POINT THOMSON GAS CYCLING PROJECT

ZONE OF SITING FEASIBILITY FOR OCEAN DUMPING OF DREDGED CHANNEL SPOILS

DRAFT REVISION 1

Prepared for:

ExxonMobil

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01 August 2002

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1.0 INTRODUCTION

ExxonMobil Production Company (ExxonMobil) and the Point Thomson Unit Owners plan to develop the Point Thomson Gas Cycling Project for production and transport of sales-quality gas condensate to the Trans-Alaska Pipeline System (Figure 1-1). The production target is the Thomson Sands Reservoir, which will be developed from gravel pads, an in-field road system, airstrip, dock, and a gravel mine situated on the Alaska mainland between Brownlow Point and Point Hobson (Figure 1-2).

As part of this development, camp and facility modules will be transported to the project site by a sealift using oceangoing barges and tugs. It is anticipated that a minimum of 9 feet of water will be required for loaded barges to safely navigate; however, water depths immediately adjacent to the proposed dock are 6 to 7 feet. Thus, the project proposes to establish a 400 by 1,000-foot channel extending from the dock toward the northeast, with a design depth of 9 feet. It is anticipated that approximately 30,000 cubic yards (cy) of sediments will be dredged to create the channel.

1.1 PURPOSE

Ocean dumping is the predominant method to dispose of dredged spoils, though upland dumping and beneficial uses such as beach nourishment are occasionally employed. Regulatory statutes require designation of an Ocean Dredged Material Dump Site (ODMDS) prior to ocean dumping; however, at this time, an ODMDS has not been established in the Beaufort Sea. The purpose of the *Zone of Siting Feasibility for Ocean Dumping of Dredged Channel Spoils, Point Thomson Gas Cycling Project* is to initiate the process that will ultimately designate an ODMDS for project use. The scope of this analysis is to identify an operationally- and economically-feasible area for an ODMDS.

1.2 NEED

The basis for determination of need for ocean dumping is found in 40 Code of Federal Regulations (CFR) § 227 subpart C of the implementing regulations (40 CFR § 227.14-16). A need for ocean dumping is considered to have been demonstrated when a thorough evaluation of 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. Currently, an Environmental Impact Statement (EIS) is being prepared following National Environmental Policy Act of 1969 (NEPA) guidance, and thus, dredge spoils disposal options will be thoroughly reviewed. The Point Thomson Gas Cycling Project will be in jeopardy unless an economic and efficient method to dispose dredged channel spoils is available.

1.3 STATUTORY AND REGULATORY REQUIREMENTS

The Marine Protection, Research and Sanctuaries Act of 1972, as amended (MPRSA), also known as the Ocean Dumping Act, was passed in recognition of the fact that the disposal of material into ocean waters could potentially result in unacceptable adverse environmental effects. Under Title I of the MPRSA, the U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (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. Under Section 102 of the MPRSA, the EPA in consultation with the Corps, established environmental criteria that are to be addressed before an ocean dredged material disposal permit can be granted. The Corps, after consultation with the EPA, issues permits for the transportation of dredged material for the purpose of ocean disposal in compliance with these environmental criteria.

The MPRSA Criteria (40 CFR, Part 228) states that final site designation under Section 102(c) must be based on environmental studies of each site and on historical knowledge of the impact of dredged material disposal on areas similar to such sites in physical, chemical, and biological characteristics. General criteria (40 CFR 228.5) and specific factors (40 CFR 228.6) that must be considered prior to site designation will be described and evaluated. Related federal statutes applicable to the site 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. As required by Section 104(a)(3) of the MPRSA, ocean disposal of dredged material can occur only at a site that has been designated to receive dredged material. Pursuant to Section 102(c), the EPA has the responsibility for site designation. 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. However, the same Ocean Dumping Criteria (40 CFR 228.5–6) are used in the evaluation process that leads to alternative site selection and the EPA must concur with the selection.

Designation of an ODMDS in itself does not result in disposal of dredged material. A separate evaluation of the suitability of dredged material for ocean disposal must be undertaken for each proposed use of the site by either the Corps or by the non-Corps permit applicant.

2.0 SITE CONDITIONS

2.1 ENVIRONMENTAL SETTING

The proposed channel excavation area is located due north of the proposed Point Thomson Central Processing Facility (CPF), in the lagoon system between Bullen Point and Brownlow Point, along the Alaska Beaufort Sea coast. The lagoon system, commonly known as Lions Bay, is approximately 46 miles east of Prudhoe Bay (Figure 1-2).

The barrier island complex shelters much of Lions Bay from exposure to storm waves generated in the Beaufort Sea during open-water periods. Mary Sachs Entrance, a broad 2.25-mile passage located between North Star and Flaxman islands, divides the lagoon system. The lagoon east of the Mary Sachs Entrance is shallow and is protected by Flaxman Island, while west of Mary Sachs Entrance is a deeper and wider lagoon that is open at the west end.

The eastern third of the lagoon is shallow, with depths generally less than 10 feet. Shoals are common near the mouth of the Staines River and the western tributary of the Canning River and extend toward Point Brownlow. The channel between the east end of Flaxman Island and Point Brownlow (Flaxman Pass) is narrow (1,200 feet) and relatively deep (26 feet). Historical soundings obtained from NOAA Chart No. 16045, revised in 1996, suggest the lagoon is asymmetrical, with deeper waters near the mainland shore and a gentle slope from min-channel north to Flaxman Island. Water depths within the lagoon gently increase towards the west to a depth of 8 feet approximately mid-length of Flaxman Island and reach 11 feet immediately northeast of Point Thomson.

Mary Sachs Entrance is a broad and relatively deep channel, with a northeast/southwest-oriented channel that extends toward Point Thomson. Water depths within the channel are typically 9 to 11 feet with the 10-foot isobath approximately 2,400 feet north of the mainland shore in the vicinity of Point Thomson. Mary Sachs Entrance provides a break in the protection offered by the barrier islands, exposing the shoreline adjacent to and east of Point Thomson to offshore storm events. The increased exposure to waves is evidenced by the well-developed spit and bar formation along the mainland shore.

The western portion of the lagoon is protected by a group of barrier islands known as the Maguire Islands (Challenge, Alaska, Duchess, and Northstar islands). This portion of the lagoon widens from 1.5 miles at Point Thomson to 3.5 miles near Challenge Island. Water depths adjacent to the mainland between Point Thomson and Point Hobson are typically 7 to 10 feet and gently increase to 16 feet at the west end of the lagoon (URS 2000).

2.2 CLIMATE

The project area is classified as an Arctic Marine climate, characterized by extremely low winter temperatures and short, cool summers. Based on Barter Island, Alaska meteorology data, the mean annual temperature is -12 degrees Celsius (°C) (10 degrees Fahrenheit [°F]), with mean temperatures ranging between -45°C (-49°F) to 26.3°C (79°F) (USFWS 1987). Precipitation in the project area is light (6 inches annually), but frequent, occurring as drizzle in the summer and as light snow in the winter. On average, foggy conditions occur 76 days per year at Barter Island, and occur as ice fog when ambient air temperatures drop below -29°C (-20°F) (USACE 1984).

2.3 SEA ICE

The Beaufort Sea is covered by sea ice that begins to form in late September with freeze-up completed by the end of October. By April, the sea ice reaches a maximum thickness of about 6.6 feet (MMS 1996).

Sea ice is classified into three zones: the land-fast ice zone, shear ice zone, and the polar pack ice zone. The landfast ice zone is adjacent to the mainland shore barrier islands and is composed of first-year bottom-fast (grounded) ice and floating-fast ice. As the name indicates, landfast ice is relatively stable and fixed. Bottom-fast ice is frozen to the seafloor to water depths of approximately 6.6 feet and does not deform during the winter. Floating-fast ice is relatively stable, attached to the bottom-fast ice, and occurs in water depths between 6.6 and 65 feet. All marine construction activities proposed by the project will be restricted to the landfast ice zone with bottom-fast and floating-fast ice conditions.

The shear ice zone is a transition between the slowly rotating multi-year polar pack ice and the fixed land-fast ice. The sea ice within the shear zone is unstable with drifting ice floes, open water leads, and pronounced sea ice ridges and keels. According to Stringer et al. (1980), the land-fast ice zone typically extends to the 65-foot isobath; however, yearly variations could result in unstable ice conditions in shallower water depths.

