US Army Corps of Engineers
Alaska District

ALASKA BARGE LANDING SYSTEM DESIGN STATEWIDE PHASE 1

Various Locations, Alaska

FINAL REPORT

JANUARY 2009

Alaska Barge Landing System Design
Data Gathering Study and Preliminary Design Planning

Various Locations, Statewide, Alaska
Phase 1

Prepared for:

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ACRONYMS AND ABBREVIATIONS

°F	degrees Fahrenheit
ADOT&PF	Alaska Department of Transportation and Public Facilities
ANTHC	Alaska Native Tribal Health Consortium
ATV	all terrain vehicle
ASCE	American Society of Civil Engineers
AVEC	Alaska Village Electric Cooperative
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
CDQ	Community Development Quota
Commission	Denali Commission
CVRF	Coastal Villages Region Fund
DCCED	Alaska Department of Commerce, Community and Economic Development
ft	Feet
Knik	Knik Construction
LOA	length overall
M	million
mph	miles per hour
NRCS	Natural Resources Conservation Service
NSEDC	Norton Sound Economic Development Corporation
OPCC	Opinion of Probable Construction Costs
RO/RO	roll-on / roll-off
Shannon & Wilson	Shannon & Wilson, Inc.
TNH	Tryck Nyman Hayes, Inc.
US	United States
USACE	US Army Engineers, Alaska District
VSW	Village Safe Water

EXECUTIVE SUMMARY

Introduction

In 2007, the Denali Commission (Commission) partnered with the US Army Corps of Engineers, Alaska District (USACE) to develop a Statewide Barge Landing Assessment to analyze barge mooring and fuel/freight transfer needs at Alaska's coastal and riverside communities. This work was undertaken to further the general findings of three studies that had previously identified barge landing improvements as a critical need in rural Alaska.

The Commission provided funding, scoping, and general services to their partner USACE, who provided professional and technical services for the project. USACE hired Tryck Nyman Hayes, Inc. (TNH) to develop the barge landing needs analysis in concert with barge operators, freight and fuel companies, state and federal agencies, and community development groups. The Assessment reflects those findings. The Assessment contains:

- Catalog of existing facilities
- List of barge landing infrastructure improvement needs by community
- An assessment of potential design solutions to address the general categories of infrastructure need
- Concept-level design drawings for selected designs that address a wide range of site conditions expected in the regions covered by the study
- Project ranking system used to develop priority needs
- List of projects that ranked highest in the priority ranking system for a first generation of design and construction (Priority Sites)
- Site plans showing possible landing site improvements at each of the Priority Sites
- Estimates of probable construction costs associated with the proposed improvements at each of the Priority Sites

This Executive Summary consists of an outline of barge landing needs, design features that address those needs and a table identifying improvements selected for a first generation of projects.

For this first phase of the Assessment, the analysis team focused its attention on the Alaska Peninsula, the Yukon, Kuskokwim and Kobuk Rivers, and the Bering, Chukchi and Beaufort Sea coasts. Barging is the dominant re-supply method for communities throughout these areas of Alaska, and in most cases, the shore side receiving facilities are entirely absent or primitive. DOT&PF has requested that the remaining areas of the state be reviewed in a similar manner so that all community needs are identified in a single document. This work, funded in large part by DOT&PF, is being undertaken in a second phase of work, and the results will be incorporated into the Assessment.

The goal of the Assessment is to identify for construction, projects that will improve barge operations, increase worker and environmental safety and/or cumulatively improve fuel and freight delivery costs through system improvements. Shore side improvements will also take into consideration other vessels at each community, including subsistence fishing fleets, commercial fleets represented by the Community Development Quota (CDQ) groups, other local fleets, and construction material supply operations. In addition, the Assessment identifies operational improvements that could be implemented by the communities themselves, including most importantly, consolidation of marine fuel header locations to facilitate a single stop/landing for delivering fuel in each community.

In some communities, especially at sites exposed to severe weather, or where the landing sites are unconsolidated beach materials and/or are subject to rapidly changing ocean conditions, barge operations will continue as they do now to land when and where practical, holding firm through tug maneuvering. In most communities however, some level of infrastructure improvements are both practical and cost-effective. For example, the Assessment illustrates that relatively inexpensive mooring points were identified as the greatest need in most communities.

The Assessment outlines improvements that barge operators and other users have identified for each community via an interview process. In addition, the study prioritizes the sites to identify those projects that would be suitable for a first generation of capital improvements (referred to as Priority Sites in this report). Conceptual landing facility improvement designs, site plans and associated construction cost estimates have been completed and are included to facilitate discussions with community and user groups, and to prepare a capital projects list for Commission funding.

Background

Fuel is the primary product delivered to rural communities. Deck freight, delivered along with fuel orders or separately on regular scheduled barges, is the second highest volume of products delivered. Deck freight is generally delivered as steel shipping containers and break-bulk cargo (loose non-containerized material such as long lengths of pipe and timber, vehicles, palletized cargo, etc.).

The third key delivery product is construction materials delivered by chartered barges. These products are generally associated with community construction projects like schools, fuel tank farms, health clinics and airports. In addition, commercial fishing vessels and tenders operate in the area of barge landing sites.

In general, barge operators and communities report that the larger communities such as Nome, Bethel, and St. Mary's have sufficient barge landing facilities in place and are in relatively good shape, with the exception that maintenance upgrades are needed at some sites. The barge operators also report that in general, the communities on the lower Yukon and Kuskokwim Rivers have the most difficult landings, and are most in need of improvements. Especially problematic are those that have marginal permafrost, soft soils and high erosion rates, and low-lying villages with boardwalks and utilities close to the shoreline that get in the way of offloading operations. The report finds that improvements at these sites would generally consist of gravel causeways or ramps, docks, stabilized staging pads, and/or barge mooring points.

Fuel deliveries are generally made by side tying to a dock, where available, or in most cases by pushing the front of the barge into the beach and holding it in place with the tug while product is pumped through hoses to shore-based fuel headers or tanks. The key issues that impede operational efficiency in fuel deliveries include:

- Multiple tanks and/or headers, each of which requires a separate barge landing within the same community. This extends delivery times, and at some tidally-influenced sites can halt operations for up to 24 hours.
- Tank farms that have no marine header, so fuel delivery operations require dragging hose up to 1,500 feet to the tank farm locations. This increases worker safety and environmental risks associated with longer hose runs. These circumstances also extends the time it takes to offload fuel.
- Barges cannot access the beach in front of a fuel header or tank due shallow water or because of large boulders or other hazards near the shore. In these cases, fuel barges anchor offshore and float the hoses to shore. Although fuel transfers are done as safely as possible, floating hose to the shore increases operational risks, including environmental risk associated with potential spills.

