter, many polar bears of the Chukchi Sea stock are found in the northern Bering Sea where they sometimes venture as far south as the Kuskokwim Delta on the eastern side. Most, however, go only as far south as Saint Mathew Island (Kalxdorff 1997). Some polar bears also winter along coastal areas farther north in the Chukchi Sea where there are concentrations of seals and marine mammal carcasses (Kalxdorff 1998). In the spring most polar bears that winter in the northern Bering Sea follow the ringed seals and receding ice north through the Bering Straits and Chukchi Sea.

Polar bears are known to make infrequent feeding excursions up the Wulik River, and are occasionally present in the Portsite area during winter. Kalxdorff (1997) reported two observations of polar bears (1974 and 1992), and two were reported during marine mammal counts in the spring of 2000. They are reported as frequent visitors to the Kivalina dump and have been seen at Portsite. There is no traditional knowledge of polar bears denning on land at Portsite, although there is traditional knowledge of polar bears denning on the offshore pack ice. No areas have been designated as critical habitat for polar bears on the Alaska coast or in the seas off Alaska. There are areas where polar bears are especially abundant during particular seasons. There also are areas where polar bears are known to den and give birth to cubs on land. There are no known on-land denning habitats or areas where polar bears are particularly abundant near Portsite or in the surrounding waters of the southeastern Chukchi Sea.

***Ringed Seal*.** There are no accurate population estimates of Arctic ringed seals, but they are believed to be the most abundant subspecies due to their widespread distribution. A very rough estimate of 2.3 to 7 million for all subspecies was made in the late 1980's, with 1 to 1.5 million in Alaska waters (Hill and DeMaster 1999, SCS 2000).

Ringed seals are in the Portsite area during the months when ice cover is present. They generally reside closer to shore than most other seals for most of the winter and spring and are more abundant near shore than the larger bearded seals. Ringed seals typically arrive in the Portsite area with the advancing ice pack in late fall, and leave with the retreating ice pack in early summer. They are most abundant in the late spring as they follow the retreating Arctic ice pack northward. They are not common in the ZSF or near Portsite during shipping and loading operations.

Ringed seals eat a variety of fish and invertebrates, with fish forming a larger percentage in their diets than in the diets of bearded seals, the only other seal common in the general Portsite area. Ringed seals are abundant and widely distributed in the coastal waters of the southeastern Chukchi Sea. There are no designated critical habitats or habitats of special importance to ringed seals in the Chukchi Sea, but they may be more abundant in some areas than in others. Some hunters of the region identified the area south between Kivalina and Cape Krusenstern as a reach of coastline where ringed seals are relatively abundant.

Gray Whale. The population size has been increasing over the last several decades and the abundance estimate from the 1997/1998 censuses was 26,635 whales.

Gray whales seasonally inhabit waters in near shore areas of Kotzebue Sound including waters near the Portsite and coastal waters of the Chukchi Sea north of 69° north latitude (USEPA et al. 1984). The southward migration appears to be along the western Chukchi Sea coast of Russia. Migratory movement patterns are broad, however, and they move through habitat throughout most of the Chukchi Sea. They are known to feed intensively where amphipods and other benthic invertebrates are particularly dense. There are no identified areas of critical importance or where usage is especially high in the southeastern Chukchi Sea.

5.4.5 Birds

Most species of birds found along the northwest coast of Alaska are seasonally present in the DMT area.

Gulls, sea ducks, cormorants, murres, and other seabirds are present in the waters off Portsite. They appear in the spring as leads develop in the ice pack and migrate south through coastal waters as the ice pack encroaches in the autumn. While they are present, they may feed, rest, and stage for migration. There have been no observations of particularly large concentrations of birds on or over the water near or offshore from Portsite. The closest seabird colonies are at Cape Thompson, more than 50 miles north of Portsite. Gulls, ducks, and other birds nest along the coast, but there are no notable nesting aggregations near Portsite.

5.5 Special Status Resources

The Corps consulted with the United States Fish and Wildlife Service (USFWS), the National Marine Fisheries Service (NMFS) and the State of Alaska regarding special-status species and habitats that could be affected by marine navigation improvements at the DMT Portsite. Correspondence related to that coordination is presented in appendix 4 of the DMT draft EIS.

5.5.1 Threatened and Endangered Species

Section 7 of the Endangered Species Act, (16 U.S.C. Section 1536(a)(2)) requires all federal agencies to consult with the National Marine Fisheries Service or the United States Fish and Wildlife Services as appropriate if they are proposing an "action" that may affect species listed as threatened or endangered under the Act, or their designated habitat. Section 7 consultation with the appropriate federal agency is intended to ensure that actions proposed by federal agencies do not jeopardize listed species or destroy or adversely affect critical habitat. Section 7 applies to management of federal lands as well as other federal actions that may affect listed species, such as federal approval of private activities through the issuance of federal permits, licenses, or other actions.

Consultation with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service to determine the presence of species listed under the Endangered Species Act, as amended, is documented in appendix 4 of the DMT draft EIS.

Plants. Plant species listed as endangered or threatened by the U.S. Fish and Wildlife Service are not known to inhabit the DMT project site or adjoining areas (USEPA 1984, AKNHP 2000).

Birds. Two species of threatened sea ducks, Steller’s eider and spectacled eider, occur in the Portsite area.

The spectacled eider is a threatened sea duck that in Alaska nests on coastal Arctic tundra north of Cape Lisburne and winters in the Bering Sea south of Saint Lawrence Island. Spectacled eiders do not nest in the Portsite area, but likely migrate through the area and may molt in adjacent marine waters (USFWS 1999). Confirmed molting areas for the species are in Ledyard Bay north of Cape Lisburne and in the Bering Sea’s eastern Norton Sound. Spectacled eiders, like many other species of northern sea ducks, tend to migrate along offshore leads where they fly as low as 100 feet or less. Dames and Moore (1983) reported small numbers of spectacled eiders migrating north through the Kivalina area during the spring of 1982. Small numbers of spectacled eiders were also found in lagoons north of Kivalina Lagoon during the summer (Erikson 1983).

The U. S. Fish and Wildlife Service does not list the area around the Portsite as critical or nesting habitat for spectacled eiders, but areas used by non-breeding spectacled eiders is not well known (USFWS 1999). Non-breeding spectacled eiders are believed to scatter in small flocks of less than a few hundred birds throughout their coastal range, and the small numbers of eiders noted by Erikson (1983) were likely composed of non-breeders.

A second species of threatened sea duck, the Steller’s eider, also sometimes migrates through the Portsite area. The Portsite area is not designated as critical habitat, and like the spectacled eider, the Steller’s eider generally migrates along offshore leads. Only the Alaska nesting population of Steller’s eiders is threatened, and Steller’s eiders do not nest in the Portsite area.

Steller’s eiders molt and winter in areas of the Bering Sea and North Pacific Ocean, and the southward migration route is thought to be far offshore of Portsite. Steller’s eiders, however, may occasionally come inshore on their southward migration as indicated by a

Steller's eider that was fitted with a satellite tag near Barrow, Alaska, and tracked to a coastal location about 50 miles northwest of Portsite during August 2000 (P. Martin, personal communication).

Consultation determined that structures required for the tentatively recommended alternative could cause a taking of both threatened species, but would not jeopardize existence of the species. The U.S. Fish and Wildlife Service biological opinion did not cite dredging or disposal of dredged material as a potential source of a taking.

Marine Mammals. The only threatened or endangered mammal known to be in the Portsite area on recurring basis is the bowhead whale. The range of finback whale includes the western Chukchi Sea, and they could be present far offshore of Portsite on rare occasions. Iñupiaq Natives of the northwest Alaska coast hunt the bowhead whale for subsistence and have seen what they believed were finback whales in the past (W. Adams Sr. personal communication). Informal consultation with the National Marine Fisheries Service determined that the tentatively preferred action would not cause a "take" of bowhead whale and that further consultation was not required (appendix 4, DMT draft EIS).

Terrestrial Mammals. There are no known threatened or endangered species of terrestrial mammals in the Portsite region.

Fish. There are no known threatened or endangered species of fish in the Portsite region.

5.5.2 Essential Fish Habitat

The 1996 reauthorization of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) amendments mandate that Federal agencies assess the effects of Federal projects on essential fish habitat (EFH) and consult with the Department of Commerce (50 CFR 600.905-930). Essential fish habitat is defined as waters and substrate necessary to commercial fish for spawning, breeding, feeding, or growth to maturity. Fish habitats also include near-shore marine, intertidal, and submerged and emergent vegetation that provide feeding, spawning, and rearing habitat for diverse assemblages of fishes that include commercially important species.

The National Marine Fisheries Service has developed an EFH online database of fish species in Alaska waters that includes five species of North American salmon, selected species of forage fish including rainbow smelt and herring, selected species of groundfish, and three species of king crab (NOAA 2002). All species listed as requiring EFH are of commercial fisheries value. This online database was consulted to identify EFH in the area surrounding Portsite and Kivalina. Although several species requiring EFH in other areas of Alaska are known to be present near Portsite during some stage of their life histories, only salmon are listed in the database as requiring EFH near Portsite.

Marine waters, lagoons, and spawning and rearing rivers known to have runs of Pacific salmon are considered EFH. Adult Pacific salmon use marine waters for feeding and migration corridors. They also use the lagoons for staging and passage to the upriver spawning grounds. Adults use the rivers and creeks for spawning. Juveniles use the rivers, creeks, and lagoons for rearing, and the lagoons for acclimatization to marine waters when smolting.

Of the drainages near the DMT, only those that have runs of salmon are EFH. The Wulik River, about 15 miles up the coast from the DMT, is the most important EFH river in the area. Five species of Pacific salmon return to the Wulik River to spawn. The Wulik River and nearby Kivalina Lagoon are also important to juvenile salmon for rearing and acclimatization to marine waters.

Other EFH freshwaters close to Portsite are the Omikviorok River and Ipiavik Lagoon. The Omikviorok River is a small drainage that has a small run of chum salmon and a few pink salmon. The juveniles of these species also use Ipiavik Lagoon for transition to marine waters during the spring.

5.5.3 State Listed Species of Concern

The Alaska Department of Fish and Game (ADFG), the Alaska Natural Heritage Program (AKNHP) and the U.S. Geological Service Biological Research Division (USGS-BRD) maintain lists of species of special concern. Although not required under NEPA, the Corps consulted those lists to determine which species are known to be or are likely to be present in the Portsite area.

Species of concern to the state that are known to be seasonally present in the Portsite area include spectacled and Steller's eiders, oldsquaw duck, common eider, black scoter, and king eider (AKNHP 2000). Declining trends in population size have been detected among these species and are the principal reason for state concern. Reasons for declining numbers of the listed species vary and include pollution, habitat loss, and lead-shot poisoning. During the Corps' spring and summer 2000 wildlife surveys, oldsquaw ducks, common eiders, and black scoters were noted to be relatively common in the Portsite area, but king eiders were not observed. These listed waterfowl may occasionally use offshore waters of the southeastern Chukchi Sea, including the ZSF, but none of those waters are critical habitat for any species listed by Alaska.

Other state species of concern that may range into the area include the gray-cheeked thrush, black poll warbler, and Arctic peregrine falcon. The gray-cheeked thrush is reported to be an occasional visitor, and the black poll warbler is reported as a rare visitor to the Cape Krusenstern National Monument south of the DMT Portsite (NPS 1996). During the spring and summer 2000 wildlife survey, peregrine falcons were occasionally seen along the DMTS road to the east of Portsite, but not at the DMT.

The State of Alaska's rare plant list (AKNHP 2000) was consulted, and the ranges of the listed plants were checked in Hulten's *Flora of Alaska and Neighboring Territories* (Hulten 1974), and in the *Alaska Rare Plant Field Guide* (Lipkin and Murray 1997) to identify rare plants that might be found in the Portsite area. The U.S. Fish and Wildlife Service, National Park Service, Bureau of Land Management, and U.S. Forest Service were also consulted as to distribution of these plants. Although local populations of three rare plants (Muir's fleabane, Barneby's locoweed, and Kobuk locoweed) are reported in several areas of northwest Alaska, none are reported in the Portsite area (AKNHP 2000), and none were found during the summer 2000 biological survey at Portsite.