Ice cover persists until spring warming initiates in river breakup, resulting in sea ice melting near river and stream deltas. Breakup of the sea ice usually occurs by June or July. As melting continues most of the sea ice retreats from shore with the pack ice, but occasionally winds may bring ice floes into the near-shore waters during the summer open-water season.

Webster (1982) calculated probabilities for half (i.e., 50%) of the open-water to be covered with sea ice during the summer months (Figure 2-1). During mid-June, there is a 50% probability that half (50%) of the near-shore (Lions Bay) and adjacent Beaufort Sea waters would be covered with ice floes. On average, Webster (1982) determined that half coverage of ice floe concentration drops to 25% probability by early August. Figure 2-2 illustrates the patchy distribution of sea ice, its proximity to the project area, and the apparent seaward-limited access by barges. It should be noted that the Steffanson Sound barrier islands west of Point Thomson restrict sea ice incursion into Mikkelsen and Foggy Island bays and thus obstruct movement of sea ice into those waters.

3.0 OVERVIEW OF NORTH SLOPE APPLICABLE DREDGING METHODS

Dredging and ocean dumping of spoils in the coastal waters of the Beaufort Sea are rare activities that have unique operational characteristics. During winter, the sea surface is covered with a relatively thick (6-7 ft) layer of stable sea ice that provides access for standard terrestrial heavy equipment (e.g., dump trucks, backhoes, graders). Also, the sea ice serves as a platform for construction operations in the near-shore marine environment without the aid of conventional marine vessels. Autumn and spring seasons are characterized by thin or unstable sea ice, and thus preclude access for construction activities. The summer open-water season provides a brief (45 to 60 days) window of opportunity for use of marine vessels and conventional marine construction techniques in the near-shore waters.

The variety of water and sea ice conditions requires uncommon applications of conventional marine and terrestrial equipment and construction methods in the near-shore Beaufort Sea waters. Current project construction procedures regarding the dredging and disposal of channel spoils are at a conceptual level, with alternatives developed for winter and summer operations.

3.1 WINTER CONSTRUCTION METHODS

Heavy construction equipment adapted for arctic conditions is proven and reliable technology that has many (+25) years of operational history associated with oil exploration and production activities, and use in the North Slope villages. For the last several years, the oil industry has spurred development of sea ice road and winter marine construction techniques that demonstrate winter operations are safe and economical.

The Northstar Development island and sub-sea pipeline installation demonstrated that artificially-thickened ice roads and pads are able to support construction activities associated with gravel placement, excavation of seafloor sediments, and fill activities in the marine environment. The backhoe is the excavation equipment of choice due to its reliability, cost to operate, availability, and efficient production rate. Typically, spoils are temporarily stockpiled on the sea ice adjacent to the excavation until sufficient material is available to load into dump trucks for hauling to the ocean disposal site. Ocean dumping in the winter consists of dump trucks depositing the spoils onto the sea ice where a grader works the spoils into prescribed lifts, typically no thicker than 2 feet. The spoils remain at the site until sea ice breakup and melting serves to release the spoils into the water column and onto the underlying seafloor.

3.2 SUMMER CONSTRUCTION METHODS

There are numerous dredging methods that are possible for use; however, the remote location, relatively small volume (about 30,000 cy) of spoils anticipated to be generated, and lack of conventional dredging equipment based on the North Slope of Alaska pose unique challenges to the project if summer construction is the selected alternative.

Barge-mounted backhoes have been successfully deployed in the nearshore Beaufort Sea for dredging operations while small suction head dredges are considered a viable alternative. Regardless of the excavation tool, the spoils would be placed in containers on barges, and once full, towed to the approved ocean dumping site, where unconfined dumping would occur.

A variation of disposal options for the suction head dredge involves side-casting the sediment slurry directly to the seafloor adjacent to the channel dredging operations. This method is viable in the event that a storm induces filling of the channel.

4.0 DEFINING A ZONE OF SITING FEASIBILITY

Joint EPA/Corps guidance for site designation suggests establishing a zone of siting feasibility (ZSF), as ocean disposal sites must be located within an operationally and economically feasible distance from the point of dredging (Corps/EPA 1984). Generally, for most alternatives, the *operationally* feasible distance will be further from the point of dredging than the *economically* feasible distance due to the high costs of transporting dredged material. All operationally feasible disposal sites for the Point Thomson dredging project are presented below, and then further evaluated for economic feasibility.

The following table summarizes the seasonal variation of marine ice and open water conditions that affect the operational feasibility of construction activities.

DATES	SEASON	ACTIVITY	SEA ICE STABILITY	OPEN WATER STATUS
15 July – 10 August	Summer	Channel Excavation	Poor	Good
10 August – 31 August	Summer	Module Transport via Sealift	Poor	Good
1 September–15 October	Fall	Whale Migration	Not Applicable	Not Applicable
November	Late Fall	Freeze Up	Poor	Poor
December - April	Winter/Spring	Land-Fast Ice Development	Good	None
15 May - 15 July	Summer	Breakup	Poor	Poor

4.1 Operationally Feasible Disposal Sites

The first step in establishing a ZSF is to determine all disposal sites that could be used, without considering the associated costs. Factors that influence determination of operational feasibility include safety considerations, ability to meet project schedules, and design criteria.

Summer Disposal Sites

Summer dredging requires the use of suction dredges or excavators (i.e., backhoes) mounted on barges. Ocean dumping alternatives include barging spoils away from the dredge site or side-casting the sediment slurry directly to the seafloor adjacent to the channel. The summer alternatives are evaluated below.

> Safety - Both of the dredging methods could be accomplished safely. However, the barging option for offshore ocean dumping is limited to the open water area, as the available barges are not constructed to operate within sea ice.

Schedule – Typically, marine transportation of equipment via barge to the dredge site could occur on approximately July 15, and the sealift barges would arrive on approximately August 10, allowing approximately 26 workdays. According to calculations attached to this document, the barge mounted excavator option would require approximately 17 days with two barges (the maximum number available to the project) hauling spoils and a travel distance of 3.5 miles, a distance that would allow dredging to continue non-stop. The cutterhead-suction dredge method is reported to be less efficient (15% efficiency) than the excavator method (95% efficiency) due to the high seawater volume entrained during the dredging process. The cutterhead-suction dredge option would require approximately 150 days to complete the dredging with two barges. This option would not meet the operational schedule of 26 days if dredging and module construction were to be completed in the same season.

Design Criteria – The barges, when loaded with spoils, require approximately 8 feet of water to navigate and thus could not dump in shallower water. Additionally, dumping spoils from barges often creates mounding on the seafloor and could create a navigation hazard in water less than 20 feet deep.

Therefore, the operationally feasible summer dredging option is to excavate sediment into barges using a barge-mounted excavator, as this method can be accomplished within the schedule. The operationally feasible summer dumping area includes water greater than 20 feet offshore to a maximum distance of 3.5 miles from the point of dredging. This effectively eliminates most of the area within the barrier islands.

Winter Disposal Sites

Winter dredging involves excavating ice and sediment into trucks for transport to the disposal area using excavators. Winter transportation on the North Slope is typically over ice roads constructed on sea ice or tundra. Winter disposal sites are discussed below.

Safety – Ice roads can be constructed offshore on floating-fast ice. As presented in Section 2.3, floating-fast ice can extend as far as the 65-foot isobath. However, a buffer zone between stable floating-fast ice (45-foot isobath) and unstable shear ice (65-foot isobath) will be established as a safety measure and will not be entered in winter. As a result, the limit of operational feasibility for ice road construction and therefore safe winter transportation is the safe ice zone (offshore to the 45-foot isobath).

Schedule – It is assumed that acceptable ice conditions will exist from January 15 to April 15 (approximately 90 days). According to calculations attached to this document, ice excavation and dredging will require approximately 41 days. As many trucks could be obtained for the project, lengthy haul distances would not likely increase the time required past 90 days.

Design Criteria – Given the large amount of equipment and personnel available at Prudhoe Bay and elsewhere in Alaska, ice road construction and truck transportation could be accomplished at great distances from Point Thomson, both within the barrier islands and offshore to the shear ice zone. It is conceivable that with good ice conditions and without considering costs, spoils could be transported to virtually anywhere along the Alaska Beaufort Sea coast.

Therefore, the operationally feasible disposal area for winter dumping of excavated sediment is anywhere with acceptable ice for road construction and truck traffic. This typically includes offshore water up to 45 feet in depth. Schedule will not impact the winter feasible disposal areas.

4.2 Economically Feasible Disposal Sites

The next step in the ZSF is to determine which areas within the operationally feasible zones are economically feasible to use. For either the summer or winter construction seasons, increasing haul distance greatly increases costs.