Barge Landing Designs

Conceptual designs were developed to address barge landing facility improvement types recommended by user groups during the interview process. A drawing was created to illustrate each of the design concepts including:

- Several options for mooring points including gravity anchor deadmen, concrete block deadmen, buried navy anchor, and stake piles as well as mooring bollards associated with a dock or wharf.
- Gravel pads for use as staging areas to offload and store cargo and materials, ranging in size from 10,000 to 40,000 square feet depending on the size of community and volume of goods delivered.
- Gravel causeway or access ramp consisting of a gravel spit that juts out into the water, protected from erosion and ice on each side by armor rock, with smaller, sacrificial rock at the end to provide for a softer barge-landing surface. These facilities are appropriate in areas where access to deeper water is required; where ice-damming is not a significant issue and regular maintenance of the structure can be accomplished.
- Concrete plank ramp, including driven sheet pile to retain the gravel and planks on each side and to retain the upper slope. This type of structure can also include a geotextile filter fabric wrap around the gravel to protect the material from scouring. Additional armor rock may be added in areas where high erosion or ice damming is a concern. This is a more robust structure intended for use in areas where a permanent hard surface across the beach is needed and where appropriate slopes can be accomplished.
- The diaphragm cellular sheet pile bulkhead dock is chosen as the recommended dock design for appropriate sites within the study area. It is chosen because of the design's flexibility to the varying and remote conditions expected at the range of locations in western Alaska, and its high

performance in less stable conditions such as weak soils and erosion, which are known to exist at many sites as well as its relative ease of construction. During the design phase of each dock project it may be determined that existing site conditions allow for an alternate, more cost-effective dock design.

- A combination sheet pile bulkhead dock and earthen ramp structure has also been developed based on recommendations by the barge operators to allow flexibility for side, end and ramp offloading. This type of configuration is found in locations like St. Mary's and works especially well for sub region hubs where freight redistribution occurs.

Recommendations

The following recommendations are central to development of a barge landing design and construction program at the Commission.

Fuel Deliveries

The primary recommendation for improving fuel delivery operational efficiency is to consolidate marine fuel headers to a single landing site location at communities where multiple landings are currently required (i.e., power company, school, village corporation and/or stores all have separate tanks and headers).

A second recommendation is to improve environmental concerns associated with floating fuel hose to shore by providing barge access to the shore. This effort could include removing navigation hazards and/or relocating the barge landing to a site where shore side receiving is practical.

Fuel system improvements such as header and pipeline work are generally not included in the scopes of work emerging from this analysis, however the Commission will work with individual communities and tank farm operators to find opportunities to combine these improvements in individual projects where practical.

In some communities, a gravel causeway into the water may be a feasible approach to reaching sufficient water depth. In other cases, especially in areas of very shallow water, installing a new landing facility or dredging may not be practical. In these communities, relocating tanks and/or fuel headers may be the most feasible approach to improved delivery.

About 33 communities in the proposed project list have long hose runs and/or multiple stops at fuel tank farms in the community. About ten of these sites do not currently have marine fuel headers, resulting in the need for extensive fuel hose runs from the beach up to the tank farms. Fuel barge operators indicate all parties would benefit from providing marine fuel headers and consolidating the location of the headers at a single landing site. Future planning for locating headers should consider barge operators' recommendations for placement. They indicate that the header location is ideal if installed no more than 300 feet from the landing site, while about 100-feet from the landing is preferred.

It is often difficult to access the upper river villages and it would be ideal to go to these communities once a year instead of two times a year for fuel deliveries. Providing a centralized tank farm, capable of annual fuel storage, would facilitate this goal.

In addition, in many villages there is a need to consolidate tank farms or at a minimum, bring separate pipelines to a consolidated headers system. These shore side improvements offer significant opportunities to improve barge operations. Communities and the Commission will examine the potential to build new headers or consolidate existing headers to avoid the increased time/cost associated with multiple barge landings and long hose runs. Providing and properly co-locating marine fuel headers should also be a primary consideration for all future fuel tank and distribution project upgrades in these communities.

Freight Deliveries

Freight deliveries are generally accomplished by a tug and barge, or landing craft nosing into shore, lowering a ramp and using loaders or forklifts to offload or board goods. Another method of on/offloading used by some barges is to side-tie to a dock or land parallel to shore and side-load using a crane that is positioned either on the barge or onshore. Key difficulties associated with freight deliveries include:

- Soft soils on the beach make driving loaders difficult
- Environmental concerns associated with disturbing the river bottom and changing navigation channels when pushing into the beach as well as the additional fuel expenditure needed to do this
- Keeping position in areas with swift currents without dedicated mooring
- Limited dry storage areas located close to the landing site
- Roads may not be wide enough for bulk materials to pass

The foremost recommendation to improve landings at communities is to install mooring points to hold position and to provide upland storage pads/staging areas. Where practical and needed, the Commission program will seek to design and construct dedicated landings such as a bulkhead dock or ramp to improve and expedite freight transfers. At a number of sites, this work may also include single instance dredging or rock removal at the landing site.

Summary of Needs

All parties involved in the assessment including barge operators, transportation planning experts and engineering specialists agree that even small-scale practical improvements at most sites will significantly improve delivery services, help to contain costs, improve worker safety, lower environmental risk, and/or provide better product quality at the end destination. Landing facility improvements needs (not including fuel system upgrades) in order of priority are:

(1) Installing mooring points with chains for tie-offs

(2) Upland staging areas/gravel pads for freight operations,

(3) Dredging for access to shallow areas or for navigation safety (i.e., removing specific boulder hazards)

(4) A dedicated landing site including permanent ramps and/or bulkhead docks with erosion protection

(5) Minor repairs to existing facilities such as dock repairs, widening, grading or repairing landings, erosion protection, road widening, and staging area improvements

More than 50 percent of the communities studied need mooring points that will allow barge operators to control position, which will increase safety during freight and fuel offloading and decrease the potential for environmental damage caused by prop wash while they are "pushing" onto the beaches.

At a minimum communities with multiple fuel tank farm and/or freight delivery points, need mooring points at each delivery site. . The ideal capital project in these cases would be to develop a single fuel header location at the landing for all fuel customers in a community. Until the ideal project can be realized, mooring points at separate landings would be relatively inexpensive and are considered the primary and immediate need.

The freight delivery companies and communities, in general expressed a desire for construction of stable, dedicated gravel storage pads located at or near the landing sites. About 40 communities would experience increased operational efficiency if these stable gravel pads were constructed. A gravel staging area would also provide a dedicated location to store shipping containers for fall pickup, which would improve operational efficiencies and minimize the chance of the containers sinking and freezing into the tundra or beaches.

Barge operators reported it would be beneficial for about 50 communities to have ramps and/or wharfs or docks to increase operational efficiency and improve worker and environmental safety. Of these communities, there are up to 20 communities that are experiencing increased activity levels and/or may have suitable site conditions and could benefit from a sheetpile dock structure.

Five or so communities in the proposed project list require minor dredging such as boulder/hazard removal to improve access to landing sites. An additional seven communities were identified as possibly benefiting from more involved dredging in order to maintain safe, all-tide access to the sites or to eliminate the need for lightering to shore. One of these sites, Quinhagak, was cited as needing immediate emergency dredging in order to allow continued fuel deliveries. While one-time boulder/hazard removal may well be practical in a Commission transportation program, dredging improvements need to be carefully considered for their long-term stability. Routine or repeat maintenance dredging is not practical under the Commission's funding parameters. For these sites, a feasibility study of dredging and/or alternate landing sites was recommended as a first step to making a practical long-term improvement.