5.5.4 Cultural Resources

There are two documented cultural sites onshore near Portsite (Section 3.6 of the draft EIS). No cultural or historic sites are known in offshore waters. No historic shipwrecks are known to exist near Portsite.

5.6 Physical and Environmental Processes

A summary of physical environmental processes and conditions and background information relevent to the dredging and material disposal actions associated with the DMT project are provided below. More detailed information is presented in the DMT draft EIS and/or its appendices.

5.6.1 Meteorological Conditions

The DMT Portsite is in a transitional climate zone characterized by long, cold winters and cool summers. The average low temperature during January is -15 ˚F; the average high during July is 57 ˚F. Temperature extremes have been measured from -54 ˚F to 85 ˚F. Precipitation includes averages of 8.6 inches of rain, and 57 inches of snow per year. The snowmelt period is short and ends abruptly.

Fog is most frequent during May (10 days), June (11 days), July (9 days), August (9 days), September (6 days), and October (6 days). Fog is most dense in the morning hours but can last all day. It has occasionally lasted for several days. In July and August, visibilities drop below 2 miles up to 25 percent of the time in the Bering Strait and Chukchi Sea. Winds at Portsite during winter are generally from the west, while winds during the shipping season are typically from the west and northwest.

5.6.2 Geology

The entire sea bottom off Portsite is gently sloping with large areas of sand/silt interspersed with sand areas and sand/gravel areas. The coarser gravel areas are concentrated near shore in water less than 45 feet deep.

The upper sediment layer generally consists of fine-grained soils that vary from firm to very hard in consistency and sandy soils that are typically of medium density. Occasionally, organic soil layers and lenses of peat have been encountered. Data from boreholes indicate that the subsurface materials are composed of a layer of sand/silt/gravel/clay materials (from 10 to 25 feet thick) overlying a denser layer of sand/gravel (from 10 to 100 feet or more thick) and a basement material of sandstone bedrock.

The deeper sand/gravel materials protruded near the surface at sporadic locations in the area surveyed. Geological evidence indicates that the sand/gravel materials may be alluvial deposits. The submerged gravel and coarse sands may be remnant gravel beaches.

The bedrock surface in the project vicinity varies from north to south and east to west. Bedrock is 39 feet below the seabed near shore and 90 feet below the seabed at the 40 to 45-foot depth contour. Beyond this water depth, bedrock was not detected with the equipment used.

Bedrock coring indicates that the upper several feet of bedrock is weathered and that the material becomes more competent with depth. Bedrock material was homogenous, and described as either lavender sandstone or gray sandstone. The locations of the soil borings and a description of the soil are included in the Geotechnical Appendix.

5.6.3 Oceanography

The Chukchi Sea is a shallow sea that is, in some ways, more like the main body of the Arctic Ocean to the north than the Bering Sea to the south. Oceanographic conditions that might affect or be affected by a project at DMT are discussed in greater detail in the Hydraulic Design Appendix to the DMT Feasibility Report, and the draft EIS, respectively. Material from those documents were used to generate the following summary of oceanographic conditions that are relevant to the selection of an appropriate ODMDS.

The Chukchi Sea is virtually ice covered and without wave action for about 7 months of each year. The lack of wave action results in greatly reduced sediment transport, less suspended solids, and greatly increased water clarity. However, the presence of ice greatly reduces light penetration and photosynthesis, which significantly reduces marine habitat productivity. Ice gouging and scraping of the sea bottom also limits near-shore colonization by perennial plants and animals.

The embayed southeastern Chukchi Sea is predominantly a flat, featureless plain with gradients rarely greater than 4 feet per mile and a maximum depth of 210 feet. The beach at DMT Portsite drops steeply to about 10 feet deep, and then the sea floor slopes gently southwestward to a depth of only about 50 feet at 3 miles and about 60 feet at 5 miles offshore. Beyond this point, the seafloor slopes gently over the Chukchi shelf to the edge of the Hope Basin about 31 miles from shore. The bathymetric characteristics and sediment composition are homogenous throughout the ZSF.

The existing DMT facilities have slightly altered the local bathometry. Water is a few feet deeper just off the dock face where tugs tie up and near where the lightering barges are loaded with concentrate. Movement of the barges and turbulence from tugboat props probably displace some of the bottom material at both locations.

Waves, tides, and currents influencing the DMT Portsite area occur mostly during the open water season, which runs from about July through October. Waves in the DMT area are mainly generated by wind. The wave climate can be complex because of the variable winds in seas far from the site. The 16-year (1985-2000) average mean wave heights for July, August, September, and October are 1.4 feet, 1.9 feet, 2.4 feet, and 2.6 feet, respectively. The average maximum wave heights over the same 16 years period for July, August, September, and October are 6.1 feet., 7.9 feet., 7.7 feet., and 10.1 feet, respectively. Fast moving weather systems of short duration in the Chukchi Sea generate most of the storms that influence waves at the DMT. The larger storms (with wave heights greater than 6.7 feet) typically last between 24 and 48 hours. The largest storm of record occurred in November 1970. Waves peaked at 29.5 feet with a 12 to 13-second period. Waves of 19.7 feet from that storm were sustained for over 14 hours, and 13-foot waves were sustained for over 20 hours.

Tides in the Portsite area are bi-diurnal with two high tides and two low tides in each 24-hour period. Tidal characteristics at DMT Portsite are similar to those at NOAA Station 949-1253 at Kivalina Corwin Lagoon entrance. Table 9 presents a summary of NOAA data collected between October 1, 1985 and September 30, 1986.

Table 9
Tidal Characteristics (Kivalina Corwin Lagoon)

Item	Elevation (ft)
Highest Observed Water Level (11/10/1985)	4.16
Mean Higher High Water (MHHW)	0.90
Mean High Water (MHW)	0.77
Mean Sea Level (MSL)	0.43
Mean Low Water (MLW)	0.10
Mean Lower Low Water (MLLW)	0.00
Lowest Observed Water Level (12/19/1985)	-3.12

Marine currents in the Portsite area are of two general types: offshore and near shore. Offshore currents in the Chukchi Sea can move both vertically and horizontally as temperature and salinity change, whereas near-shore currents generally move horizontally. Near-shore current patterns and velocities are complex and variable in the DMT area.

Based on existing data, near-shore currents in the DMT area are primarily wind generated during the open water season and predominantly flow parallel to the coast. According data collected between 1998 and 2000, northward-flowing currents were recorded as occurring approximately 70 to 75 percent of the time, while southward-flowing currents occurred about 25 to 30 percent of the time. The seasonal mean northbound current during the hypothetical year was 0.36 miles/hour, while the seasonal mean southbound current was 0.25 miles/hour. Peak measured currents flowing north during the open-water period generally were higher than peak currents flowing to the south. The highest recorded northbound current in the upper portion of the water column, where velocities tended to be greatest, was 2.5 mph. The highest recorded current flowing to the south, also measured in the upper part of the water column, was approximately 1 mph. During winter, currents are generally weak, with flows less than 0.2 mph for more than 90 percent of the time.

Based on the data obtained from several studies and model predictions, the net transport of near-shore sediment is to the south. The majority of sediment movement appears to occur during storm events. These results and predictions are supported by the accretion of material along the north side of the shallow-water dock that was constructed at the DMT in 1986.

5.6.4 Marine Water Quality

Marine water quality in the DMT area is generally good. Turbidity is the parameter that is most likely to be impacted by activities associated with the proposed project. Increased turbidity in the water near Portsite is caused by the presence of suspended sediment, organic matter, plankton, and other microscopic organisms. This turbidity is a natural occurrence and is generally cyclical in nature. The highest turbidity levels occur during the open water season, and fluctuate with the frequency and intensity of storms that stir the coastal waters in the area. Generally, the newly ice-covered waters begin to clear in early winter as wave action and light penetration are gradually reduced. Relatively clear water prevails during winter, with occasional increases from near-shore ice gouging and offshore feeding by bearded seals. By late April, the water becomes increasingly turbid from massive blooms of diatoms and other microscopic single-cell algae that mostly cling to the undersurface of the ice where light penetration is greatest. These large algal blooms attract large numbers of zooplankton such as microscopic copepods, as well as larger shrimp-like euphausiids or krill. Turbidity increases further when, during spring breakup, turbid coastal streams, swollen with melting snow, fill local lagoons, overtop their beach berms, and run into the southeastern Chukchi Sea. After the melting marine ice leaves the Portsite area in early summer, shallow areas and beaches are subjected to wave action, further increasing turbidity. The generally highly turbid conditions prevail through the summer months until fresh and marine water begin to freeze, locking freshwater runoff in ice, calming the marine waters, and limiting algal growth.

The Corps measured turbidity and other water quality parameters (pH, temperature, TDS/salinity, specific conductance, and oxidation/reduction potential), at several near-shore and offshore locations on September 11 and 12, 2001. Turbidity results approximately 5 to 6 miles offshore ranged from 1.0 to 5.1 Nephelometric Turbidity Units (NTU), while turbidity near the shipping channel ranged from 7.2-16.9 NTU. Turbidity generally decreased with depth and distance from shore. The pH of near-shore and offshore water samples ranged from 7.8 to 8.1. The average water temperature measured near the DMT ranged from near 0 degrees C during most of the winter to 9.9 degrees C offshore in September 2001. Specific conductance ranged from 44.0 to 49.1 mS/cm, and salinity results ranged from 2.82 percent to 3.18 percent. Oxidation/reduction potential (ORP) results ranged from 146 mV to 227 mV. Specific conductivity, salinity, and ORP results were generally higher offshore than near shore. Samples for laboratory analysis to determine total suspended solids (TSS) concentrations were also collected. TSS concentrations ranged from 5.8 to 13.4 mg/L, and averaged 9.2 mg/L in the offshore samples, compared with a range of 8.8 to 74.8 mg/L and an average of 19.7 mg/L in the near-shore samples.

5.6.5 Seabed Characteristics

The surface layer of bottom material generally consists of fine-grained material that varies from a firm to very hard consistency and sandy material that is typically of medium density. The results of the subsurface investigations indicate that the deeper soils typically consist of more sandy and gravelly soils over deeper layers of predominantly silt and clay soils at some locations. Occasionally, organic soil layers and lenses of peat were encountered in the samples. It was also noted in the survey that in some locations deeper sand/gravel materials came to the surface of the sea bottom. Geological evidence suggests that the sand/gravel materials might be alluvial deposits or remnant gravel beaches. The seabed in the ZSF has not been altered by human activity.

5.7 Current Uses of the ZSF

5.7.1 Subsistence Use

Dr. Stephen Braund conducted interviews with subsistence hunters and fishers at Kivalina in 1999. The subsistence users were asked what areas they use and about the movements and locations of the species they pursue. Dr. Braund transferred verbal information he collected to maps (section 3.3 of the EIS). The information supplied in these maps may be modified by public comments during public review. The maps indicate the migratory routes of subsistence species and areas customarily hunted for marine mammals. Alaska Natives hunt bowhead and beluga whales, bearded and ringed seal, and occasionally walrus and polar bear in waters off the coast of the southeastern Chukchi Sea. The ZSF is in waters that are hunted for those marine mammals. Hunting is typically from the ice or from boats as the ice pack is receding north in the late spring or early summer. Marine mammals are not hunted with any regularity in the ZSF during the periods when dredging or disposal would be conducted, but they are hunted in areas over sea bottom that would be modified by disposal of dredged material.

5.7.2 Commercial and Recreational Use

There are commercial and subsistence/recreational fisheries in the Chukchi Sea, but none in the waters offshore of Portsite. Research indicates that the stocks are insufficient to support substantial commercial fisheries (BSFS 2001). Vessel traffic in this portion of the Chukchi Sea is limited to activities associated with the DMT and barge traffic that services communities along the Chukchi and Beaufort Seas. The number of barges is small, with only a few visits per year to the communities. The tug and barge vessels and the commercial ships that load and transport mineral products at the DMT make up the majority of large vessels present in the area. The bulk carriers that transport the concentrate require a minimum of 45 feet of water to navigate. Large loaded fuel tankers and coastal barges require about 40 feet and 20 feet of water, respectively, to navigate safely.

5.8 Unique, Sensitive or Incompatible Areas

No unique or especially sensitive areas were identified within the ZSF.