Conceptually, the economically feasible zone includes all areas within the operationally feasible zone up to the point where the cost of the dredging project becomes so high that the entire project is no longer economically feasible. Determination of that economic breakeven point is beyond the scope of this study. A more practical approach is a cost/benefit analysis of increasing haul distance within the operationally feasible zone.

It should be noted that the EPA has issued a notice of intent to prepare an environmental impact statement (EIS) for this project in 2002. The EIS will examine in detail potential impacts from this project and ultimately will choose specific dumping areas based on a thorough evaluation of all alternatives and potential impacts from the project. However, in order to prepare this ZSF and to proceed with an evaluation of sediment quality in the project area, certain assumptions have been made in this ZSF that may or may not be confirmed in the EIS. These assumptions include that the spoils will prove to be free of human-induced contaminants due to the pristine nature of this area and that ocean dumping can occur anywhere that hauling equipment can operate, provided the spoils do not create a hazard to navigation.

Therefore, at this time due to the apparent lack of negative impacts to the marine environment caused by non-contaminated sediment placement, there does not appear to be any benefit from hauling the spoils any further than the nearest water that is deep enough to avoid creating a hazard to navigation (any depth in winter up to 45 feet and greater than 20 feet in summer). As there is currently no apparent benefit associated with increased haul distances, more distant disposal areas are not economically feasible due to increased costs.

Therefore, this study focuses on areas determined to be within a reasonable hauling distance that will actually meet project objectives based on the following parameters:

- Amount of dredging necessary for project needs, including the volume and occurrence of subsequent dredging;
- Availability of dredging, hauling, and dumping equipment;
- Dredging and ocean dumping time window based on physical, biological, and human-use constraints;
- Workforce safety, including favorable sea ice and open water conditions; and
- Associated dredging and ocean dumping costs.

Since winter and summer construction techniques and environmental conditions are unique, the resulting winter and summer ZSF are significantly different. To ascertain the ZSF for a given season, several construction schemes using a variety of equipment applicable for North Slope work were evaluated to maximize haul distance within project economies (Appendix A). The following summarizes key issues for the winter and summer sessions.

4.3 WINTER CONSTRUCTION

Volume of Dredge Spoils

- 33,000 cubic yards

Availability of Equipment

- *Dredging Equipment – Backhoe:* Supply is readily available from multiple local North Slope suppliers. There are a sufficient number of backhoes available to meet current North Slope demand during the project construction schedule.
- *Hauling/Dumping Equipment – 30 cy dump truck, loaders, and graders:* Supply is readily available from multiple local North Slope suppliers. There are a sufficient number of dump trucks, loaders and graders available to meet current North Slope demand during the project construction schedule.

Schedule

- *Construction Time Window:* January 15 to April 15 (90 days). Estimated maximum ice and sediment excavation time is 41 days, providing ample schedule flexibility.

Safety Considerations

- *Equipment Movement:* Increased safety risk associated with increased traffic levels as the number of dump trucks increases.
- *Sea Ice Constraints:* Unstable sea ice conditions may persist where the water depth exceeds 45 feet. Reinforced ice roads will probably be necessary where water depths exceed 7 ft (i.e., corresponds with floating land-fast sea ice). Minimal ice road construction coincides with grounded (bottom-fast) ice (<7 ft water).

Costs

- *Ice Roads:* Costs for dedicated ice roads constructed in water depths greater than 7 feet to dumping sites located north (seaward) of the barrier islands is $300K/mile. Costs diminish for ice roads that coincide with grounded (bottom-fast) sea ice ($30-100K/mi) and are used for multiple purposes.
- *Expanded Hauling Capabilities (more trucks):* Fuel costs, labor, and billeting requirements increase as the number of dump trucks increase. An increase in trucks extends the maximum haul distance but does not equate to a reduction in construction period.

Maximum Haul Distance (for continuous dredging operation)

- 10.7 miles

4.4 SUMMER CONSTRUCTION

Volume of Dredge Spoils

- 33,000 cubic yards (backhoe)
- 225,000 cubic yards (cutter-head suction dredge)

Availability of Equipment

- *Dredging Equipment – Backhoe:* Supply is readily available from multiple local North Slope suppliers. There are a sufficient number of backhoes available to meet current North Slope demand during the project construction schedule.
- *Dredging Equipment – Cutterhead Suction Dredge:* Supply is limited to Lower 48 and Canadian vendors, with no readily available dredges in Alaska. Due to the low operational efficiency and extended duration of operation (150 days), this method is not a practical option.
- *Hauling/Dumping Equipment – Self-propelled Barge:* The only barge type that is readily available on the North Slope. It is anticipated that no more that two barges will be available during the project construction schedule. A cursory review of transporting dump barges or other barges from vendors outside Alaska resulted in an order of magnitude increase in cost and thus these options were not evaluated further.

Schedule

- *Construction Time Window:* Approximately 26 days starting on July 15 and ending on August 10, with the arrival of the sealift barges.

Safety Considerations

- *Sea Ice Constraints:* Ice floe concentrations increase toward the north (see Figure 2-2). Vessel maneuverability becomes more restricted as ice concentrations increase. Thus for planning purposes, the maximum sea ice concentration for ocean dumping operations is set between 25 and 50%. This limits operations to water depths less than 50 or 60 feet.

Costs

- *Dredging Equipment:* Increased cost for cutter head suction dredge due to low efficiency and extended excavating time, and mobilization/demobilization from Lower 48 or Canadian vendor.

Maximum Haul Distance (for continuous dredging operation)

- 3.5 miles

5.0 POINT THOMSON ZONES OF SITING FEASIBILITY

The results and constraints listed above for the winter and summer ZSF evaluation provide operational and project economical dredging and ocean dumping activities. Based on these findings and expanded description found in Appendix A, physical boundaries for the winter and summer ZSF can be determined. *The costs provided in Appendix A are a reasonable estimate of the costs associated with basic dredging and hauling operations and are to be used only for comparison between different dredging and hauling options.*

5.1 WINTER

Figure 5-1 presents the ZSF associated with winter channel dredging and ocean dumping activities. The primary factors limiting the size of the ZSF are the construction costs estimated at $300,000/mile for ice roads that coincide with floating-fast ice (water depths >7 ft), and costs associated with the number of dump trucks.

The excessive costs to establish significant lengths of ice roads on floating-fast ice eliminate sites seaward of the barrier islands. Dumping east of the channel dredging site was not considered due to the prevailing westward currents that could serve to transport the spoils back into the channel. It is assumed that the ice road between Badami and Point Thomson will be in place and available for hauling, and thus, the maximum one-way haul distance along this route is approximately 10 miles. A spur ice road extending across Lions Bay to the barrier island complex west of the channel excavation is economically feasible, even though part of the ice road coincides with higher costs due to floating-fast ice conditions. Since it is economically feasible to extend the ZSF to the barrier islands, it is reasonable to conclude that dumping is feasible along the spur ice road and thus the applicable Lions Bay waters are included in the ZSF. It is anticipated that more than four dump trucks would add excessive traffic on the primary ground transportation route connecting the project construction activities with the Prudhoe Bay infrastructure.

The proposed winter ZSF is unique in that it identifies shallow water areas for potential dumping sites as compared to conventional deeper water disposal sites. Shallow water sites are practical during winter construction and ocean dumping because the thickness and distribution of spoils on the sea ice can be more carefully managed then conventional dumping through the water column from a barge.

5.2 SUMMER

The maximum, one-way haul distance for summer construction is 3.5 miles based on the limited availability of barges on the North Slope of Alaska, the associated cycle times to fill, haul, and dump the spoils, and the relatively short construction time window (Figure 5-2). Securing barges from Lower 48 vendors is not effective since the barges would arrive within the same timeframe as the module sealift and thus would not be available within the construction time window.