The Priority Projects

Thirty-Five Priority Sites, with a total preliminary cost estimate of about $50 Million are recommended for the first round of barge landing facility improvements. The Priority Sites were chosen based on a scoring matrix that evaluated:

- the urgency of need/time frame in which a project can be completed
- frequency of use and impact for a community
- the relative simplicity for which the project can be planned and constructed

The goal of the scoring exercise is to determine which sites have the most positive impact for the funds expended and are projects that can reasonably be expected to be ready for near-term funding and construction.

Opinion of Probable Construction Cost (OPCC) estimates were prepared for each of the Priority Sites to assist the Commission with the planning and budgeting the first generation of work. These estimates were completed based on a stand-alone project and include budget-level estimates for mobilization, field investigation, design, and construction administration or for execution of a feasibility study. Reflecting a key program goal, there has also been an effort to recommend reasonable grouping, or bundling of projects to realize savings on costs associated with mobilization and materials purchases.

The result is 10 bundled projects, each less than $10M and grouped together based primarily on geography. The following table summarizes the proposed projects and associated OPCCs.

Proposed Alaska Barge Landing Facility Improvements, Priority Sites

<table>
<tr><th>#</th><th>Region</th><th>Community</th><th>Brief Description of Recommended Barge Landing Facility Improvements</th><th>Total Estimated Cost</th><th>Bundled Project Cost</th></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Norton Sound/ Bering Sea</td><td>Elim</td><td>Provide a ramp and staging area, preferably at a co-located fuel and freight landing site to reach deeper water and avoid rocks and sewer outfall. Site conditions and land availability may preclude a co-located site; and two separate ramps may be considered. Design should include mooring points.</td><td>$3.12M</td><td rowspan="3">$6.96M (3 sites)</td></tr>
<tr><td>White Mountain</td><td>Provide 2 mooring points at each of 2 landing sites.</td><td>$0.16 M</td></tr>
<tr><td>Savoonga</td><td>Fuel barge anchors and floats hose in to shore and freight barges land 2 miles west, in the bay. Provide a dock or gravel causeway to at the freight landing to allow them to drop their bow ramp while staying offshore to avoid rocks, and a ramp to the upland area. Design should include erosion protection and mooring points. Improvements at the fuel landing site may include mooring dolphins and/or coastal protection; however, this requires a site investigation to determine feasibility, siting, and other site specific information.</td><td>$5.01M</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Lower Yukon River and Delta</td><td>Alakanuk</td><td>Provide a gravel causeway/ramp and 2 mooring points at a new barge landing site, plus mooring points at 3 other landing sites.
Two optional locations for the gravel causeway are shown. Option A utilizes the existing landing near already developed upland staging areas; however it is at a highly erodible location. Option B shows an alternate location, with a new staging area.</td><td>A:$1.03M
B:$2.01M*</td><td rowspan="2">$3.92 M (4 sites)</td></tr>
<tr><td>Mountain Village</td><td>Improve the existing gravel causeway/ramp at the City landing site and provide an upland staging area. Install 3 mooring points each at the Native Corporation landing and the City landing and provide 2 mooring points at the fuel barge landing for the School/AVEC tanks.</td><td>$1.62 M</td></tr>
</table>

#	Region	Community	Brief Description of Recommended Barge Landing Facility Improvements	Total Estimated Cost	Bundled Project Cost
		Anvik	Provide a gravel or concrete ramp and 3 mooring points at the existing barge landing located adjacent to the fuel header.	$1.19M	
		Grayling	Install 2 new mooring points at the downriver landing site, located just south of the access road. In addition, replace the cable with chain at the three existing cable/deadmen mooring points located in the trees at the upriver fuel barge landing.	$0.15M	
3		Emmonak	Provide a sheet pile dock with a downstream ramp. Provide improvements to expand the existing staging area in the adjacent uplands. Also provide 2 mooring points both at this site as well as at the downstream fuel landing for the Store.	$7.12M	$9.09 M (2 sites)
		Kotlik	Provide a sheet pile dock with a downriver loading ramp. Extend dock out 20-ft min. from shoreline and provide 50-ft min. width ramp. Provide gravel pad at the existing upland staging area and consider expansion of the staging area to the south.	$2.63M	
4	Middle Yukon River	Nulato	Install 3 mooring points at the existing co-located fuel/freight barge landing site and one additional mooring point above the waterline at the upland AVEC fuel barge landing site.	$0.13M	$2.41 M (10 sites)
		Galena	Provide 3 mooring points at one fuel landing and 2 mooring points at an upriver fuel landing.	$0.15M	
		Tanana	Install 2 mooring points at 2 upriver fuel barge landings and 4 mooring points along the beach landing in front of the runway.	$0.19M	
	Upper Yukon River	Stevens Village	Provide total of 4 mooring points at 2 barge landing sites.	$0.13M	
		Fort Yukon	Provide total of 8 mooring points at 3 barge landing areas.	$0.19M	
	Kuskokwim River Delta	Quinhagak (Kwinhagak)	A feasibility study is a priority to analyze alternatives for long-term access to this site. Some alternatives suggested include: A: Dredge an access channel to the existing City dock. Periodic maintenance dredging would likely be required. B: For a long term solution, consider providing a new dock at a landing site that is not experiencing problems with sediment accretion. o One alternate site is on a spit of land upriver. A residential house is nearby, and property ownership issues may need to be resolved. o Another option would be to study whether Arolik Creek is accessible by barge and constructing a new landing facility at the end of the existing 3+ mile long Arolik Rd., on Arolik Creek.	$0.16M	
		Chefornak	Improve and widen existing gravel causeway with new armor rock and smaller 6" minus rock at landing end. Dredge boulders from shallow area (<6ft) around causeway.	$0.78M	

#	Region	Community	Brief Description of Recommended Barge Landing Facility Improvements	Total Estimated Cost	Bundled Project Cost
5		Toksook Bay	Provide gravel ramp to extend 100-ft or more from shore to reach water deep enough to land. At a minimum, consider dredging out large rocks in shallow water near the landing site.	$0.85M	
		Chevak	Provide three mooring points at the existing beach landing site.	$0.12M	
		Goodnews Bay	Provide dedicated upland staging areas and 5 mooring points at the existing beach landing areas. Additionally, study the feasibility of deepening the existing channel from Platinum to allow passage of vessels drawing 6-ft or more.	$0.70 M	
		Kongiganak	Provide a sheetpile dock and staging area. A 500 to 1000-ft long access road to the staging area may be required to reach uplands area (Another project is possibly underway to accomplish some of this work as part of airport work). Also, provide mooring points at two upriver fuel barge landing sites.	$3.51M	$8.74 M (3 sites)
		Kwigillingok	Provide a co-located fuel/freight landing at the downriver fuel landing area by installing an upland staging area using a thick layer of crushed rock and gravel to create dry ground. Install mooring points at this landing area as well as at the downriver fuel landing, located near the Native Corp. building.	$3.30M	
		Kipnuk	Provide 3 mooring points at the fuel header/landing site. Provide a sheetpile dock and ramp, and a gravel pad at the existing upland staging area at the freight landing site.	$2.93M	
6	Lower Kuskokwim River	Eek	Provide a causeway/ramp to reach deeper water and provide stable surface for offloading. Provide 2 mooring points and expand upland staging area.	$2.49M	$3.58 M (4 sites)
		Akiachak	Install 2 mooring points at the fuel/freight barge landing site.	$0.10M	
		Nunapitchuk	Option A in the Site Plan presents one possible co-located fuel/freight ramp landing located on the same side of the river as the main part of the community. Requires a site investigation to determine whether there is sufficient depth available for barge access. Option B in the Site Plan presents an option for development of the existing landing site at the fuel barge landing area located north of the airport landing area, across the river from the community. For this option, provide a co-located fuel/freight barge ramp landing and staging area. This is low elevation and likely susceptible to flooding and would require more fill for a dry staging area.	A:$1.36M* B:$0.49M	