5.9 Identification of Candidate Sites

Based on a total maximum lift thickness limit of 5 feet, target maximum elevation limit of –57 feet MLLW, and the need to limit the aerial extent of the dispersed material to predefined boundaries, an ocean-disposal site would need to be about 5,600 acres. If the estimated 9.3 million cubic yards of material from the initial construction and first maintenance dredging were evenly distributed over the entire site, the lift thickness would be about 1 foot. However, the material would not be evenly distributed over the entire site.

Approximately 3,000 disposal actions from a hopper dredge, barge or scow would likely be performed over a period of about 3 construction seasons. Overall, the relative compositions of gravel, sand, and fines that would be dredged for initial construction is estimated to be about 6 percent, 25 percent, and 69 percent, respectively. Based on the relatively large number of disposal events and the fact that the proposed dredged material is primarily composed of fines, the overall distribution of material would be relatively uniform over the majority of the receiving seafloor. However, for individual disposal actions, distribution would depend on the composition of the dredged material, depth of water, and the equipment used to dredge and dump it. Because particle size and density are the primary factors that determine particle settlement rates, gravel would be dispersed over a smaller area than sand and sand would be dispersed over a smaller area than the fines. However, material dredged in a manner that maintains its in-situ structure and density would be dispersed over a smaller area than material dredged using a method that separates the material and entrains enough water to pump it. If all other factors were equal, material from a large capacity vessel would generally be dispersed over a smaller area than the same amount of material dumped from two or more smaller vessels.

To contain the material within the site boundaries, no direct placement of material along the margins of the site would be allowed. Based on the composition of the material, anticipated currents, and the general types of equipment expected to be used, the material from a single dump from a large moving hopper dredge containing 4,600 cubic yards of typical bottom material would probably be deposited in mounds 1 to 3 feet high containing most of the fines and nearly all the sand and gravel portions and covering up to about 2 acres. Beyond the primary mound, a relatively small amount of finer material would be dispersed in a gradually thinning layer down current. Material from clamshell dredges dumped from smaller barges or scows would typically be deposited in mounds of similar height but would cover a smaller area. To maintain the maximum lift thickness and elevation limits, care would be exercised to avoid placing multiple loads at precisely the same location. Information from current gauges that could be deployed near the disposal site could be combined with Global Positioning System (GPS) data associated with individual disposal events and bathymetry data obtained during construction. This combined data could be used to track deposition, prevent the creation of large mounds of material, and confine the primary turbidity plume within the boundaries of the disposal site.

Up to about 2,000 acres of seafloor would likely be covered with 1 foot or more of dredged material annually during construction. A total of about 2,500 to 3,500 acres within the 5,600-acre site would be covered with 1 to 5 feet of dredged material from initial construction work. Due to predominant northward currents, most dredged material would be deposited in the southern and central segments of the site. Depending on the equipment and processes utilized, about 1,500 to 2,500 additional acres of seafloor within the site would be covered with less than 1 foot of dredged material consisting primarily of fines transported by currents.

Alternative sites sizes were evaluated. However, if a site significantly smaller than 5,600 acres was used, it would become burdensome to track disposal and deposition locations and coordinate future disposal actions while attempting to precisely anticipate the impacts of changing currents. It would also increase the likelihood of material being accidentally deposited outside the boundaries of the site and could complicate future site monitoring efforts. A significantly larger site would be easier to use but would extend the impacts over an unnecessarily large area without generating corresponding positive effects.

Initial screening within the ZSF identified four 5,600-acre ocean-disposal sites as candidates for detailed evaluation. Each site is approximately 2 miles wide and 4.3 miles long and orientated parallel to predominant currents. The sites are illustrated in figure 13 and include: (1) a site about 5 to 8 miles offshore and about 5 to 10 miles north of Portsite, (2) a site about 5 to 7 miles directly offshore of Portsite, (3) a site about 18 to 20 miles directly offshore of Portsite and (4) a site about 30 to 32 miles directly offshore of Portsite. The uniformity of the Eastern Chukchi Sea and the lack of identifiable features near Portsite make the process of identifying candidate sites within the ZSF appear somewhat arbitrary. Without significant differences in use, physical characteristics, habitat or productivity, candidate sites were identified primarily based on their locations relative to the project. Site 1 was identified because of its location in minimum feasible water depths close to but north of the project. Site 2 was identified because of its proximity to the project. Sites 3 and 4 were identified to ensure locations throughout the ZSF were considered in the detailed site evaluation process.

The orientation of each site is dictated by the directions of predominant currents relative to its location. Sites 1 and 2 begin at approximately the –62 MLLW contour line and extend to about the –72 MLLW contour line. Depths at sites 3 and 4 range between –100 and –110 feet MLLW. No reasonable beneficial use alternatives were identified within the ZSF.

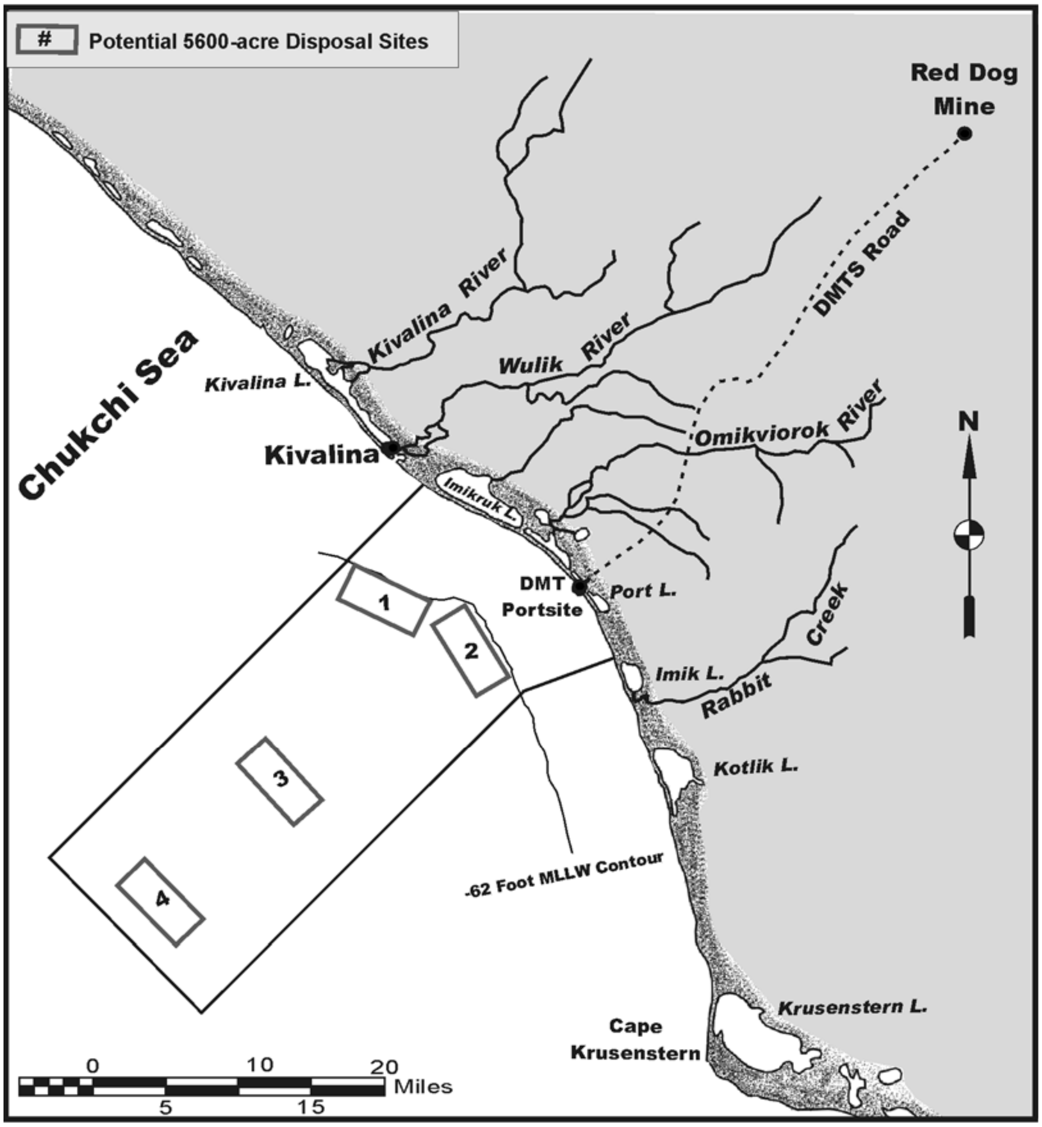

***figure 13**: Candidate Sites*

6. EVALUATION OF CANDIDATE SITES AND OTHER ALTERNATIVES

6.1 No-Action Alternative

The No-Action alternative, in this context, would be to not dispose of dredged material at an ODMDS. This would make the Trestle-Channel alternative infeasible and therefore reduce or eliminate the benefits that would be achieved by its construction.

6.2 Disposal off the Continental Shelf

The potential to dispose of the material off the continental shelf was not considered in detail because the continental shelf is more than 500 miles from the site.

6.3 Evaluation of Candidate Sites

The sites presented in figure 13 were initially identified as candidates for disposal site selection. To help select the most appropriate site, each site was individually screened by criteria using Candidate Site Evaluation Matrix Sheets. The criteria in the matrix sheets were developed through the identification of issues relevant to a variety of stakeholders that are associated with one or more of the five general or eleven specific criteria provided in 40 CFR 228.5 and 228.6, respectively, or any other criteria determined to be appropriate for the selection of an ODMDS for the DMT project. Following that evaluation, the selected site is compared with the five general and eleven specific criteria provided in 40 CFR 228.5 and 228.6 using detailed site specific information to verify its compliance with all applicable regulatory requirements.

All the sites would impact areas that have been historically used for subsistence hunting, and for migration and feeding by a variety of animals. However, most marine mammal subsistence hunting is on the ice or as the ice pack is receding northward, and most is within 15 miles of shore.

6.3.1 Candidate Site Evaluation Matrix

The Candidate Site Evaluation Matrix, presented below, allows general comparison of the candidate sites based on concerns relevant to the selection of an ODMDS for the DMT Navigation Improvements project. The general and specific criteria applicable to each concern are also identified. Additional details needed to identify small differences in site characteristics and the impacts their use may have are discussed in the text following the Candidate Site Evaluation Matrix.

Candidate Site Evaluation Matrix

Concern or Issue Considered	Anticipated Impact				Comments	Relevant Criteria	
	Site 1	Site 2	Site 3	Site 4		Specific Criteria (40 CFR 228.6)	General Criteria (40 CFR 228.5)
1. Unusual Topography/Unique Bottom Features	N	N	N	N		1,6,8,11	a
2. Physical Sediment Compatibility	N	N	N	N		3,4,9	b, c, d
3. Chemical Sediment Compatibility	N	N	N	N		3,4,7,9	a, b, c, d
4. Influence of Past Disposal	N	N	N	N		5, 7, 9, 10	a, b, d
5. Living Resources of Limited Distribution	N	N	N	N		2,3,6,8,11	a, b, d
6. Commercial Fisheries	N	N	N	N		2,8	a, b
7. Recreational or Subsistence Fish/Hunting	P	P	P	P	Subsistence Hunting	2,8	a, b
8. Breeding/Spawning Areas	N	N	N	N		2,8	a, b
9. Nursery Areas	N	N	N	N		2,8	a, b
10. Feeding Areas	P	P	P	P	Bearded Seal Ringed Seal	2,8	a, b
11. Migration Routes	P	P	P	P	Beluga Whale and other marine mammals	2,8	a, b
12. Critical habitat of Threatened or Endangered Species	N	N	N	N		2,8	a, b
13. Spatial Distribution of Benthos	N	N	N	N		2,8,10	a, b
14. Marine Mammals	P	P	P	P	Seals and Whales	2,8	a, b
15. Mineral Deposits	N	N	N	N		1,8	a, b, c
16. Navigational Hazards	N	N	N	N		1,8	a b, d
17. Other Uses (cables, pipelines, etc.)	N	N	N	N		8	a, b, d
18. Degraded Area	N	N	N	N		4,6,7	a b, d
19. Water Column Chem/Phys Characteristics & Effects	N	N	P	P	Deeper water would increase dispersion	4,6,9	a b, d
20. Recreational Uses	P	N	N	N	Potential near Kivalina	2,8,11	a, b, c, d
21. Cultural/Historic Sites	N	N	N	N		11	b
22. Physical Oceanography: Waves/Circulation	N	N	N	N		1,3,6,7	a b, d
23. Direction of Transport/Potential for Settlement	N	N	N	N		1,3,6,7	a b, d
24. Monitoring	N	N	N	N		5	c
25. Shape/size of Candidate Site	N	N	N	N		1,4,7	d
26. Size of Buffer Zone	N	N	N	N		2,3,4,7,11	b, d
27. Potential for Cumulative Effects	N	N	N	N		4,7	c, d
28. Distance from Dredging Area	P	N	C	C	Haul distance	1	d

C: Conflicts with a resource, use or issue.