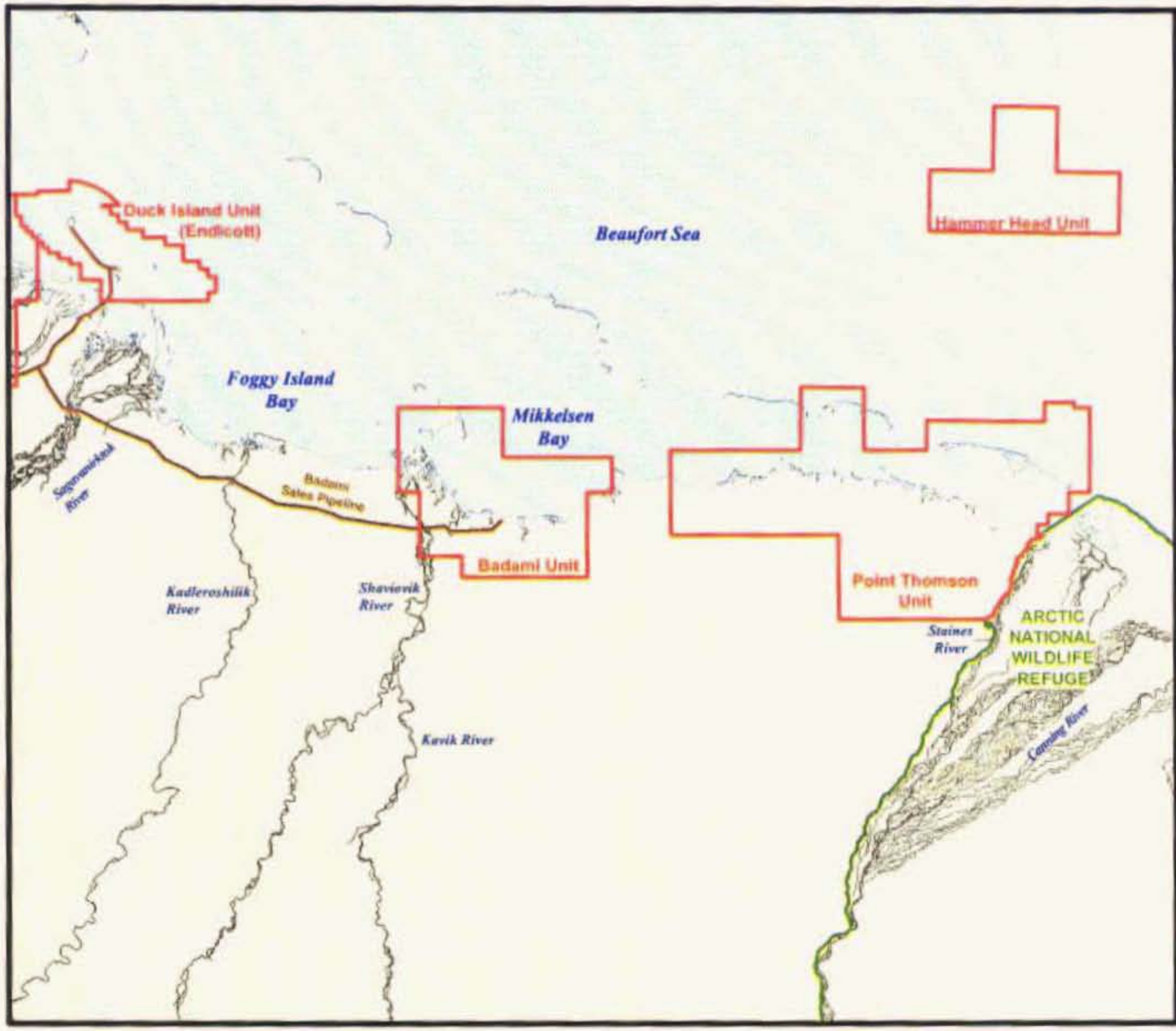
There is a possibility that unconfined dumping through the water column of spoils could cause mounding on the seafloor, and thus, water depths must be greater than 20 feet to prevent creation of navigation hazards. These operational limitations result in a small ZSF located immediately seaward of Mary Sachs Entrance (Figure 5-2).

Summer storms could generate sufficient currents to rework nearshore sediments resulting in partial filling of the channel. In the event that sediment deposition in the channel prohibits the sealift barges from reaching the dock, a suction head dredge will be deployed to re-establish the channel. The slurry discharge of seawater and sediments generated by the suction head dredge will be side casted immediately adjacent to the channel. The deposition area for the side-casted spoils would fall outside of the summer ZSF presented in Figure 5-2; however, the amount of spoils generated from a channel clean out is anticipated to be significantly less (<5,000 cy) than the volume of spoils generated to establish the channel. It is anticipated that the relatively small volume of side-casted spoils associated with channel clean out will not create mounding that would result in a navigation hazard.

6.0 CONCLUSIONS

Two Zones of Siting Feasibility (ZSF) associated with winter and summer construction activities have been delineated to support the Point Thomson Gas Cycling Project. Economic and physical site conditions affected the distribution and location of each of the ZSFs. Upon approval by the EPA and Corps, a sampling and analysis plan will be developed to characterize the physical and chemical properties of the seafloor sediments, with the ultimate goal of designating site(s) suitable for ocean disposal of channel spoils.

FIGURES



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Point Thomson Gas Cycling Project

Figure 1-1

Point Thomson Vicinity Map

N

6 0 6

Miles

Base maps provided by BPXA Cartography.

URS Anchorage, Alaska

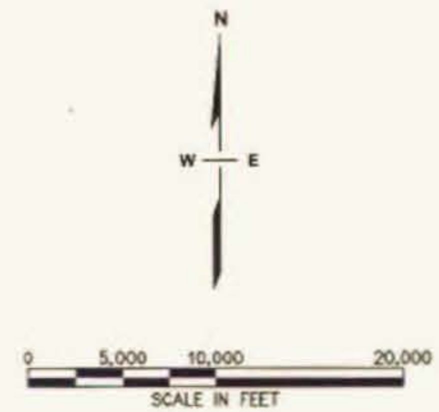
ExxonMobil

Point Thomson Gas Cycling Project

Figure 1-2
Point Thomson
Location Map

LEGEND

Unit Boundary



Source: Base map from the National Oceanic and Atmospheric Administration (NOAA) nautical chart No. 16045, revised in 1996

URS Anchorage, Alaska

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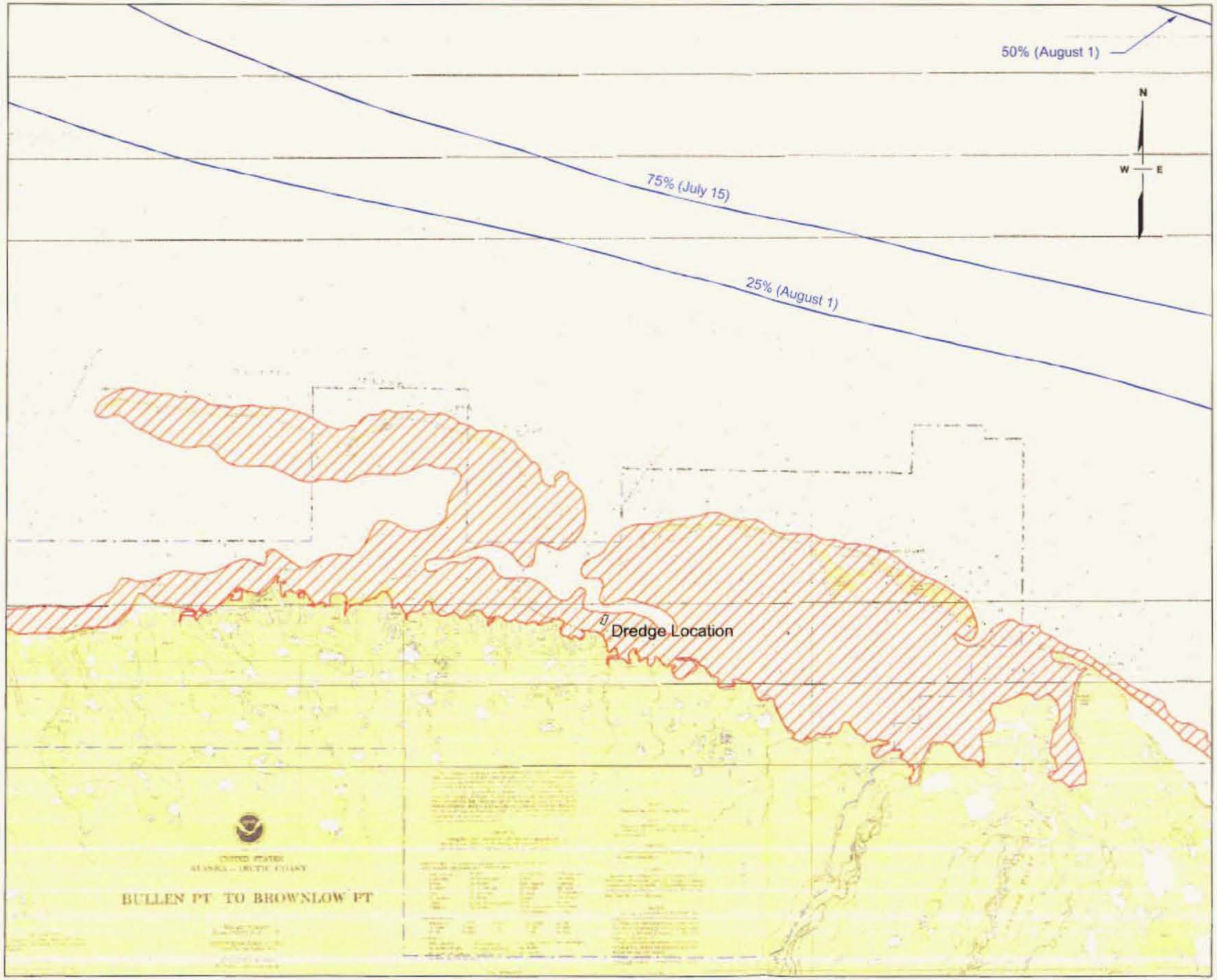