#	Region	Community	Brief Description of Recommended Barge Landing Facility Improvements	Total Estimated Cost	Bundled Project Cost
		Napaskiak	A feasibility study is a priority to analyze alternatives. Some alternatives may include: Option A: Improvements to existing landing area. Provide a gravel ramp with erosion protection and expand and elevate the existing upland staging area. Dredge the washout area on the opposite bank and shallow area in front of the landing. A study is required to determine the feasibility of maintaining dredging before proceeding. Option B: Alternatively, a new landing site could be developed in an area of less sediment accretion. Provide a new concrete ramp and a new staging area. Three mooring points would be needed at this landing due to the swifter currents along the main branch of the Kuskokwim River.	$0.13 M	
7	Middle Kuskokwim River	Upper Kalskag	Install 2 mooring points at both the fuel and the freight barge landing sites.	$0.13M	$3.07 M (3 sites)
		Aniak	Provide a dock and upland staging area for freight, near the existing freight barge landing area. Although somewhat steep, a ramp could be provided on the downstream end of the dock. 25,000 to 30,000 sq. ft. of staging area is recommended for this small hub community. Also, provide 2 mooring points at the fuel barge landing area.	$3.09M	
	Upper Kuskokwim	McGrath	Provide a gravel ramp and 3 mooring points to facilitate offloading from fuel barge/lighter vessel.	$0.35M	
8	Bristol Bay	New Stuyahok	Create a new dedicated barge landing site, near the downriver end of the community. Provide a gravel or concrete plank ramp, a staging area, and access to the road system.	$2.71M	$2.71 M (1 site)
9	Kotzebue Sound	Buckland	Provide a new landing site and upland staging area located closer to the existing marine fuel header. Grading and/or a small gravel ramp may be needed to create room for landing at the new site. A site assessment is required to confirm that access to this area is feasible and/or whether rock hazards can be removed. At a minimum, install mooring points at the existing landing area.	$1.73M	$5.06 M (3 sites)
	Kobuk River	Noorvik	Install 2 mooring points at each of 4 landing sites. Provide a gravel ramp and upland staging area near the existing freight barge landing area.	$2.07M	
		Kiana	Provide improvements and a dedicated barge landing upriver of the existing freight barge landing area, to alleviate the issues associated with mooring at the confluence of the rivers. Improvements include a new upland staging area, access road, and mooring points. In addition, mooring points are needed at the downriver fuel barge landing.	$2.25M	
10	Aleutians	Pilot Point	Provide two mooring points at the fuel/freight barge landing site.	$0.10M	$0.10 M (1 site)
TOTALS:				**$45.6 M**	**$52.6 M**

*Where two project options are presented, the option with the higher estimated individual cost was used to estimate the bundled project cost.

1.0 INTRODUCTION

In March 2007, the Denali Commission (Commission) partnered with the US Army Corps of Engineers, Alaska District (USACE) to develop a Statewide Barge Landing Assessment (Assessment) to analyze barge mooring and fuel/freight transfer needs at Alaska's coastal and riverside communities. This work was undertaken to further the general findings of three studies that had previously identified barge landing improvements as a critical need in rural Alaska. The 1997 USACE Reconnaissance of Navigation Improvements, which examined marine facility needs in western Alaska states in Chapter 8, Conclusions and Recommendations "Every community in the study needs improved barge access and loading facilities for the delivery of fuel and cargo" The Alaska Department of Transportation and Public Facilities (DOT&PF) state in their Yukon-Kuskokwim Delta (March 2002, page 6-18) and Northwest Alaska Transportation Plans (February 2004, page 4-13) barge landing improvements for mooring and upland staging are critical infrastructure improvements needed in virtually all communities in the study areas.

The Commission provided funding, scoping, and general services to their partner USACE, who provided professional and technical services for the project. USACE hired Tryck Nyman Hayes, Inc. (TNH) to develop the barge landing needs analysis in concert with barge operators, freight and fuel companies, state and federal agencies, and community development groups. The Assessment reflects those findings.

After an initial statewide assessment of barge operations, the analysis team has focused its attention on the Alaska Peninsula, the Yukon, Kuskokwim and Kobuk Rivers, and the Bering, Chukchi and Beaufort Sea coasts. Barging is the dominant re-supply method for communities throughout these areas of Alaska, and in most cases, the shore side receiving facilities are entirely absent or primitive. During the review phase of the Assessment, DOT&PF requested that the remaining areas of the state be reviewed in a similar manner so that all community needs are identified in a single document. This work, funded in large part by DOT&PF, is being undertaken in a second stage of work, and the results will be incorporated into the Assessment.

The goal of the Assessment is to identify for construction, projects that will improve barge operations, increase worker and environmental safety and/or cumulatively improve fuel and freight delivery costs through system improvement.

In some communities, especially at sites exposed to severe weather, or where the landing sites are unconsolidated beach materials and/or are subject to rapidly changing ocean conditions, barge operations will continue as they do now to land when and where practical, holding firm through tug maneuvering. In most communities however, some level of infrastructure improvements are both practical and cost-effective. All parties involved in the assessment including barge operators, transportation planning experts and engineering specialists agree that even small-scale practical improvements at most sites will significantly improve delivery services, help to contain costs, improve worker safely, lower environmental risk, and/or and provide better product quality at the end destination.

This assessment outlines improvements barge operators and other users have identified for each community via an interview process. In addition to fuel and freight barges, the recommended shore side improvements also take into consideration other vessels including commercial and subsistence fishing fleets represented by the Community Development Quota (CDQ) groups, other local fleets, and construction material supply operations. In addition, the study prioritizes the sites to identify those projects that would be suitable for a first generation of capital improvements (referred to as Priority Sites in this report). Conceptual landing facility improvement designs, site plans and associated budgetary level construction cost estimates have been completed and included in this assessment to facilitate discussions with community and user groups as well as planning and funding the work.