P: Identified potential to conflict with a resource, use or issue.

N: No anticipated conflict with a resource, use or issue.

In general, the activity and noise generated by the use of a site farther from the dredging area would impact a larger area. Disposal in deeper water would increase the magnitude and extent, and prolong the existence of the turbidity plume by increasing segregation and dispersal of material in the water column.

The similarity of the results summarized in the Candidate Site Evaluation Matrix highlight the homogenous nature of the ZSF. However, subtle inconsistencies identify some minor differences between the sites. These differences relate primarily to the magnitude of potential conflicts and are related to the site's relative position in relation to Kivalina, the proposed dredging work, and the shipping activities associated with the DMT.

Site 1 is about 10 miles south of Kivalina and is the closest candidate site to the community where a large percentage of people who participate in recreational and subsistence related activities in the area reside. Because of its location and the predominant currents, disposal activities at Site 1 have the greatest potential to impact personal use activities. Although it is several miles to the south, Site 2 is the next closest candidate site to Kivalina. Sites 3 and 4 are the farthest from Kivalina but are in deeper water where the material would be more difficult to contain within the disposal site and water quality impacts would be greater.

Site 2 is closest to the existing DMT and near the location where bulk ships normally anchor for loading. It has the greatest potential to interfere with existing shipping activities, but only activities directly associated with the DMT. Because of adjustments to accommodate dredging operations and the lack of other traffic in the area, none of the candidate sites would be expected to impact existing shipping operations.

Site 2 is the closest to the dredging site and its use would contain vessel traffic and associated noise to an area similar in size and location to existing shipping activities. Use of Site 1 would shift much of the traffic and noise to the north, toward Kivalina. Use of Site 3 and Site 4 would distribute the vessel traffic and noise over a much larger area and could increase the potential to impact offshore marine mammal migration patterns.

Based on its lower direct impact to personal use and marine wildlife, its proximity to the area proposed to be dredged, and existing shipping, Site 2 was determined to be the most appropriate site for use as an ODMDS for the DMT navigation improvements project.

6.3.2 Application of Criteria to Site 2

The selection of an ODMDS is based primarily on the characteristics of the disposal site and its interactions with the surrounding environments. The selection and use of an ODMDS will be based on the federal government's evaluation of compliance with the five general criteria and eleven specific criteria listed in 40 CFR 228.

6.3.2.1 Specific Criteria for the Selection of ODMDS

The specific criteria for the selection of ODMDS can be found in 40 CFR 228.6. The specific criteria and a discussion related to site and project compliance with each criterion are presented below:

(1) *Geographical position, depth of water, bottom topography, and distance from coast:*

The proposed disposal site is illustrated in figure 14. It begins about 5 miles from shore and 2 miles from the outer limit of the proposed dredged channel in the Chukchi Sea. The disposal site is approximately 5,600 acres (8.75 square miles) with a depth ranging from about 62 to 75 feet. The bottom topography is typical of the nearly featureless, gently-sloping bottom of the majority of the eastern Chukchi Sea.

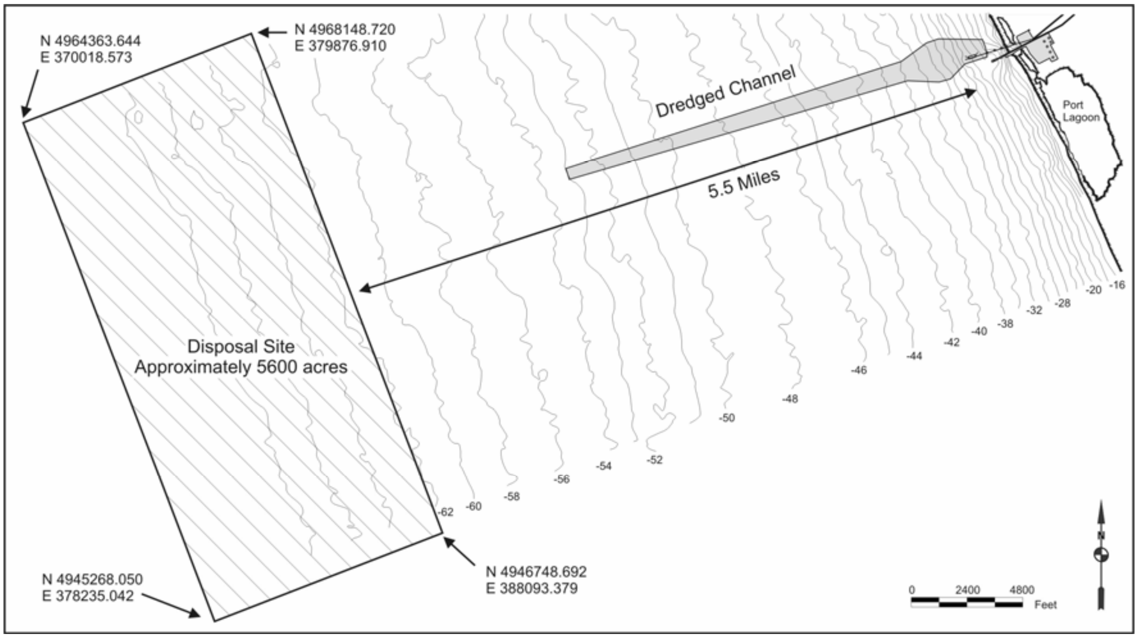

***Figure 14**: Site Proposed for use*

(2) Location in relation to breeding, spawning, nursery, feeding, or passage areas of living resources in adult or juvenile phases:

The proposed ODMDS was selected using economic, engineering, and environmental criteria. To ensure that a site was selected to minimize effects on living resources, literature searches on species life histories, chemical and physical sediment studies, benthic invertebrate studies, water movement and circulation studies, water column water quality studies, crab studies, fisheries studies, and subsistence studies were conducted. The information gathered from these studies helped to determine the location of the proposed disposal site. The proposed ODMDS is not located within or near any special breeding, spawning, nursery, feeding, or passage areas of adult or juvenile phase living resources. For additional in-depth discussion of the physical and biological environment, refer to the appropriate sections of the accompanying EIS.

(3) Location in relation to beaches and other amenity areas:

The area in the immediate vicinity of the DMT is almost completely undeveloped except for the facilities associated with the operation of the terminal. The site is approximately 5 to 7 miles offshore and significant movement of material, once placed, is not anticipated. No beaches or other amenity areas would be impacted by disposal activities at the site.

(4) Types and quantities of wastes proposed to be disposed of, and proposed methods of release, including methods of packing the waste, if any:

The only material expected to be placed in the proposed ocean disposal site originates from the proposed ship channel and turning basin. The overall composition of the total amount of dredged material is about 65 percent fines, 25 percent sand, and 10 percent gravel. Approximately 8.1 million cubic yards of ocean bottom sediments would be dredged during the initial effort to complete the channel and turning basin. Maintenance dredging efforts are expected to generate between 1.1 and 1.2 million cubic yards each. The Corps-selected site would also be used for the initial maintenance dredging effort approximately 5 years after construction. However, an EPA-designated site would likely be used for the subsequent maintenance dredging efforts anticipated to occur in post-construction years 17, 33 and 49. Without a compelling reason to select an upland or undisturbed ocean site, EPA may chose to designate all or a portion of the Corps-selected site for the remaining maintenance dredging efforts.

Standard methods of dredged material disposal, as described previously for scows and hopper dredges are anticipated. No packing or other treatment prior to disposal is anticipated.

(5) Feasibility of surveillance and monitoring:

Surveillance of the disposal site would be performed during the disposal operation. Direct surveillance of the site could only occur during open water periods because of the uncertainty associated with any type of travel on the sea ice. Aerial surveys during the disposal operation could be performed, if required, and could verify the size and direction of turbidity plumes. Surveillance and monitoring during and after the disposal operation, including bathometric, physical, and chemical analysis, would be required to confirm that significant mounding from the disposal of dredged material has not occurred within the disposal area, that there is no appreciable resuspension of material into the water column or transport of the material outside the site, and that the disposal complies with conditions developed for site use.

A dredged material management plan (DMMP) would be required for the proposed project. The DMMP would identify measures to accomplish the disposal of dredged material associated with construction in the least costly manner that is consistent with sound engineering practice and meets all federal environmental standards including the environmental standards established by Section 404 of the Clean Water Act and applicable portions of Sections 102 and 103 of the Marine Protection, Research and Sanctuaries Act.

(6) Dispersal, horizontal transport and vertical mixing characteristics of the area, including prevailing current direction and velocity, if any:

Peratrovich, Nottingham & Drage, Inc. (PN&D 2000) performed tests and described the results for column settling to provide data for settling behavior of sediments to be dredged at the ship channel and disposed of at the ODMDS. PN&D ran three column settling tests using surface sediment samples and a composite sample made up of subsurface soils. The composite (test 3) is fairly representative of the fine-grained sediments encountered throughout the proposed dredging area. No sands or gravels were part of the column settling testing. PN&D developed a correlation between turbidity (NTU) and total suspended solids (mg/l) using sediments and water from the project site.

This correlation is shown on figure 15. Suspended solid concentrations and suspended solids as percentage of initial slurry concentrations are shown in tables 10, 11, and 12 and figures 16, 17, and 18.