ExxonMobil

Point Thomson Gas Cycling Project

Figure 2-1
Summer Ice Probability

LEGEND

Percent Probability of the 50% Ice Concentration Boundary (Webster, 1982)

Shallow Water Zone (less than 10 feet of water)

Unit Boundary

0 5,000 10,000 20,000
SCALE IN FEET

Source: Base map from the National Oceanic and Atmospheric Administration (NOAA) nautical chart No. 16045, revised in 1996

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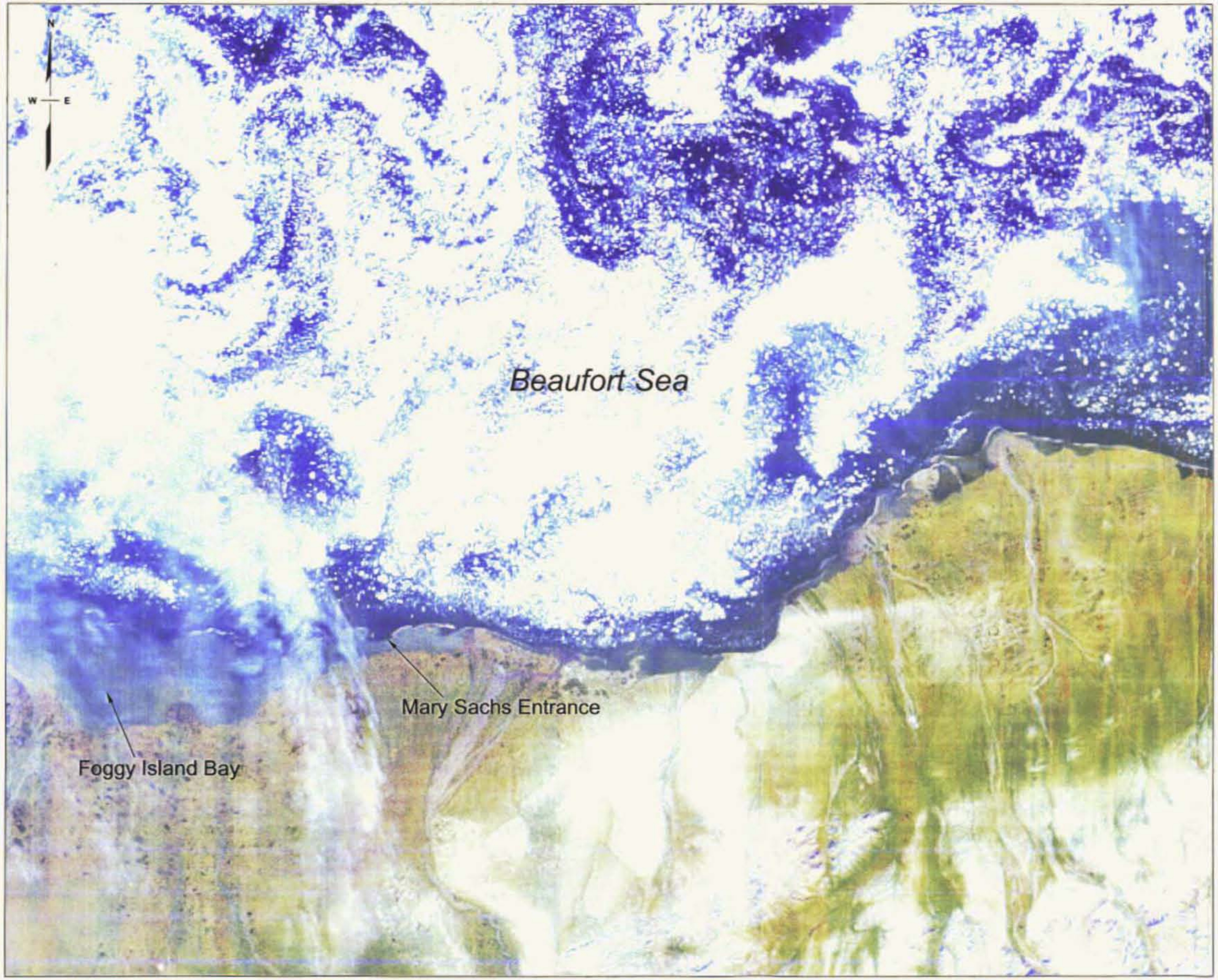

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Point Thomson Gas Cycling Project

Figure 2-2
Sea Ice Conditions on August 16, 2000

NOT TO SCALE

Source: Aerial photo taken by Multi-angle Imaging SpectroRadiometer's nadir (vertical-viewing) camera on August 16, 2000.
NASA/GSFC/LaRC/JPL, MISR

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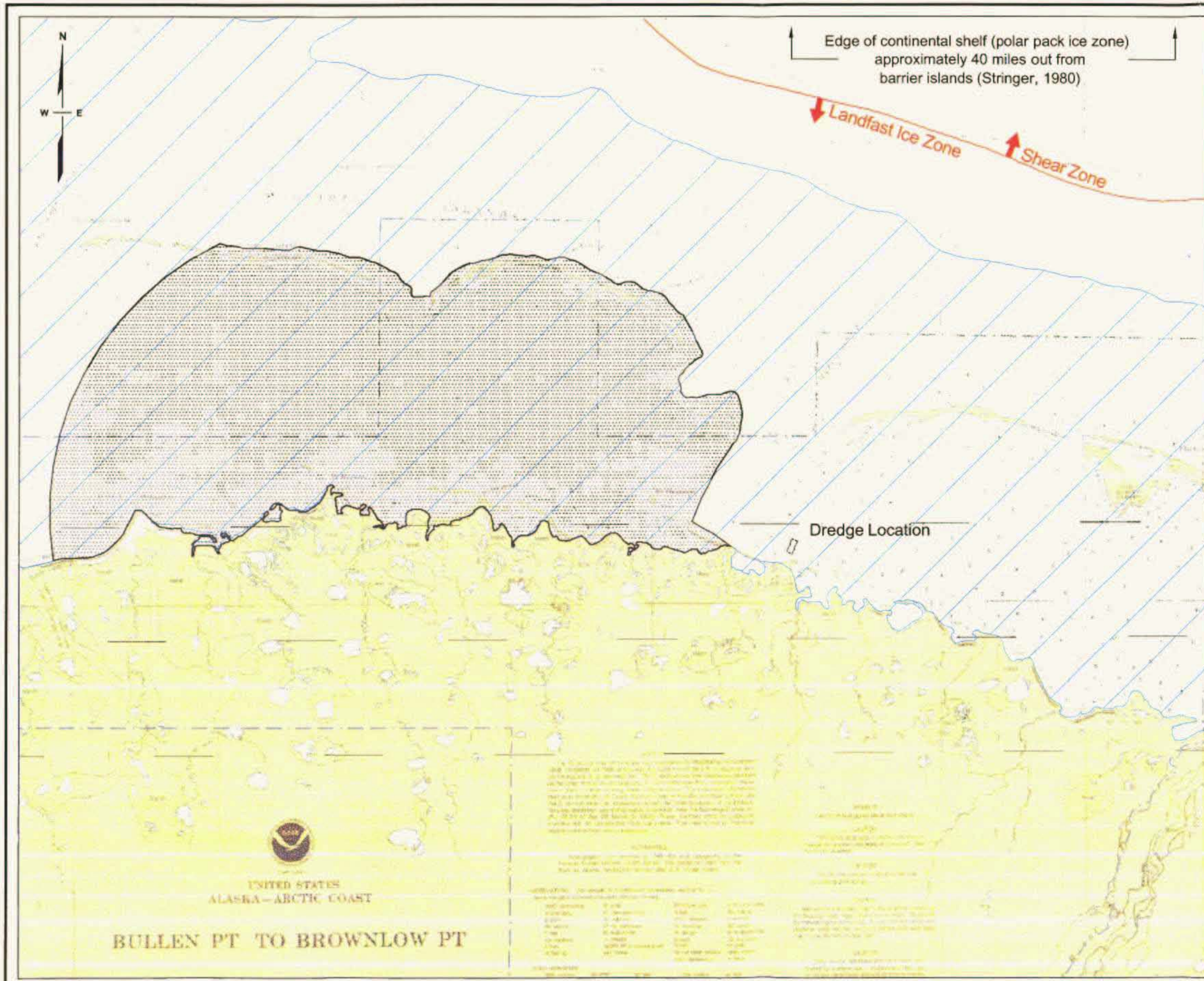