2.0 PURPOSE

The purpose of the study is to address the cost and safety concerns raised by communities and their fuel/freight transporters, and other commercial users. Through interviews with barge operators and other users, the primary catalog of needed improvements consist of fixed dock structures with bollards, primarily at hub communities, and gravel causeways or ramps and/or mooring points such as deadman anchors to facilitate mooring at suitable sites in many smaller communities. Dredge areas and protective structures are identified in a number of coastal and tidally-influenced communities. Throughout the study area the adjacent upland improvements are generally consistent—a gravel pad staging area for deck freight and a single fuel header system at the landing site for receiving all fuel deliveries in a community.

The goal of the study is to identify the locations and types of landing, mooring and transfer improvements which if constructed would:

- Provide for operational efficiencies
- Increase worker safety
- Reduce environmental impacts
- Improve the quality of goods delivered.

The primary intent of this report is to describe the needs that exist at each community as expressed by the users in a point-by-point way and provide recommendations for landing facility improvements and the associated funds that may be needed to complete the work. The report also provides a list of Priority Sites where a reasonable investment of the Commission’s funds in the near term will provide good value. To achieve this, concept designs were developed based on the users’ recommendations and site plans were developed to illustrate how the concept designs might be applied to each of the Priority Sites. An Opinion of Probable Construction Costs (OPCC) was estimated for each of the Priority Sites to help plan for design and construction of these projects.

3.0 ORGANIZATION OF THE REPORT

The first five sections of this report are intended to describe the background, purpose, goals, and method of the study for this assessment. The regions and communities included in the study are identified in Section 4. The process used to gather data and develop projects is described in Section 5.

Section 6 summarizes data collected from the interviews with barge operators and other user groups and solicitations for information. This information is provided for each community included in the study, organized by region. The intent is to document the individual sites' existing conditions and facility improvement needs information for future reference, whether or not the site is included in the list of Priority Sites projects. A record of each interview conducted is included in Appendix A. The recommendations for each community, including the priority scoring results, are summarized in the matrix table provided in Appendix B.

Section 7 discusses the site-specific conditions that need to be considered and evaluated as part of the final design for each site. Because this preliminary assessment effort did not include site-specific field investigation or study outside of readily available maps and aerial photographs and previous experience in some areas, this section is provided to illustrate the importance of site-specific design considerations in order to control unforeseen costs during construction and to ensure a quality end product.

Shannon & Wilson, Inc. completed a preliminary permafrost assessment and geotechnical review, based on their expertise in these areas. This report is included in Appendix C.

Section 8 introduces the recommended conceptual designs and associated drawings. The design concepts in this report represent those that are applicable to typical barge landing sites at the identified Priority Sites (i.e., not necessarily any barge landing site in Alaska). This section includes descriptions of numerous facility improvement options that could be considered to address the needs identified in Section 6 and goes on to narrow the choices to a select few that are most appropriate for the identified sites. Although each option presented may reasonably be expected to work for the intended purpose, the advantages and disadvantages of each option in the conditions expected at the various locations in Alaska are discussed. Subsequently, the conceptual design drawings were developed for the recommended design options. These concept design drawings are presented in Appendix D.

Section 9 prioritizes the sites for improvement projects through a scoring matrix described and presented in this section. In addition, a description of the proposed work for each of the Priority Sites projects is provided. Site plans are provided in Appendix E to illustrate the proposed work at each of the Priority Sites. The site plans consist of an aerial photograph of each Priority Site, with the recommended concept design(s) overlaid to illustrate how the concept designs might be applied and provide a basis for future planning. Note that property ownership, current site layout and topography, and other basic site planning needs have not been completed as part of this initial assessment. It is expected that changes to the siting and layout of the work will be necessary.

Section 10 provides information for budgetary planning purposes. OPCC estimates were developed based on the site plans introduced in Section 9. The individual OPCC estimates for each Priority Site are provided in Appendix F, which also outlines the general assumptions made to complete the estimates. Section 10 also provides some recommendation for grouping improvements needed at the individual sites into larger projects as a way to save on field investigation, engineering, administration, and mobilization costs.

Section 11 constitutes a brief summary of the barge landing improvement needs assessment and resulting recommendations.

4.0 STUDY AREA

4.1 Regions

The study area focuses on the established rural Alaska communities that are dependent on barge service for delivery of fuel and supplies. This study focuses on the Alaska Peninsula; the Yukon, Kuskokwim and Kobuk Rivers; and the Bering, Chukchi and Beaufort Sea coasts. Barging is the dominant re-supply method for communities throughout these areas of Alaska, and in most cases, the shore side receiving facilities are entirely absent or primitive.

The communities chosen for inclusion in this study were those communities where barge landing facility improvements were thought to have the most benefit. For example, these may be locations where improved barge service to the community (i.e., providing better access, safer and more efficient operations and deliveries) could result in reducing shipping and fuel and cargo delivery costs, improving safety of fuel transfer, and/or quality of goods delivered to the community.

The study area is divided into 14 regions including:

- Chukchi Sea/Beaufort Sea
- Norton Sound/Bering Sea
- Lower Yukon River and Delta
- Middle Yukon River
- Upper Yukon River
- Kuskokwim River Delta and Nunivak Island
- Lower Kuskokwim River
- Middle Kuskokwim River
- Upper Kuskokwim River
- Bristol Bay
- Kotzebue Sound
- Kobuk River
- Aleutians
- Cook Inlet

These regions are identified by the color-coded areas depicted in Figure 4.1.1.

Table 4.1 shows a listing of the communities that are included in the study, grouped and color-coded by region to match the regions shown on the map in Figure 4.1.1.