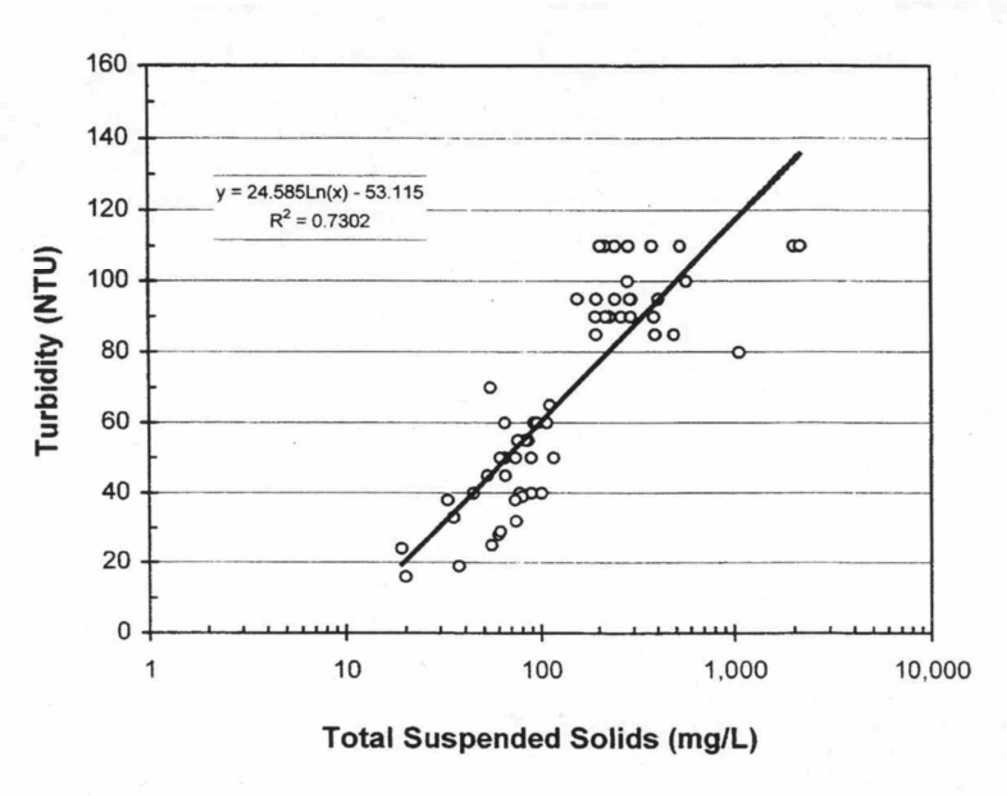

***Figure 15**: Suspended Solids vs. Turbidity (PN&D 1999)*

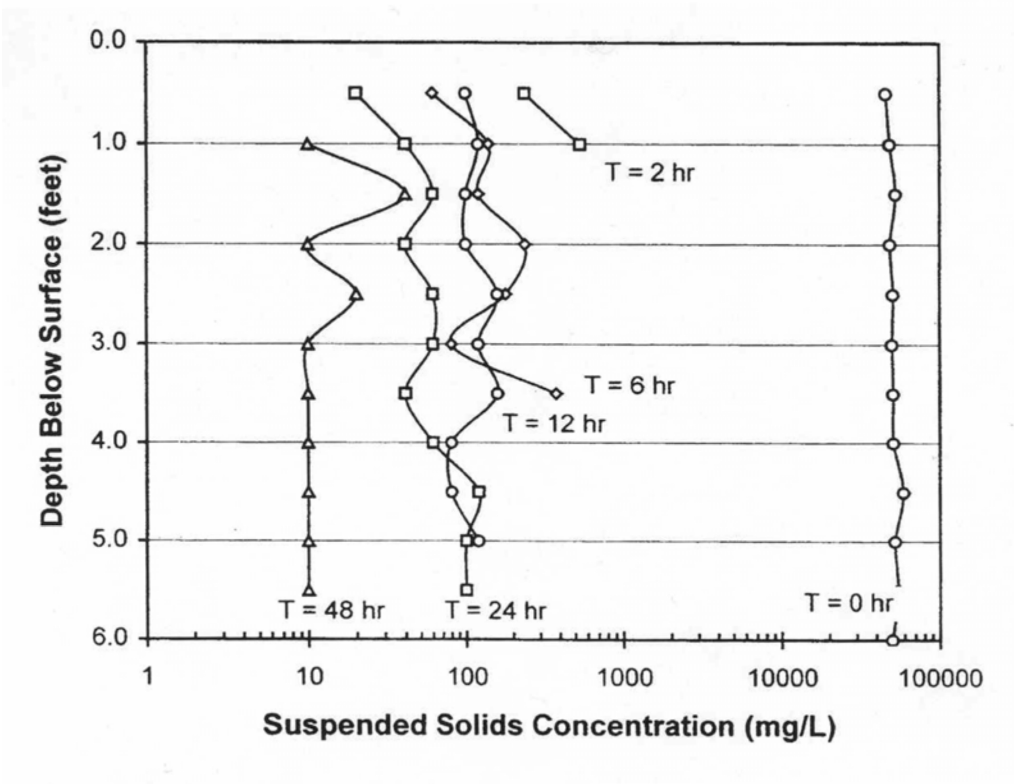

***Figure 16**: Suspended Solids Concentration (PN&D 1999)*

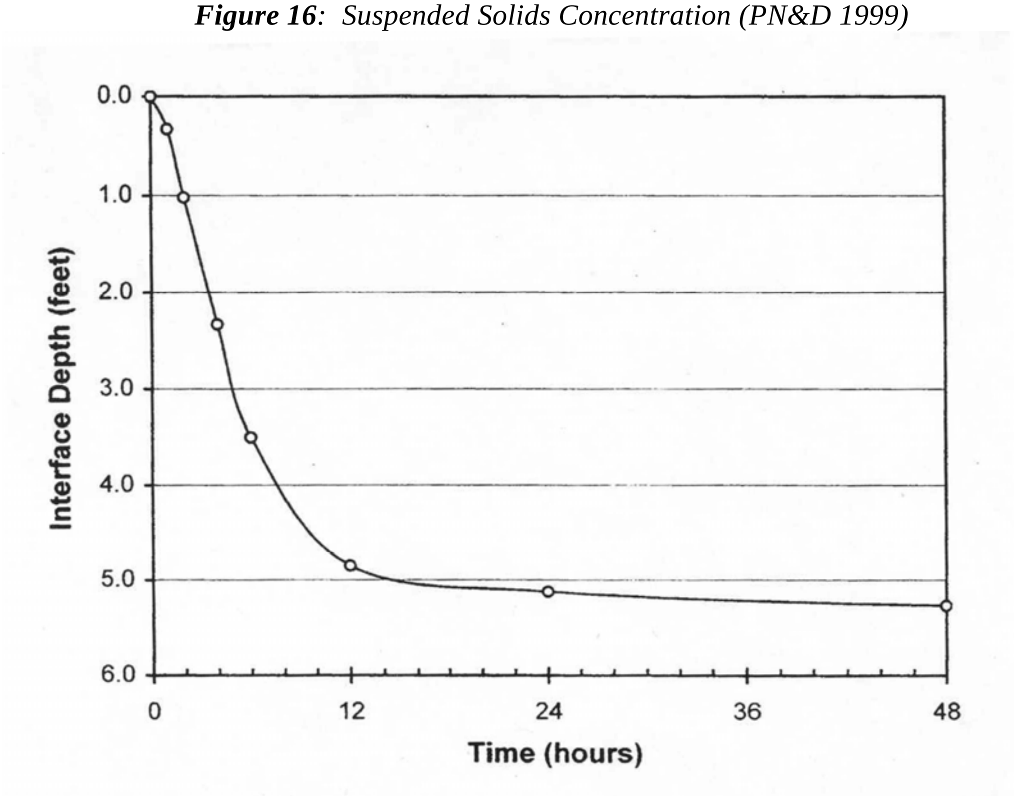

***Figure 17**: Column Settling Test 3 Results (PN&D 1999)*

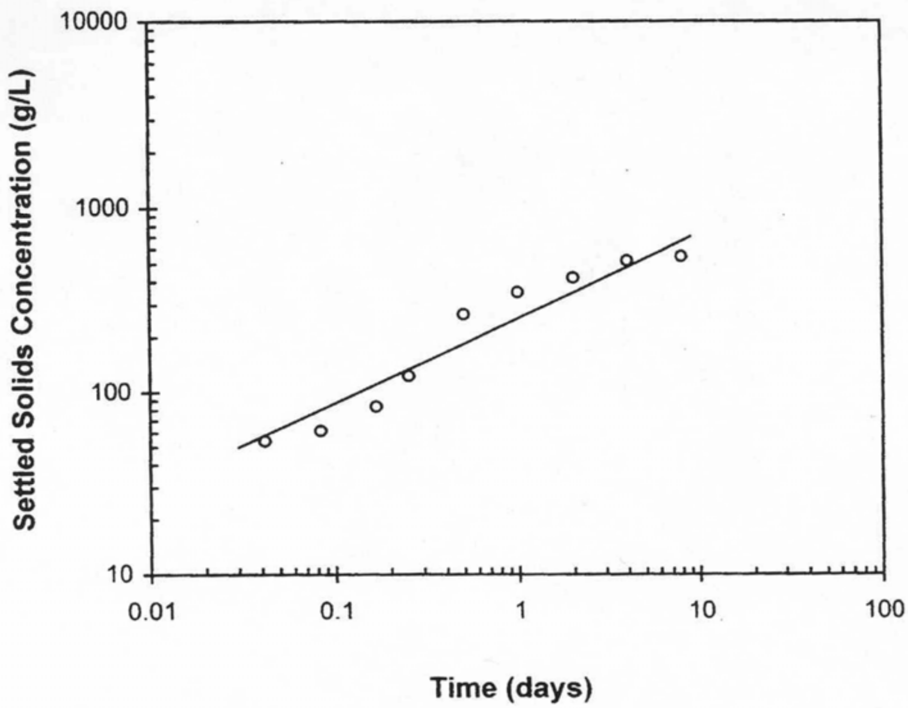

***Figure 18**: Column Settling Test 3 Results (PN&D 1999)*

***Table 10**: Suspended Solids Concentrations (PN&D 1999)*

Table 6: Test 3 Suspended Solids Concentrations Above Interface (mg/L)

Time (hours)	Depth from Top of Settling Column (feet)											
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
0	46140	48600	52820	48840	50940	50100	50800	51080	58820	52300	54500	50400
1	300											
2	240	540										
4	620	20	100	140	120							
6	60	140	120	240	180	80	380					
12	100	120	100	100	160	120	160	80	80	120		
24	20	40	60	40	60	60	40	60	120	100	100	
48		0	40	0	20	0	0	0	0	0	0	
96		20	60	80	40	380	80	420	80	40	180	
192		0	0	0	0	0	0	0	0	0	0	

Average initial suspended concentration: 51,278 mg/L

***Table 11**: Suspended Solids Concentrations (PN&D 1999)*

Table 7: Test 3 Suspended Solids as Percent of Initial Concentration

Time	Depth from Top of Settling Column (feet)											
(hours)	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
0	90.0%	94.8%	103.0%	95.2%	99.3%	97.7%	99.1%	99.6%	114.7%	102.0%	106.3%	98.3%
1	0.6%											
2	0.5%	1.1%										
4	1.2%	0.0%	0.2%	0.3%	0.2%							
6	0.1%	0.3%	0.2%	0.5%	0.4%	0.2%	0.7%					
12	0.2%	0.2%	0.2%	0.2%	0.3%	0.2%	0.3%	0.2%	0.2%	0.2%		
24	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.2%	0.2%	
48		0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
96		0.0%	0.1%	0.2%	0.1%	0.7%	0.2%	0.8%	0.2%	0.1%	0.4%	
192		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	

C_i = 51,278 mg/L

***Table 12**: Suspended Solids Concentrations (PN&D 1999)*

Table 8: Test 3 Interface Depth & Concentration of Settled Solids

Time (hours)	Time (days)	Depth to Interface (ft)	Depth below Interface (ft)	Volume below Interface (L)	Conc. below Interface (g/L)
0	0.00	0.00	6.00	59.31	51
1	0.04	0.33	5.67	56.04	54
2	0.08	1.02	4.98	49.22	62
4	0.17	2.33	3.67	36.28	84
6	0.25	3.50	2.50	24.71	123
12	0.50	4.85	1.15	11.37	268
24	1.0	5.13	0.88	8.65	352
48	2.0	5.27	0.73	7.22	421
96	4.0	5.41	0.59	5.83	521
192	8.0	5.44	0.56	5.54	549

Column volume = 8-in-dia x 6 ft = 59.307 Liters
Average solids concentration = 51.278 g/L
Total solids in column = 3041 grams

The Alaska District performed the numerical model STFATE to determine the fate of the dredged material after disposal. The model was run assuming the use of a six-bin hopper dredge with a capacity of 10,000 cubic yards traveling at 12 feet per second. Until the dredging contract is awarded, the type of equipment (a hopper dredge is presumed because of the large quantity of material, short dredging window, and the sediment composition) will not be known. However, it is notable that the assumptions used to run the model represent larger impacts than would be anticipated based on assumptions made for generating cost estimates for the project. The 10,000 cubic yard hopper dredge assumed for the STFATE model is at the large end of the dredges that would likely be used. Additionally, for safety reasons, it is unlikely that the dredges would be loaded to capacity. Thus, water quality impacts from individual disposal events generally would be expected to be lower than those predicted by the model. Disposal of material from barges or scows from clamshell operations would likely be much smaller

The model followed the silt plume for a distance of over 2 miles. Suspended solid concentrations at three depths per time are included (figures 19 through 24). The assumed currents at each depth are provided on the figures.