ExxonMobil

Point Thomson Gas Cycling Project

Figure 5-1
Winter Zone of Siting

LEGEND

- Zone of Siting
- Safe Ice Zone (0-45 foot isobath)
- Approximate Boundary of Stable Ice (Stringer, 1980) (~65 foot isobath)
- Unit Boundary

0 3500 7000 14000
SCALE IN FEET

Source: Base map from the National Oceanic and Atmospheric Administration (NOAA) nautical chart No. 16045, revised in 1996

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Pt_Thomson_ZSF.dwg SRJ 8-6-02

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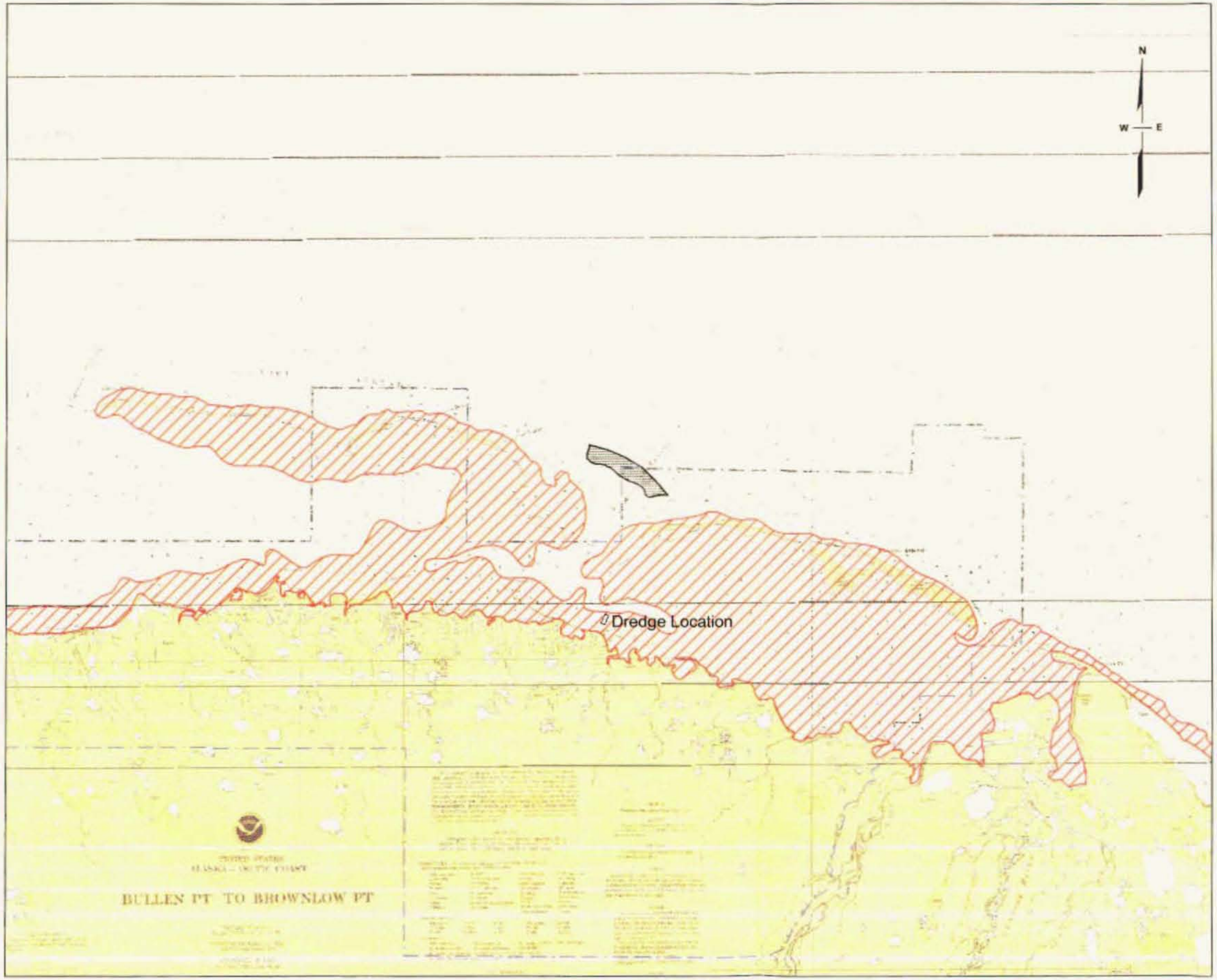

ExxonMobil

Point Thomson Gas Cycling Project

Figure 5-2
Summer Zone of Siting

LEGEND

Zone of Siting

Shallow Water Zone (less than 10 feet of water)

Unit Boundary

0 5,000 10,000 20,000
SCALE IN FEET

Source: Base map from the National Oceanic and Atmospheric Administration (NOAA) nautical chart No. 16045, revised in 1996

URS **Anchorage, Alaska**

APPENDIX A

CALCULATION SHEETS

WINTER OPTION

URS

CALCULATION SHEET

				Calc. No.			
Name	K. Swanson	Date	5/30/02	Checked	KB	Date	5/30/02
Project	Point Thomson Gas Cycling Project			Job No.	74-38877200.00		
Subject	Dredging and Disposal - Winter Option			Sheet	1	of	5

ASSUMPTIONS

Schedule

- Prudhoe to Point Thomson sea ice road construction will start November 15th and be completed by January 15.[b]
- Ice road traffic will be open on February 15.
- Ice road traffic will be closed on April 15.
- Mobilization and demobilization will take approximately 6 days total (144 hours) for North Slope equipment.
- Work will be conducted on a 24-hour per day schedule.
- Dredging operations will be continuous. Spoils could be temporarily stockpiled; however, continuous hauling is planned.

Equipment

- One backhoe will be used to excavate with an additional backhoe retained for contingency.
- 30-cy dump trucks will be utilized.
- Dump trucks are available on the North Slope.[b]
- Dump trucks can dispose of their contents without additional equipment within 5 minutes.
- Spoils excavated with a backhoe will gain about 5% volume from entrainment of additional seawater. Reference states that bucket has 100% efficiency; however, to be conservative, a 5% increase in volume has been assumed (95% efficiency).[e,g]
- The water/ice above the area to be dredged will be thickened and cut with a ditch witch prior to excavation of the ice with a backhoe.[b]
- The ditch witch will cut out the area to be dredged in eight passes with 50 ft between each pass; 8,400 linear feet will be cut.
- Calculations do not include time or materials to manipulate dredge spoils after they are deposited on the ice. It is anticipated that grading spoils within the ocean dumping zone will not result in extending the construction schedule.

Ice roads

- Standard ice road width is 35 ft with a maximum posted speed of 35 mph.[d]
- Ice roads are built at a standard rate of 1 to 2 inches of height per day. Production rates depend primarily on weather conditions and equipment limitations, but a standard assumption is 1 mile/day.[b]
- The sea ice road distance along the shoreline from Endicott to Point Thompson is approximately 42 miles and will be the primary ice road used for ground transportation.[f]
- The longest floating sea ice road that can feasibly be constructed is approximately 20 miles, using the maximum number of available pumper trucks (12).[b]
- Cost for an ice road near the shoreline in shallow water less than 2 ft deep is approximately $30,000 per mile. Ice road maintenance costs are approximately $7,500/day during ocean dredging and disposal activities to keep the road passable and remove snow drifts.[b]
- Costs for a floating ice road constructed on ocean depths ranging from 2 to 6 ft are approximately $100,000/mile, while a road constructed on depths greater than 6 ft are $300,000/mile. Maintenance costs are approximately $7,500/day.[b]

Miscellaneous

- Room and board will be provided by the project to the equipment operators.
- Support services, fuel and personnel will be available within the Point Thomson Unit.
- The existing gravel road distance from Deadhorse to Endicott is approximately 20 miles.
- The ice thickness over the dredge site will be approximately 7.5 feet thick.[h]

CALCULATIONS

Ice and Dredge Material Quantity

- The area to be dredged is 1,000 ft x 400 x 2 ft and is located in water 7 to 9 ft deep.[f]
- The volume of in situ material to be dredged is 30,000 cy.[f]
- Sea water weighs 0.83 tons/cy (assumed).
- Average fine to medium grained soil weighs 1.5 tons/cy (assumed).