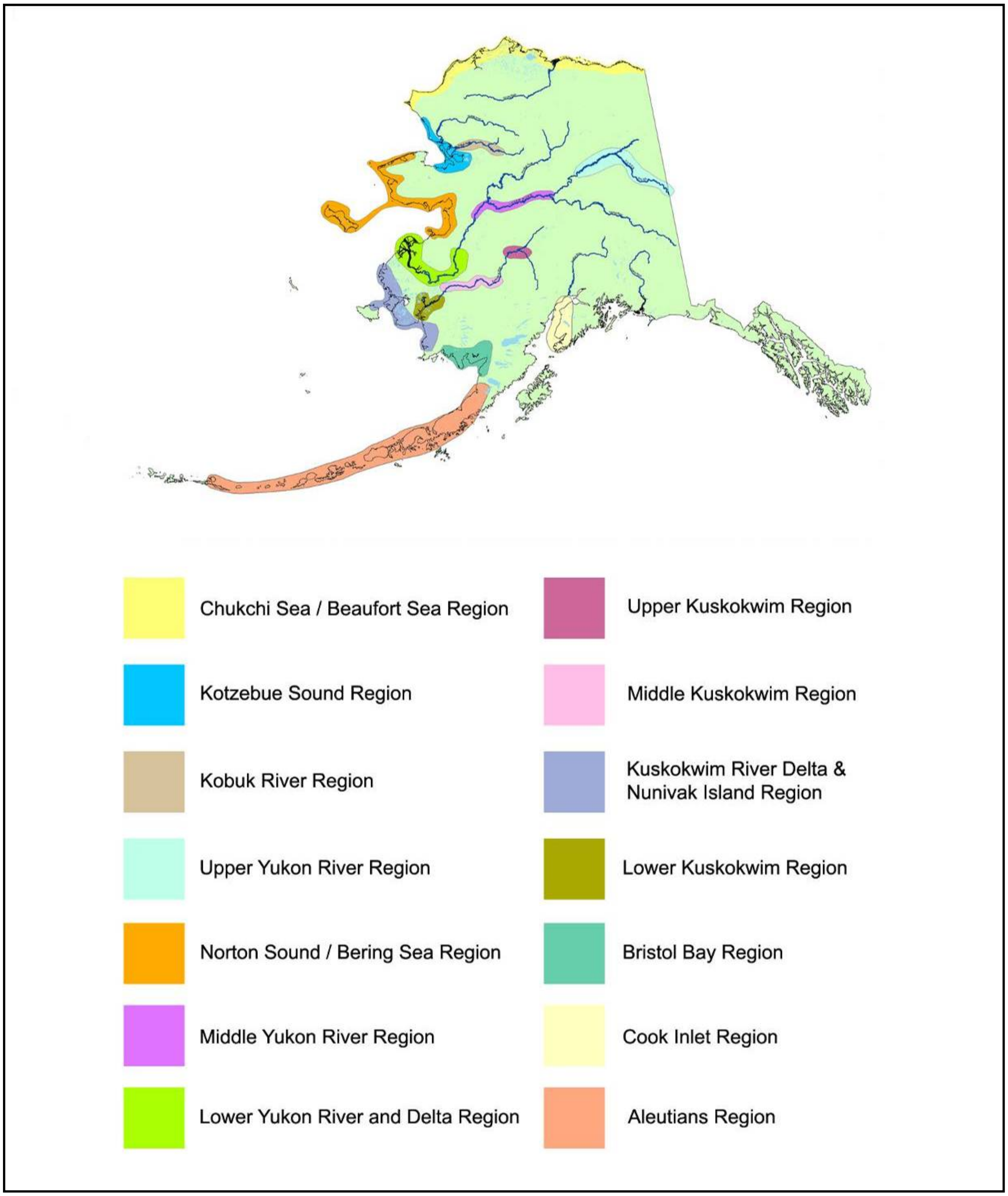

Figure 4.1.1: Alaska Barge Landing System Design, Study Regions.

Table 4.1: Alaska Barge Landing System Design Study, Communities List

Region	Community	Region	Community	Region	Community
Chukchi Sea/ Beaufort Sea	Barrow	Lower Yukon River and Delta	Kotlik	Kuskokwim River Delta & Nunivak Island	Goodnews Bay
	Kaktovik		Emmonak		Platinum
	Point Hope		Alakanuk		Quinhagak
	Point Lay		Mountain Village		Kongiganak
	Wainwright		Pitkas Point		Kwigillingok
Norton Sound/ Bering Sea	Brevig Mission		Saint Mary's		Kipnuk
	Diomede		Pilot Station		Chefornak
	Elim		Marshall		Toksook Bay
	Gambell		Russian Mission		Nightmute
	Golovin		Holy Cross		Tununak
	White Mountain		Anvik		Hooper Bay
	Koyuk		Shageluk		Chevak
	Nome		Grayling		Scammon Bay
	St. Michael		Nunam Iqua		Newtok
	Savoonga	Middle Yukon River	Kaltag		Mekoryuk
	Shaktoolik		Nulato	Lower Kuskokwim River	Eek
	Shishmaref		Koyukuk		Tuntutuliak
	Stebbins		Galena		Nunapitchuk
	Teller		Tanana		Kasigluk
	Unalakleet		Ruby		Napakiak
	Wales	Upper Yukon River	Stevens Village		Napaskiak
Bristol Bay	Togiak		Beaver		Oscarville
	Twin Hills		Fort Yukon		Bethel
	Dillingham		Circle		Kwethluk
	Clark's Point		Eagle		Akiachak
	Naknek		Eagle Village		Akiak
	South Naknek	Kobuk River	Ambler		Tuluksak
	Egegik		Kiana	Middle Kuskokwim River	Lower Kalskag
	Ekwok		Kobuk		Upper Kalskag
	New Stuyahok		Noorvik		Aniak
Aleutians	Pilot Point		Shungnak		Chuathbaluk
	Akutan				Napaimiut
	Atka	Kotzebue Sound	Buckland		Crooked Creek
	Chignik Lagoon		Deering		Red Devil
	Chignik Lake		Kivalina		Sleetmute
Cook Inlet	Tyonek		Kotzebue		Stony River
	Port Graham		Selawik	Upper Kuskokwim River	McGrath
					Nikolai

5.0 STUDY METHOD

The study approach was to focus on gathering data by interviewing the primary users of the barge landing sites in the study region. The people operating barges and commercial boats at these remote locations, often for several decades, are considered the experts when it comes to recommending landing site improvements. Information gathered from the interviews, combined with the expertise of USACE and Tryck Nyman Hayes, Inc. (TNH), provides the technical background to present solid recommendations for useful and cost-effective barge landing system improvements in the study region.

In addition to the vessel operators, each interview was attended by two representatives from USACE and a waterfront engineer from TNH. The information recorded by the attendees was compiled and summarized for each interview session. Documentation of the interviews is included in Appendix A.

The primary types of data requested from the commercial boat/barge operators and the community representatives included:

- Barge fleet/vessel types used to serve these communities
- Frequency of activity and volume/type of cargo delivered
- Existing conditions of landing facilities at each community
    - Description of the natural environment of the landing site such as type of existing facility or improvements and/or soil type, beach slope, current, erosion, etc.
    - Identification of navigation, landing, and offloading challenges.
- Recommendations for facility improvements at each site that would increase operational safety, worker safety, product delivery, environmental impacts, or quality of goods delivered.
- Identifying the sites considered to be the highest priority for improvements.

Individual aerial photographs and/or maps of each of the communities were available during the interview meeting to facilitate expressing landing site locations, issues, and recommended improvements. Some of the operators provided their own photographs of the sites to illustrate the existing conditions.

The recommendations for improvements at each community are based on information gathered from the interviews and engineering experience. Additional study, site visit, and communications with local community representatives will be necessary to confirm and complete the designs for barge landing improvements at a community.

Next, concept design drawings were developed to illustrate the various proposed landing facility improvements, including several options for mooring points, staging area, landing ramps, and docks. As part of design development, Shannon & Wilson was solicited to provide an assessment of potential permafrost and geotechnical issues at each Priority Site. The issues that were identified were considered as part of developing the conceptual designs and must be addressed further as part of the final design.

The resulting conceptual designs were distributed to the commercial boat/barge operators who were interviewed, to solicit their comment. Similarly, the draft of this report was distributed to the interviewees to ensure that the content and intent of the interview was properly represented in the report.

The information gathered by the interview and data gathering process is detailed in the following section of this report.