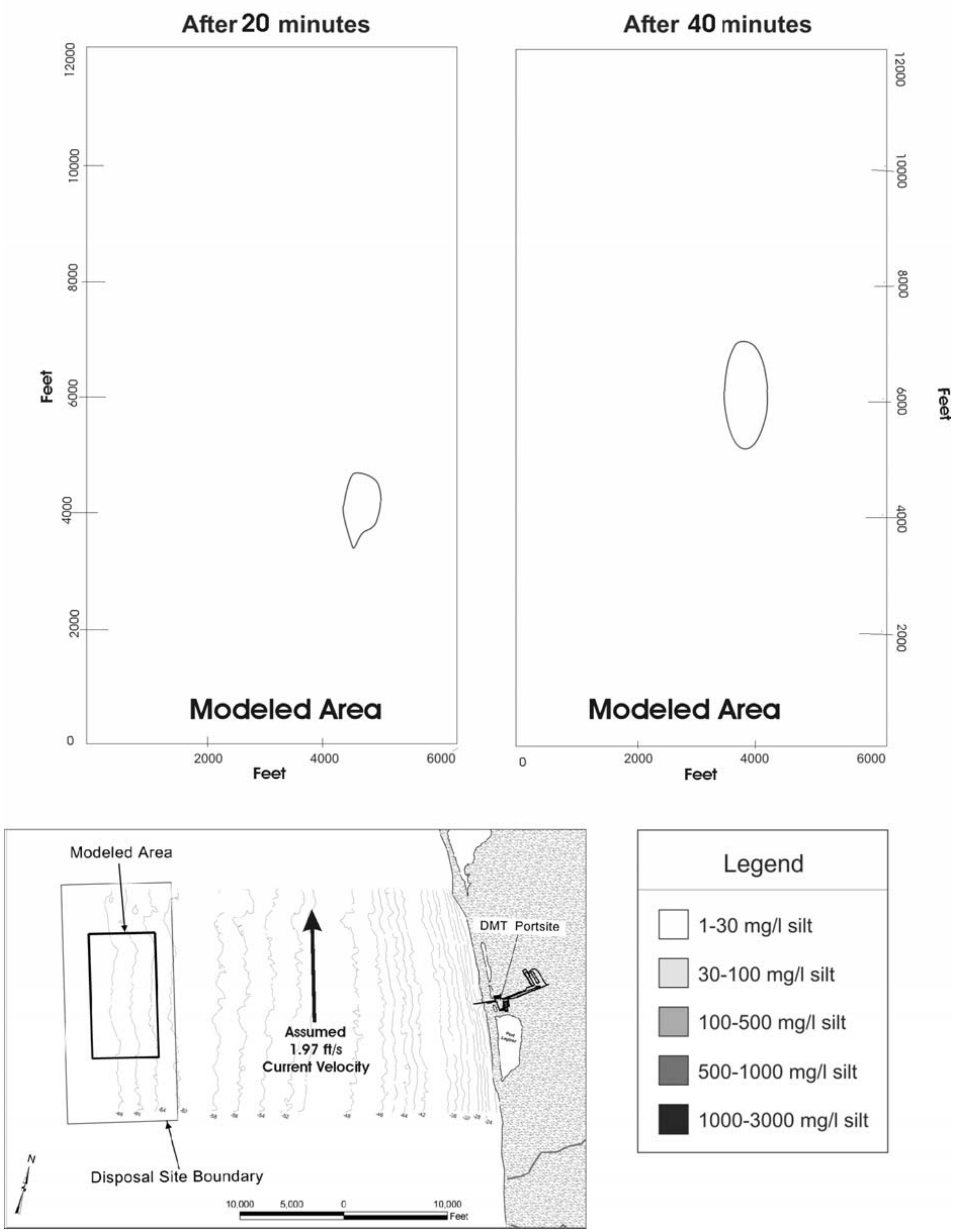

***Figure 19**: Silt Concentrations at 18 ft. Depth*

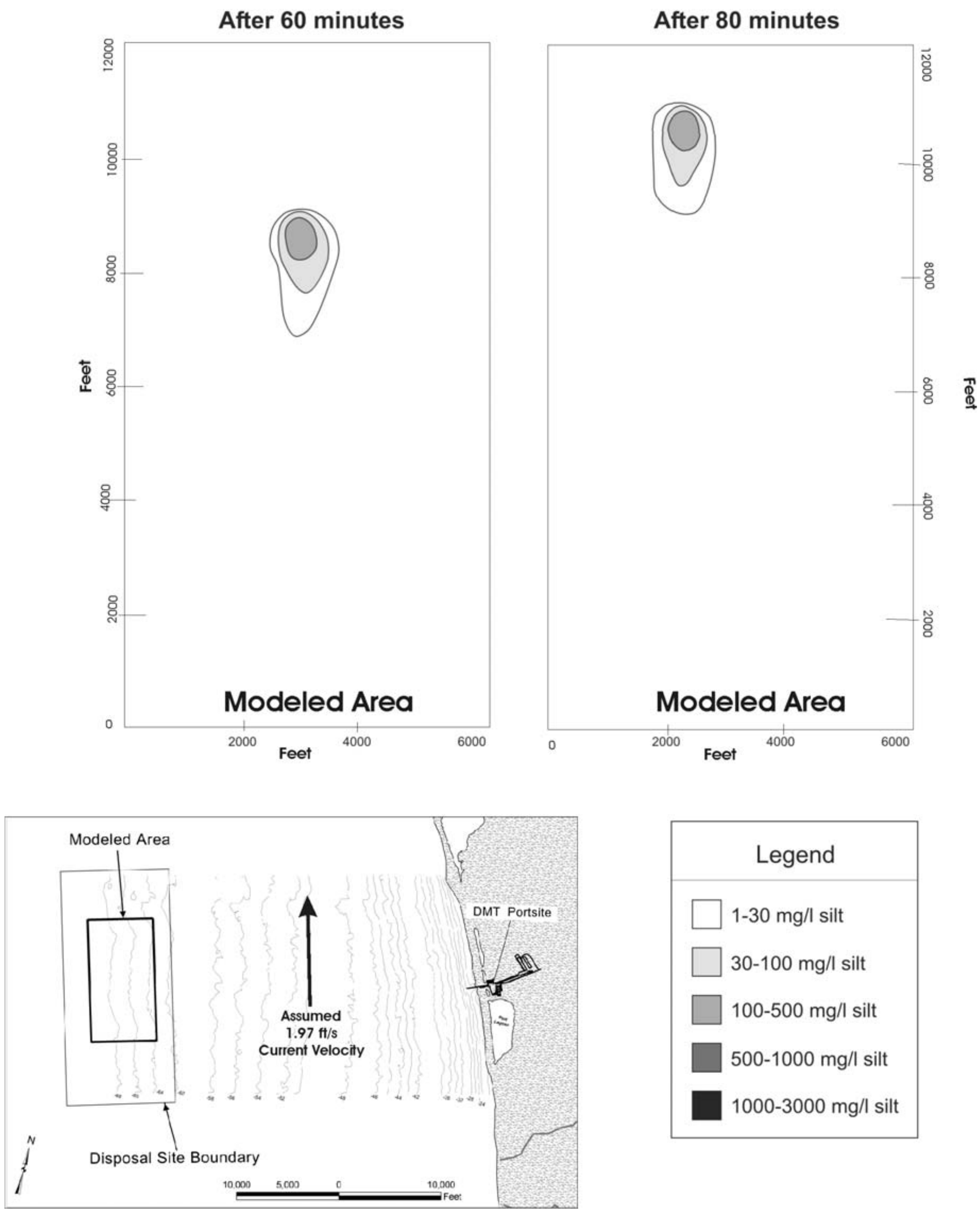

Figure 20*: Silt Concentrations at 18 ft. Depth*

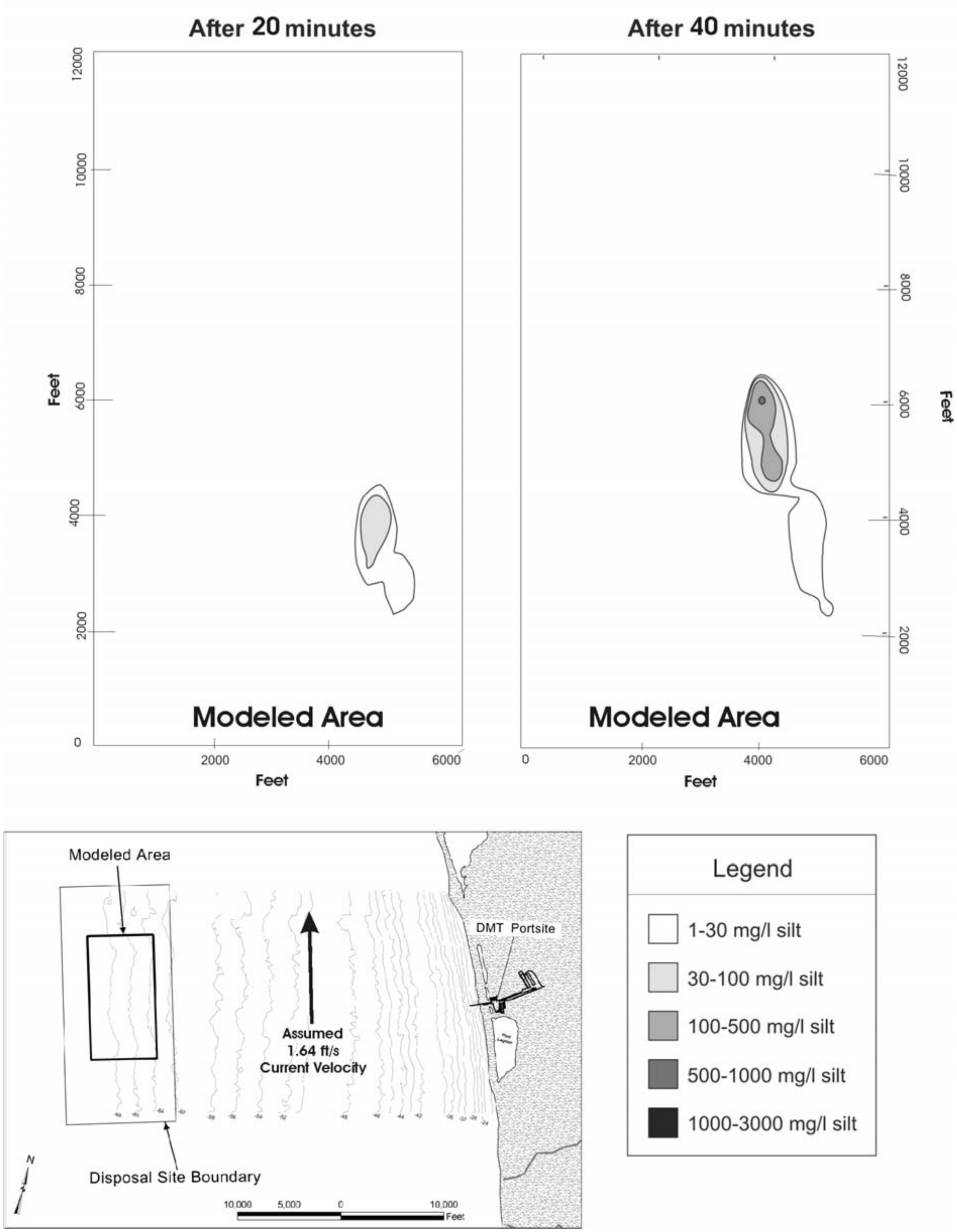

***Figure 21**: Silt Concentrations at 45 ft. Depth*

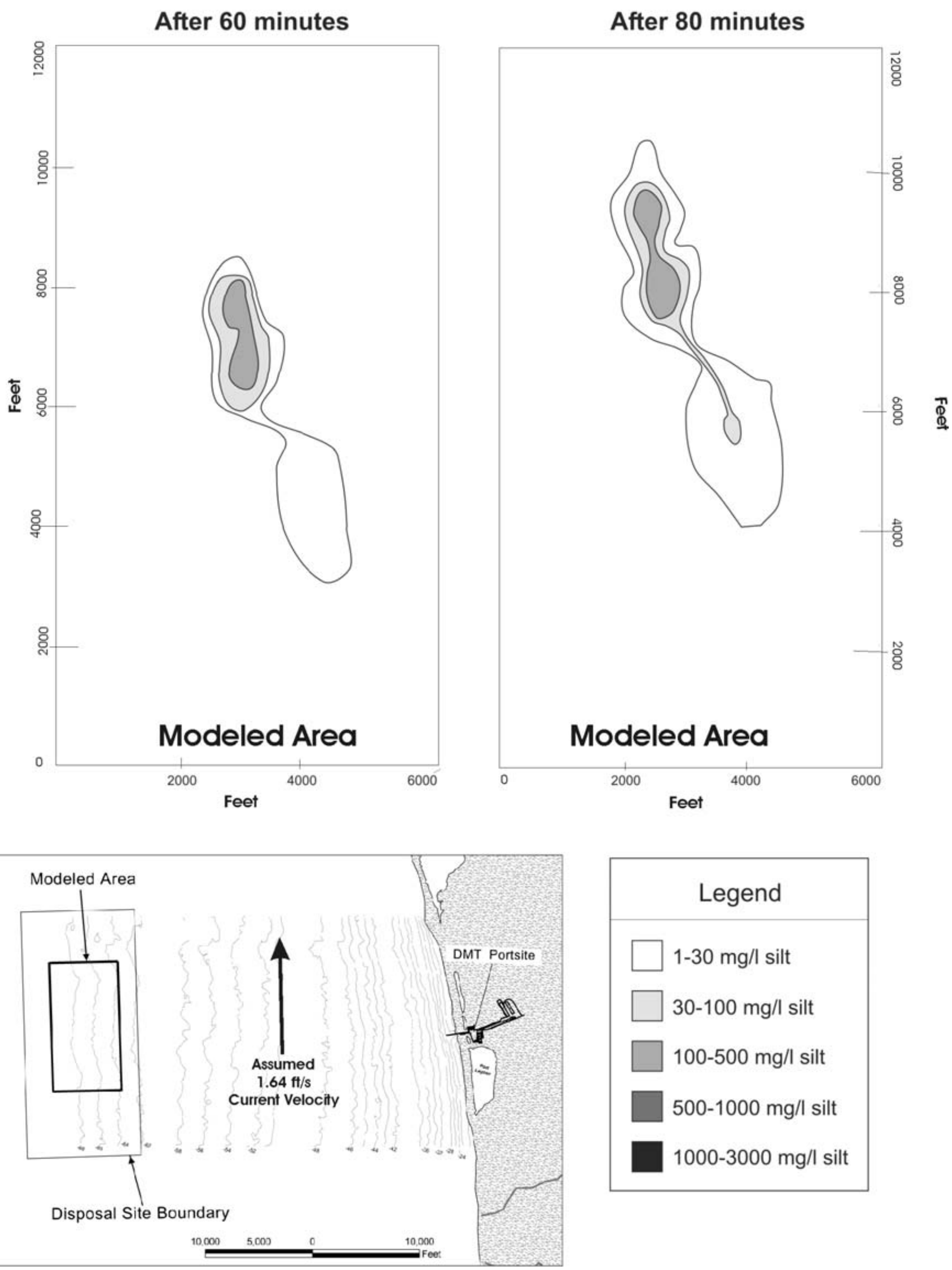

***Figure 22**: Silt Concentrations at 45 ft. Depth*

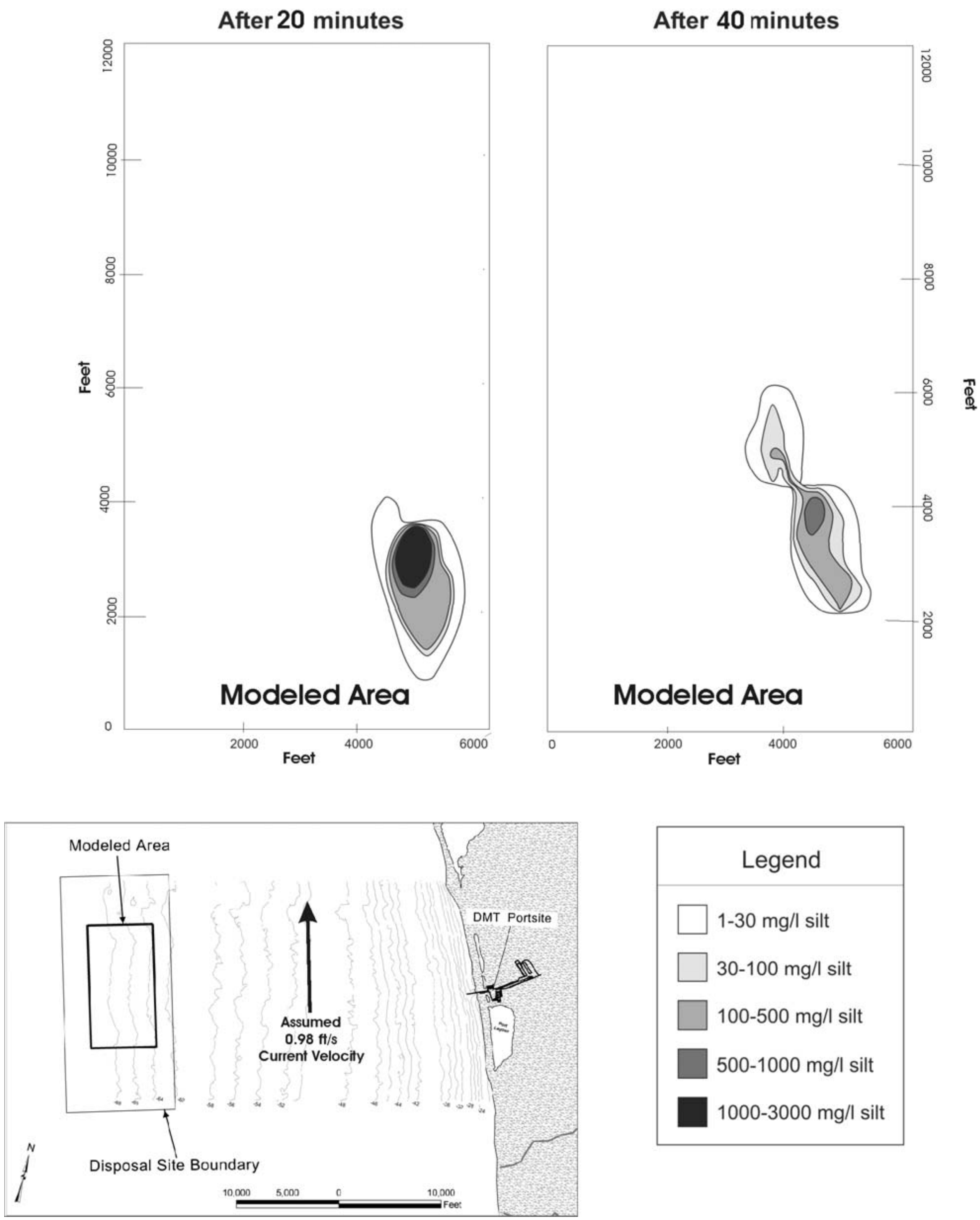

***Figure 23**: Silt Concentrations at 68 ft. Depth*

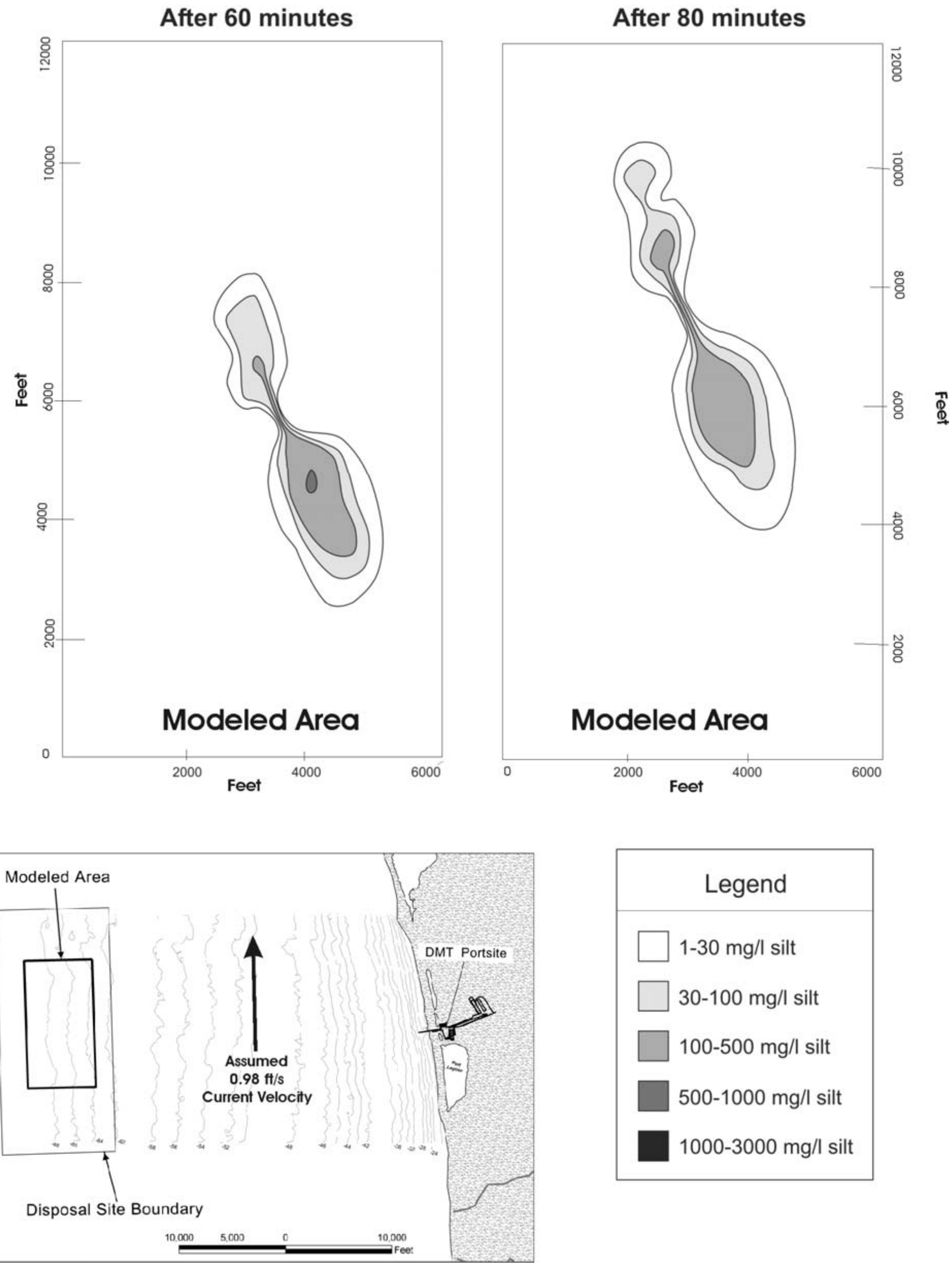

***Figure 24**: Silt Concentrations at 68 ft. Depth*

Although dispersion within the disposal site is anticipated during disposal and initial deposition, the material is not expected to migrate significantly once deposited.

(7) Existence and effects of current and previous discharges and dumping in the area (including cumulative effects):

There has been no dredging or discharge of dredged material in the project area in the past and no other dredge/disposal operations in the vicinity are anticipated. There is no other industry or community in the area that would require dredging or disposal of dredged material in the foreseeable future. There would be no cumulative effects associated with any other proposed operation. The scheduled maintenance of this proposed action is comparatively minor and would occur 5, 17, 33, and 49 years after the completion of the initial dredging and disposal. It is not anticipated that any new projects or endeavors would be induced in the project vicinity by the proposed dredging and disposal activities.

(8) Interference with shipping, fishing, recreation, mineral extraction, desalination, fish and shellfish culture, areas of special scientific importance and other legitimate uses of the ocean;

The disposal site was selected to avoid significant interference with the area's resources and their existing uses. The proposed disposal site is not within any shipping lanes, and there is no substantial commercial or recreational fishing, or fish or shellfish culturing in this portion of the Chukchi Sea. The disposal site is not within an area of significant recent or historical subsistence use, and there are no other known uses of the ocean or the ocean floor in this area. The major uses of the southeastern Chukchi Sea are shipping and subsistence gathering. The proposed dredged material disposal would not interfere with subsistence uses as the disposal would occur during the season when the area is not generally used for this purpose, and habitat effects would not substantially affect populations or behavior of marine resources used for subsistence. While dredged material disposal would not substantially affect marine biota, it could cause localized changes in marine mammal movements. Those relatively minor changes could reduce the availability of bearded seals and beluga and bowhead whales to hunters near the disposal site.