Volume of sediment to be removed in cubic yards:
(30,000 cy) + 10% additional water for entrainment and efficiency (3,000 cy) = 33,000 cy

Volume of ice to be excavated:
(1,000 ft)(400 ft)(6 ft) = 2,400,000 ft^3 = 88,900 cy

Weight of sediment to be removed in tons:
(30,000 cy)(1.5 tons/cy) + (3,000 cy)(0.83 tons/cy) = 47,490 tons

Weight per volume of sediment:
(47,490 tons) / (33,000 cy) = 1.44 tons/cy

Excavating Equipment Specifications

2-cy bucket backhoe:
- Available on the North Slope.[b]
- Production rate is 130 cy/hr.[a]
- Average cost including two operators (one per 12-hr shift) is $4,000 per 24-hr day.[b]

Ditch witch:
- Available on the North Slope.[b]
- Production rate is 350 linear ft/hr.[c]
- Average cost for a ditch witch including an operator is $4 per linear foot.[b]

Duration to complete excavation of sediment, assuming continuous dredging:
(33,000 cy) / (130 cy/hr) = 254 hrs; (254 hrs) / (24 hrs/day) = 11 days

Duration to complete excavation of ice:
Ditch witch: (8,400ft) / (350 ft/hr) =24 hrs; (24 hrs) / (24 hrs/day) = 1 day
Backhoe: (88,900 cy) / (130 cy/hr) = 684 hrs; (684 hrs) / (24 hrs/day) = 29 days

URS **CALCULATION SHEET**

Calc. No. ______

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Subject	Dredging and Disposal - Winter Option			Sheet	3	of	5

Hauling Equipment Specifications

30-cy dump truck:

- Available on the North Slope.[b]
- Is allowed to travel 35 mph.[d]
- Average cost for a dump truck including an operator is $3,500 per day.[b]

Number of truck loads required:
(33,000 cy)/(30 cy/truck) = 1,100 truck loads

Time to load dump trucks by backhoe:
(30 cy/truck) / (130 cy/hr) = .23 hr/truck (about 14 minutes)

The following costs are a reasonable estimate of the costs associated with basic dredging and hauling operations and are to be used only for comparison between different dredging and hauling options.

ALTERNATIVES

Alternative 1: 2-cy bucket backhoe; Two 30-cy dump trucks; Continuous dredging

Cycle time = (time to load 1 truck) x (available trucks)
(.23 hrs/truck)(2 trucks) = .46 hours
Time available to travel = (cycle time) - (time to load 1 truck) - (time to dump 1 truck)
(.46 hrs)-(.23 hrs)-(.08 hrs) = .15 hours (9 minutes)
Maximum truck travel distance from dredge site = ((available travel time)(truck speed))/2 (roundtrip)
((.15 hrs)(35mph))/2 = **2.63 miles**
Cost to build ice road = (length) x (ice road cost over 6 ft deep) = (2.63 miles) x ($300,000/mile)
= $789,000
Cost per day = (2 backhoes/day) + (2 dump trucks/day) + (ice road maintenance/day) =
($4,000x2) + ($3,500x2) + ($7,500) = $22,500
Duration of operation = (mob/demob) + (excavation) = (6 days) + (11 days) = 17 days
Total cost = (cost to build ice road) + (cost per day x duration) =
($789,000) + ($22,500 x 17 days) = **$1,171,500**

Alternative 2: 2-cy bucket backhoe; Three 30-cy dump trucks; Continuous dredging

Cycle time = (time to load 1 truck) x (available trucks)
(.23 hrs/truck)(3 trucks) = .69 hours
Time available to travel = (cycle time) - (time to load 1 truck) - (time to dump 1 truck)
(.69 hrs)-(.23 hrs)-(.08 hrs) = .38 hours (23 minutes)
Maximum truck travel distance from dredge site = ((available travel time)(truck speed))/2 (roundtrip)
((.38 hrs)(35mph))/2 = **6.7 miles**
Cost to build ice road = (length) x (ice road cost over 6 ft deep) = (6.7 miles) x ($300,000/mile)
= $2,010,000
Cost per day = (2 backhoes/day) + (3 dump trucks/day) + (ice road maintenance/day) =
($4,000x2) + ($3,500x3) + ($7,500) = $26,000
Duration of operation = (mob/demob) + (excavation) = (6 days) + (11 days) = 17 days
Total cost = (cost to build ice road) + (cost per day x duration) =
($2,010,000) + ($26,000 x 17 days) = **$2,452,000**

URS | **CALCULATION SHEET**

Name	K. Swanson	Date	5/30/02	Checked	KB	Date	5/30/02
Project	Point Thompson Gas Cycling Project			Job No.	74-38877200.00	Calc. No.	
Subject	Dredging and Disposal - Winter Option			Sheet	4	of	5

Alternative 3: 2-cy bucket backhoe; Four 30-cy dump trucks; Continuous dredging

Cycle time = (time to load 1 truck) x (available trucks)
(.23 hrs/truck)(4 trucks) = .92 hours
Time available to travel = (cycle time) - (time to load 1 truck) - (time to dump 1 truck)
(.92 hrs)-(.23 hrs)-(.08 hrs) = .61 hours (37 minutes)
Maximum truck travel distance from dredge site = ((available travel time)(truck speed))/2 (roundtrip)
((.61 hrs)(35mph))/2 = **10.7 miles**
Cost to build ice road = (length) x (ice road cost over 6 ft deep) = (10.7 miles) x ($300,000/mile)
= $3,210,000
Cost per day = (2 backhoes/day) + (4 dump trucks/day) + (ice road maintenance/day) =
($4,000x2) + ($3,500x4) + ($7,500) = $29,500
Duration of operation = (mob/demob) + (excavation) = (6 days) + (11 days) = 17 days
Total cost = (cost to build ice road) + (cost per day x duration) =
($3,210,000) + ($29,500 x 17 days) = **$3,711,500**

Alternative 4: 2-cy bucket backhoe; 4 30-cy dump trucks; Continuous dredging; No floating ice road

Cycle time = (time to load 1 truck) x (available trucks)
(.23 hrs/truck)(4 trucks) = .92 hours
Time available to travel = (cycle time) - (time to load 1 truck) - (time to dump 1 truck)
(.92 hrs)-(.23 hrs)-(.08 hrs) = .61 hours (37 minutes)
Maximum truck travel distance from dredge site = ((available travel time)(truck speed))/2 (roundtrip)
((.61 hrs)(35mph))/2 = **10.7 miles**
Cost per day = (2 backhoes/day) + (4 dump trucks/day) =
($4,000x2) + ($3,500x4) = $22,000
Duration of operation = (mob/demob) + (excavation) = (6 days) + (11 days) = 17 days
Total cost = (cost per day)(duration) =
($22,000)(17) = **$374,000**

URS **CALCULATION SHEET**

Calc. No. ____________

Name	K. Swanson	Date	5/30/02	Checked	KB	Date	5/30/02
Project	Point Thompson Gas Cycling Project			Job No.	74-38877200.00		
Subject	Dredging and Disposal - Winter Option			Sheet	5	of	5

FOOTNOTES

References

a. 2001 R.S. Means. *Heavy Construction Cost Data*. 15th Addition. Construction Publishers and Consultants. 2000.

b. AIC, Anchorage. Phone call from Ms. Kristina Swanson (URS) to Mr. Ken Yokey (AIC) on May 21, 2002.

c. AIC, Anchorage. Phone call from Ms. Kristina Swanson (URS) to Mr. Ken Yokey (AIC) on May 30, 2002.

d. AIC, Deadhorse. Phone call from Ms. Kristina Swanson (URS) to Mr. Jim Workman (AIC) on May 20, 2002.

e. General Construction, Seattle. Phone call from Ms. Kristina Swanson (URS) to Mr. Ron McCray (General) on May 29, 2002.

f. URS, Anchorage. *Point Thomson Gas Cycling Project Environmental Report*. July 30, 2001.

g. U.S. Army Corps of Engineers. *Dredging and Dredged Material Disposal.* March 25, 1983.

h. MMS 1996

SUMMER OPTION

URS

CALCULATION SHEET

Name	K. Swanson	Date	5/30/02	Checked	KB	Date	5/30/02
Project	Point Thomson Gas Cycling Project			Job No.	74-38877200.00		
Subject	Dredging and Disposal - Summer Option			Sheet	1	of	4

Calc. No.