6.0 SUMMARY OF DATA GATHERED

By volume, fuel is the primary product delivered to rural communities. The majority of the fuel is diesel used for community power plant operations. Deck freight, delivered along with fuel orders, or separately, on regular scheduled barges to the community is primarily containers, or break-bulk cargo (loose, non-containerized material such as long lengths of pipe or timber, vehicles, palletized cargo, etc.). Chartered barges are generally associated with community construction projects such as schools, fuel tank farms, health clinics and airports.

Loading and off-loading of barges is traditionally done by cranes positioned on a dock or on the barge, driving cargo off of landing crafts using loaders or forklifts (roll-on/roll-off [RO/RO] or pass-pass operations). Barges used in rural Alaska operations range in size from 120 to 200 feet (ft) in length overall (LOA), and 40 to 55-ft wide. Most have a draft of less than 6-ft of water, although some are shallower. Mainline barges that operate offshore and/or at hubs are generally up to 340-ft LOA and have a 16-ft draft. These vessels primarily go to hub ports (e.g., Dillingham, Bethel and Nome) where fuel and freight is transferred to smaller vessels. Along the Bering, Chukchi, and Beaufort Sea coasts, mainline barges anchor offshore and lightering barges deliver products to the coastal communities.

Operators use 80-ft by 24-ft lighter vessels with shallow drafts (3-ft) to reach shallow upper river locations or to work along shallow coastal shorelines. CDQ fishing groups and other smaller operations generally use fishing vessels with a maximum length of 32 or 42 ft and 42 to 50-ft landing craft style tenders. The 50-ft by 20-ft tenders draw as little as 18 inches (in) and are therefore able to navigate to the shallower coastal and river locations. These vessels do not generally haul cargo other than fish.

The RO/RO method of offloading cargo, where wheeled vehicles are used to pick up cargo from the barge and stage it on shore, can be performed by using adjustable ramps usually mounted on the barge. Ramps attached to the barge often operate like a landing craft with the ramp dropping down onto the river or ocean shoreline. Although, not always available in these communities, RO/RO operations usually entails an earthen ramp from shore that may have a gravel surface or in some cases, a paved surface. Pavements can be asphalt, concrete, or precast concrete spaced-planks. Pavements provide a safer operating surface for equipment moving heavy loads. Operators and construction contractors generally use rubber-tired loaders with forks to move cargo.

Pass-pass refers to an operation where a forklift or loader on the barge transfers freight to second forklift or loader on shore. Although the lack of heavy equipment available in remote communities often precludes the use of this method, it is more efficient and may be used at some of the hub communities. This method involves the forklift on the barge picking up a load and setting it on a table. The shore-based forklift then picks the load off the table and places it in a storage location on shore. As the shore-based forklift moves the freight, the barge-based forklift goes to the next item, picks it up and places it on the table. The table is normally a steel or heavy wooden platform that can be located either on the barge or positioned on shore at the interface.

In the Alaska communities included in this study, the primary method of freight loading/unloading is done by RO-RO where the barge/landing craft noses into shore and pushes the beach, lowers their ramp, and uses loaders or forklifts to offload goods. The main issues with this operation are (1) soft soils on the beach make driving the loaders difficult, (2) environmental concerns with disturbing the river bottom when "pushing" into the beach as well as the additional fuel expenditure needed to do this, (3) keeping position in areas with swift currents without dedicated mooring can be challenging, and (4) there is limited dry dedicated storage areas nearby and the roads may not be wide enough for bulk materials to pass easily. The primary items identified by operators to improve landings at these communities are to install mooring points to hold position and to provide upland storage pads, or *staging areas*. In addition, some sites have been identified as needing a dedicated landing such as a bulkhead dock or ramp.

Another method of offloading freight is by using a crane that is positioned either on a dock or, more commonly, on the barge. Cranes are available at several landing sites included in this study. In this case, the barge lands parallel to the shore and side-loads from the barge. They can also push into the beach, and load from the front of the barge. Similar issues exist in this case, with operators citing problems with equipment moving materials across soft beaches and a general lack of dedicated mooring and storage areas. Some operators currently resolve this by using heavy-duty crane mats or steel plates that they install at the site upon landing to stabilize the soft ground and allow their equipment to move up the bank to a storage location. The mats are removed prior to departing.

Petroleum/fuel barges pump their products to shore through hoses. Usually, the pumps are on the barges although there are shore-based pumps at some locations. The hoses connect to pipe headers on shore which in turn are connected to storage tanks by pipelines that are either buried or above ground.

In cases where headers are not present, hoses may be run directly to nearby upland tank farm locations. The fuel barges that land at these communities, particularly the riverside communities, tend to nose-in and push the beach. These barges can have deeper draft than some of the lighter vessels used for delivering freight at some shallow locations, and they sometimes cannot land on shore at these locations. At these sites, the barge operator will float or anchor offshore and float the hose to the beach and then drag it upland to the header or tanks. A critical operational consideration is that some communities have multiple marine headers, each requiring a separate barge landing within the same community. This extends delivery times, and at some tidally-influenced sites can halt operations for up to 24 hours.

The following sections describe the regions, communities, and specific conditions and recommendations for barge landing improvements at each site.

6.1 Chukchi Sea/Beaufort Sea Region

The Chukchi Sea/Beaufort Sea region consists of five coastal communities included in this study, which are located along the northwest and north coasts of Alaska, within the North Slope Borough. The coastal waters in this region are generally covered in ice for much of the year, with an ice-free season along the coast generally lasting from mid-June through September, when barges are able to access and deliver goods to these communities. Figure 6.1.1 depicts the communities included in the Chukchi Sea/Beaufort Sea study region.

The landing sites in the Chukchi Sea/Beaufort Sea region are generally described as non-designated sandy gravel beach landings, with a steep bluff at the head of the beach, up to low relief permafrost tundra in the upland areas. The barges generally nose in and power up to the beach or on an offshore ice ridge (sandbar) to maintain position during loading/offloading.

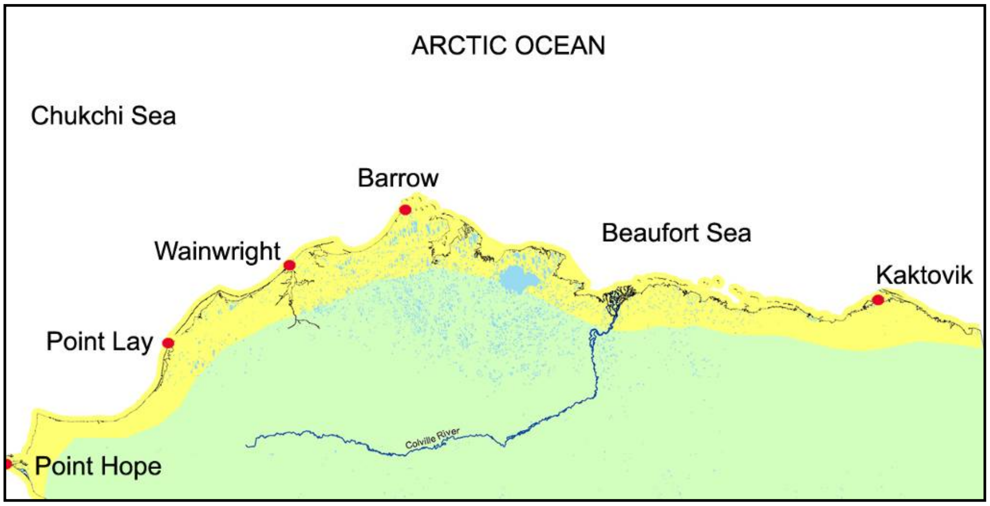

Figure 6.1.1: Chukchi Sea/Beaufort Sea Region

6.1.1 Point Hope

Point Hope is located near the tip of the Point Hope peninsula, 330 miles southwest of Barrow. The climate is arctic with temperatures range from -49 to 78°F and 10 inches annual precipitation. The Chukchi Sea is generally ice-free from late June until mid-September (DCCED 2008).