(9) The existing water quality and ecology of the site as determined by available data or by trend assessment or baseline surveys:

Water quality at the disposal site is as pristine as possible. There are no major industries, fishing grounds, or other water related resource uses in the region. Any significant degradation of water quality is from global sources of contaminants or natural consequences such as storms, earthquakes, and other natural events. The material proposed to be disposed of is marine sediment that contains no contaminants above accepted screening levels. Changes in water quality would be associated with increased suspended solids during the disposal operation. The suspended material would settle or dissipate quickly and the disposal site and surrounding region would return to pre-project conditions.

(10) Potentiality for the development or recruitment of nuisance species in the disposal site:

The proposed dredged material is from an area in proximity to the disposal site. Data collected at the disposal site as well as the proposed channel, turning basin, and reference sites indicate the flora and fauna are very similar. No species of either plant or animal would be introduced to the disposal site by activities associated with the proposed navigation improvements. Accounts of the species present at the dredge and disposal sites are summarized in the draft EIS and numerated in RWJ (2001) and RWJ (1999).

(11) Existence at or in close proximity to the site of any significant natural or cultural features of historical importance.

No known significant natural or cultural features would be affected by the proposed disposal actions. There are several cultural features near Portsite and throughout Cape Krusenstern National Monument. These features would not be impacted by ocean disposal of dredged material, but they would have to be addressed with any upland disposal scenario. Section 3.6 of the EIS discusses the locations of historic and prehistoric sites in the Portsite vicinity.

6.3.2.2 General Criteria for the Selection of an ODMDS

General criteria for the selection of ODMDS can be found in 40 CFR 228.5. The proposed ODMDS was selected using economic, engineering, cultural, and environmental criteria. To ensure the site selected minimizes effects on important resources, literature searches on species life histories, chemical and physical sediment studies, benthic invertebrate studies, water movement and circulation studies, water column water quality studies, crab studies, fisheries studies, and subsistence studies were conducted. The information gathered from these studies helped to determine the location of the proposed site and demonstrates compliance with the five general criteria specified in 40 CFR 228.5. Summaries of the studies performed, the data collected, and the analyses of these data as it relates to the protection of resources and compliance with applicable regulations and criteria are included in the discussions below. For more in-depth discussion of the physical and biological environment, refer to the appropriate sections of the accompanying EIS. The general criteria and site information related to site and project compliance with each criterion are presented below:

a) *The dumping of materials into the ocean will be permitted only at sites or in areas selected to minimize the interference of disposal activities with other activities in the marine environment, particularly avoiding areas of existing fisheries or shellfisheries, and regions of heavy commercial or recreational navigation.*

The selected site minimizes conflicts with other uses in the area. The disposal activities at the selected site would not interfere significantly with other uses including commercial and subsistence fisheries, or commercial or recreational navigation. Dr. Steven Braund performed a subsistence use study of the Kivalina/Portsite area, which included marine uses, and migrations of marine subsistence species. Like most other areas nearby, the proposed disposal site is occasionally used for marine mammal hunting but is not more intensively used for subsistence hunting than surrounding areas in similar water depths. Disposal activities would not substantially interfere with prey species. Refer to section 3.3 of the draft EIS for copies of Dr. Braund’s draft subsistence use maps. There are no substantial commercial or recreational fisheries in the Chukchi Sea and research indicates that the stocks are insufficient to support substantial commercial fisheries (BSFS 2001).

Large vessel traffic in this portion of the Chukchi Sea is limited to the barge traffic that services the DMT and communities along the Chukchi and Beaufort seas. The number of barges is small, with only a few visits per year to the communities. The tug and barge vessels and the commercial ships that load mineral products at the DMT make up the vast majority of large vessels present near the DMT. Recreational vessel use near the site is infrequent.

b) Locations and boundaries of disposal sites will be so chosen that temporary perturbations in water quality or other environmental conditions during initial mixing caused by disposal operations anywhere within the site can be expected to be reduced to normal ambient seawater levels or to undetectable contaminant concentrations or effects before reaching any beach, shoreline, marine sanctuary, or known geographically limited fishery or shellfishery.

The proposed ODMDS is far removed from any beach, shoreline, marine sanctuary, or known geographically limited fishery or shellfish fishery. The inshore boundary of the site is about 5 miles from the shore. The prevailing Chukchi Sea currents run parallel to the shoreline, further reducing the water quality impacts to areas of concern. Numeric model studies (STFATE) indicate that the dredged material would settle quickly, and hydraulic studies demonstrate that the dredged material would not be moved or resuspended when settling is complete (refer to Hydraulics appendix).

c) If at any time during or after disposal site evaluation studies, it is determined that existing disposal sites presently approved on an interim basis for ocean dumping do not meet the criteria for site selection set forth in Sec. Sec. 228.5 through 228.6, the use of such sites will be terminated as soon as suitable alternate disposal sites can be designated.

If at any time during or after disposal site evaluation studies, it is determined that an ODMDS approved on an interim basis for ocean dumping does not meet the criteria for site selection set forth in Sec. Sec. 228.5 through 228.6, the use of such site will be terminated as soon as suitable alternate disposal sites can be designated.

d) The sizes of ocean disposal sites will be limited in order to localize, for identification and control, any immediate adverse impacts and permit the implementation of effective monitoring and surveillance programs to prevent adverse long-range impacts. The size, configuration, and location of any disposal site will be determined as a part of the disposal site evaluation or designation study.

Fishery, benthic invertebrate, chemical substrate, geotechnical, and bathometric studies indicate that the entire disposal site and a wide area around it is homogeneous. The ODMDS has been sized to meet the anticipated needs and configured in an orientation that is expected to closely approximate the boundaries of the dredged material after final disposal and dispersion. The Corps is proposing to dispose of the material so the substrate would be covered with thin (less than 5 feet) layers to minimize changes to existing bathometric contours and allow the quickest recolonization of benthic species. The 8.1 million cubic yards generated by the initial dredging effort is expected to cover approximately 2,000 acres with an average of about 2.5 feet of material. Maintenance dredging is expected to result in smaller quantities and impact smaller areas to a lesser extent.

e) *EPA will, wherever feasible, designate ocean dumping sites beyond the edge of the continental shelf and other such sites that have been historically used.*

The edge of the continental shelf is between 500 and 600 miles from Portsite. The closest designated dredged material disposal site is offshore from Nome, Alaska, approximately 250 nautical miles by sea from the project area. The distance and cost of transportation dictates that disposal off the continental shelf or offshore of Nome is not feasible.

6.4 Determination of Compliance with Criteria

Based on the information provided in the evaluation of various alternatives and the specific data provided for the selected site, DMT project, and material proposed for disposal, the selected site meets the general and specifc criteria defined in 40 CFR 228.

7. DETERMINATIONS AND CONCLUSIONS

Upland use or disposal of the dredged material from the DMT project is not feasible for operational, economic, and environmental reasons. ODMDS selection and evaluation have resulted in the identification of a site that is environmentally acceptable, meets the needs of the project, and would not have unacceptable impacts to esthetics, recreational, or economic values or other uses of the site.

7.1 Environmental Acceptability of Ocean Disposal

The material to be dredged has been evaluated using the criteria in 40 CFR 227 (b) and determined to be suitable for ocean disposal. The ocean disposal site has been evaluated using the criteria specified in 40 CFR 228.5 and 228.6 and has been determined to be suitable for disposal of material dredged from the DMT project. This evaluation included literature searches for studies of the physical and biological communities in the Portsite area; chemical sediment sampling and analyses of the dredged corridor and proposed disposal site; a benthic invertebrate study; trawl surveys; water quality sampling and analyses; sediment column settling test; and a numeric model to predict the fate of the dredged material. On the basis of this evaluation, it is concluded that use of the site for disposal of dredged material associated with the DMT Navigation Improvements project would present:

1) no unacceptable adverse effects on human health and no significant damage to the resources of the marine environment;
2) no unacceptable adverse effect on the marine ecosystem;
3) no unacceptable adverse persistent or permanent effects due to the disposal of dredged materials; and
4) no unacceptable adverse effect on the ocean for other uses as a result of direct environmental impact.

7.2 Need for Ocean Disposal

The need for ocean disposal has been adequately documented through a thorough evaluation of the factors listed in 40 CFR 227.15. No practical alternatives exist to manage the sediment proposed to be dredged for the DMT project.

7.3 Impacts on Esthetics, Recreational and Economic Values

The site was located to minimize impacts to resources, not to avoid all impacts. The potential impacts to resources were evaluated and documented in the draft EIS, and this appendix. Based on that evaluation, it is concluded that the use of the selected ODMDS would not result in unacceptable adverse effects to esthetic, recreational, or economic values. Further, it is concluded that the absence of ocean disposal options would preclude the positive economic effects of the project on a wide range of businesses and communities in northwestern Alaska.

7.4 Impact on Other Uses of the Ocean

The potential long-term and temporary impacts to and conflicts with existing uses of the site were evaluated. The associated evaluations are documented in the draft EIS, and this appendix. The site was located, sized, and orientated to minimize impacts and conflicts with existing uses. Based on the evaluations, it is concluded that there would be no unacceptable adverse effect on other uses of the Chukchi Sea.

7.5 Proposed ODMDS

On the basis of the evaluation of the criteria contained in 40 CFR Parts 220 through 228, the Corps has determined that the site offshore of the DMT, illustrated in figure 25 below, is suitable for use as an ODMDS for the construction and initial maintenance dredging for the DMT Navigation Improvements project. The Corps has evaluated the material proposed to be dredged for the DMT project and determined that the material is suitable for in-ocean disposal

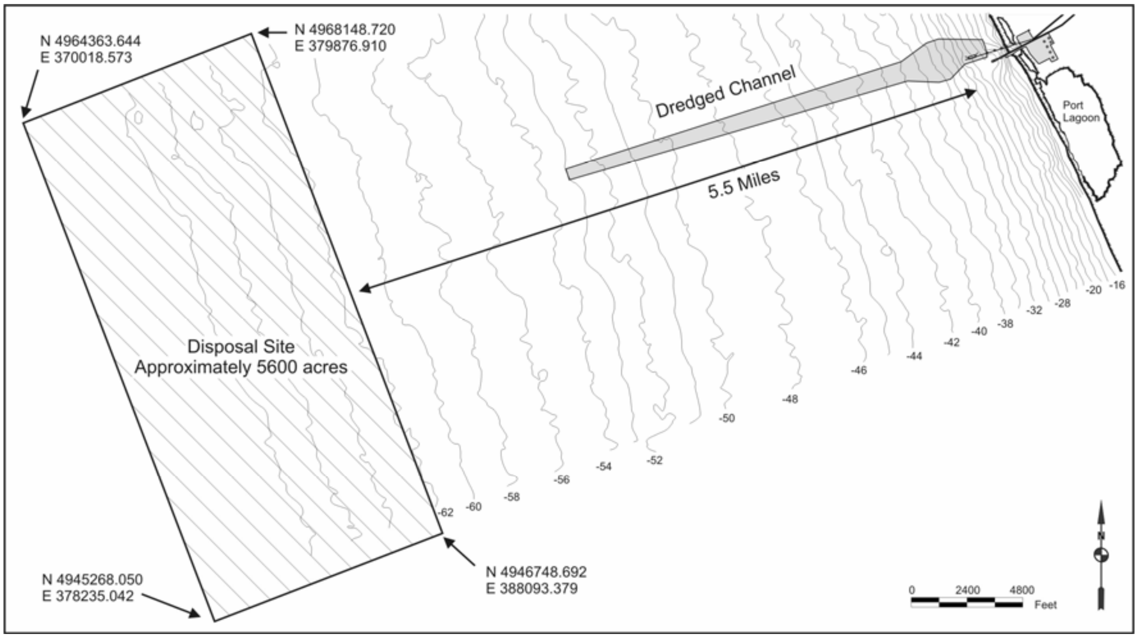

***Figure 25**: Proposed ODMDS*

It is anticipated that the ODMDS would initially serve the DeLong Mt. Terminal project and the first maintenance dredging effort. However, a formally designated ODMDS would likely be used for subsequent maintenance dredging efforts. EPA is responsible for the formal designation process and would select and designate a site using the same criteria used by the Corps for its Section 103 evaluation and selection process.