ASSUMPTIONS

Schedule

- Due to sea ice, Point Barrow is not open for marine traffic until August 1.
- Due to sea ice, marine traffic from West Dock to Point Thomson Unit is not open until July 15 at the earliest and July 25 at the latest.
- Due to fall whaling activities, marine traffic from West Dock to Point Thomson Unit is closed on August 31.
- Sealifts will arrive at Point Thomson on August 10.
- Summer dredging activities and the transportation of Point Thomson modules will happen within the same season.
- Mobilization and demobilization will take approximately 6 days total (144 hours) for North Slope equipment.
- Work will be conducted on a 24-hour per day schedule.
- Dredging operations will be continuous and spoils will not be stockpiled; therefore, barges have to keep up with dredging.

Equipment

- Due to North Slope availability, no more than 2 self-propelled barges would be available for use at one time.[c]
- Barges are already equipped to contain dredge spoils and can dump their load without additional equipment within 60 minutes.
- One dredge will be used to excavate and an additional dredge (either backhoes or cutter-head suction dredges) retained contingency.
- Spoils excavated with a backhoe will gain about 5% volume from entrainment of additional seawater. Reference states that bucket has 100% efficiency; however, to be conservative, an additional 5% increase in volume has been assumed (95% efficiency).[d,f]
- Spoils excavated with a cutter-head suction dredge will gain approximately 650% volume from seawater (approximately 15% efficiency).[b,f]

Miscellaneous

- Room and board will be provided by project to the equipment operators.
- Support services and personnel will be available within the Point Thomson Unit.

URS | **CALCULATION SHEET**

Calc. No. ______

Name K. Swanson Date 5/30/02 Checked KB Date 5/30/02

Project Point Thomson Gas Cycling Project Job No. 74-38877200.00

Subject Dredging and Disposal - Summer Option

CALCULATIONS

Dredge Material Quantity

- The area to be dredged is 1,000 ft x 400 x 2 ft and is located in water 7 to 9 ft deep.[e]
- The volume of in situ material to be dredged is 30,000 cy.[e]
- Sea water weighs 0.83 tons/cy (assumed).
- Average fine to medium grained soil weighs 1.5 tons/cy (assumed).

Volume of material to be removed in cubic yards:

Cutter-head suction dredge = (30,000 cy) + 650% entrained sea water (195,000 cy) = 225,000 cy
Backhoe = (30,000 cy) + 10% additional water for entrainment and efficiency (3,000 cy) = 33,000 cy

Weight of material to be removed in tons:

Cutter-head suction dredge = (30,000 cy)(1.5 tons/cy) + (195,000 cy)(0.83 tons/cy) = 206,850 tons
Backhoe = (30,000 cy)(1.5 tons/cy) + (3,000 cy)(0.83 tons/cy) = 47,490 tons

Weight per volume per dredging method:

Cutter-head suction dredge = (206,850 tons) / (225,000 cy) = 0.92 tons/cy
Backhoe = (47,490 tons) / (33,000 cy) = 1.44 tons/cy

Excavating Equipment Specifications

Cutter-head suction dredge:

- Available on the North Slope.[b]
- Production rate is 65 cy/hr.[b,f]
- Average cost including an operator is $1,000 per 24-hr day.[b]

2-cy bucket backhoe:

- Available on the North Slope.[b]
- Production rate is 130 cy/hr.[a]
- Average cost including an operator is $4,000 per 24-hr day.[b]

Duration to complete excavation, assuming continuous dredging:

Cutter head suction dredge:(225,000 cy)/(65 cy/hr) = 3,462 hrs; (3,462 hrs)/(24 hrs/day) = 144 days
2 cy bucket backhoe: (33,000 cy) / (130 cy/hr) = 254 hrs; (254 hrs) / (24 hrs/day) = 11 days

Hauling Equipment Specifications

Self-propelled hopper barge:

- Available on the North Slope.[c]
- Travels at an average speed of 7 mph.[c]
- Requires approxiately 8 ft of draft water depth to navigate when fully loaded.[c]
- Can travel 300 miles on one fuel tank.[c]
- Average capacity of 400 tons.[c]
- Average cost including an operator is $15,000 per 24-hr day.[c]

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Project Point Thomson Gas Cycling Project Job No. 74-38877200.00

Subject Dredging and Disposal - Summer Option

Hauling Equipment Specifications Cont'd

Number of barge loads required:

- Self-propelled barge with cutter-head suction dredge = (206,850 tons) / (400 tons/barge) = 517 barge loads
- Self-propelled barge with 2 cy bucket backhoe = (47,490 tons) / (400 tons/barge) = 119 barge loads

Time to load barges:

Self-propelled barge with cutter-head suction dredge = (65 cy/hr)(0.92 tons/cy) = 60 tons/hr;
(400 tons/barge) / (60 tons/hr) = 7 hrs/barge
Self-propelled barge with 2 cy bucket backhoe = (130 cy/hr)(1.44 tons/cy) = 187 tons/hr;
(400 tons/barge) / (187 tons/hr) = 2.1 hrs/barge

The following costs are a reasonable estimate of the costs associated with basic dredging and hauling operations and are to be used only for comparison between different dredging and hauling options.

ALTERNATIVES

Alternative 1: 2 cy bucket backhoe; self-propelled barge; continuous dredging and loading

Cycle time = (time to load 1 barge) x (available barges)
(2.1 hrs/barge)(2 barges) = 4.2 hours
Time available to travel = (cycle time) - (time to load 1 barge) - (time to dump 1 barge)
(4.2 hrs)-(2.2 hrs)-(1 hr) = 1hour
Maximum barge travel distance from dredge site = ((available travel time)(barge speed))/2 (roundtrip)
((1hr)(7 mph))/2 = **3.5 miles**
Cost per day = (2 backhoes/day) + (2 barges/day) = ($4,000x2) + ($15,000x2) = $38,000
Duration of operation = (mob/demob) + (excavation) = (6 days) + (11 days) = 17 days
Total cost = (cost per day) x (duration) = ($38,000) x (17 days) = **$646,000**

Alternative 2: Cutterhead-suction-dredge; self-propelled barge; continuous dredging and loading

Cycle time = (time to load 1 barge) x (available barges)
(7 hrs/barge)(2 barges) = 14 hours
Time available to travel = (cycle time) - (time to load 1 barge) - (time to dump 1 barge)
(14 hrs)-(7 hrs)-(1 hr) = 6 hours
Maximum barge travel distance from dredge site = ((available travel time)(barge speed))/2 (roundtrip)
((6 hrs)(7mph))/2 = **21 miles**
Cost per day = (2 dredges/day) + (2 barges/day) = ($1,000x2) + ($15,000x2) = $32,000
Duration of operation = (mob/demob) + (excavation) = (6 days) + (144 days) = 150 days
Total cost = (cost per day) x (duration) = ($32,000) x (150 days) = **$4,800,000**

Alternative 3 : Cutterhead-suction-dredge; side-casting; continuous dredging and loading

Cost per day = (2 dredges/day) = $1,000x2 = $2,000
Duration of operation = (mob/demob) + (excavation) = (6 days) + (144 days) = 150 days
Total cost = (cost per day) x (duration) = ($2,000) x (150 days) = **$300,000**

URS

CALCULATION SHEET

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Subject	Dredging and Disposal - Summer Option			Sheet	4	of	4

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FOOTNOTES

References

a. 2001 R.S. Means. *Heavy Construction Cost Data*. 15th Addition. Construction Publishers and Consultants. 2000.

b. AIC, Anchorage. Phone call from Ms. Kristina Swanson (URS) to Mr. Ken Yokey (AIC) on May 21, 2002.

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f. U.S. Army Corps of Engineers. *Dredging and Dredged Material Disposal.* March 25, 1983.