The population of Point Hope is about 737 and has remained relatively steady in recent years. Residents are dependent upon marine subsistence. Most full time employment is with the city and borough governments or making and selling craftwork. The North Slope Borough provides all utilities (DCCED 2008).

The State-owned airstrip provides the only year-round access and skiffs, umiats and snow machines are used for local transportation. Barges deliver fuel and goods during summer months (DCCED 2008).

Fuel and cargo deliveries are made by barge during the summer ice-free season. Similar to the many of the other North Slope coastal communities, the barge operators indicate that the landings consist of good gravel and tend to be weather dependant. They land at the most accessible area on the beach and hold position on the beach during offloading by nosing in and pushing onto the beach, as shown in the photograph in Figure 6.1.2. Fuel is offloaded by pulling the hose a short distance over land to the tank farm. Cargo offloading is more difficult, because the round "marble" gravel has low traction. The barge crew will lay down 50-ft platforms to use as ramps to allow their loaders to travel the 80 to 90 feet up the gently sloping beach to the hard ground upland. The water levels on this coastline are predominately affected by the wind-driven waves/swells and setup on the beach can cause water levels to vary by several feet. Natural water depths at this site drop to 30 to 40 ft, within 150 feet of shore.

The barge operators advised mooring points and/or a ramp would not be desirable because it would restrict landing at a specific location, which may not be appropriate depending on the level of swell present when deliveries are made. Although ramps across the beach may help cargo offloading, they may not stay in place due to land-fast winter sea ice and erosion. Removable load-distributing mats could be used to provide better traction across the beach. Otherwise, barge operators had no ideas for improving the barge landings.

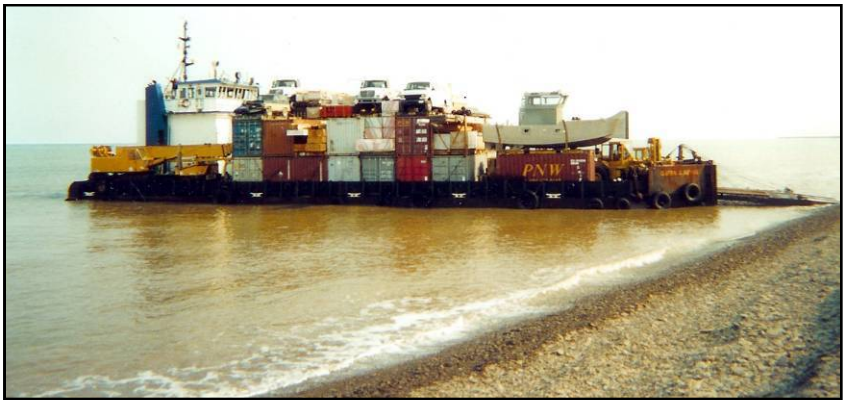

Figure 6.1.2: Landing craft on the beach at Point Hope.

6.1.2 Point Lay

Point Lay is located south of the Kokolik River mouth, about 300 miles southwest of Barrow on the Chukchi Sea coast. The climate is arctic with temperatures range from -55 to 78°F and average of 6.9 inches annual precipitation. The Chukchi Sea is ice-free from late June until September (DCCED 2008).

Point Lay has a slightly increasing population, currently at 235 compared to 139 in 1990. The community is dependant upon subsistence activities. The primary year-round employment opportunities are with the borough government. A public gravel airstrip, owned by the US Air Force, provides Point Lay's only year-round access. Marine and land transportation provide seasonal access (DCCED 2008).

Fuel and cargo deliveries are made by barge during summer. The coastline is protected by a series of offshore barrier islands, making marine access to the community difficult. Fuel barge operators reported although the landings tend to be weather dependant, they can usually access the communities without too much trouble. Access beyond the barrier island is not possible for larger barges, so they offload by lightering to shore with a small tug and barge operation. Because the volume of fuel delivered here is relatively small, operators say this tends not to be too problematic from an efficiency/cost perspective.

Freight deliveries are conducted with a line haul barge and lightering to a landing craft. They land on the barrier island/spit, located offshore, offload the cargo about 1 mile across the spit, and then load it onto smaller very low draft barges, such as the 20–inch draft push boat and 6–inch draft barge shown in Figure 6.1.3. These shallow draft barges travel into the lagoon and beach on shore. Because the water levels are primarily driven by wind/wave setup, good weather tends to lower the water levels of the lagoon, which can vary from about 18-inches to about 5-feet deep within hours. The only suggestion barge operators had for improving this situation is dredging. There is an opening between the barrier islands, offshore of the community. Dredging a permanent channel from there to the shore would provide access during periods when the water levels are relatively low. Because of the prevalent fine grained sediments and constantly shifting barrier islands, which are typical in this region, dredging would likely require regular maintenance dredging to maintain the channel.

Figure 6.1.3: Shallow draft barge and push boat used to lighter to shore.

6.1.3 Wainwright

Wainwright is located on the Chukchi Sea coast, 3 miles northeast of the Kuk River estuary. The climate is arctic with temperatures ranging from -56 to 80°F and an average annual precipitation of 5 inches. The Chukchi Sea is ice-free from mid-July through September (DCCED 2008).

Most of the relatively steady population of 517 practices a subsistence lifestyle. Economic opportunities in Wainwright are influenced by its proximity to Barrow and that it is one of the older, more established communities. Most year-round employment positions are in borough services. Sale of local arts and crafts supplements income. The North Slope Borough provides all utilities (DCCED 2008).

Air travel provides Wainwright's only year-round access. Marine and land transportation provide seasonal access. Fuel and cargo deliveries are made by barge during the summer ice-free season. Similar to many of the other North Slope coastal communities, the barge operators indicate that landings tend to be weather dependant. One barge operator noted a recent dredging/beach nourishment project intended to protect the community from erosion, initially created a sloping bank on the beach with gravel material. Subsequently, wave action pulled the nourishment material offshore and created a shelf that resulted in water depths of about 2-ft well offshore. Although this has helped to cause waves to break further offshore and thereby decrease erosion, the resulting shallow water has made barge landings more difficult. Fuel barges can no longer access the two fuel headers on shore. They land and hold position during offloading by pushing onto the offshore ice ridge. Fuel is offloaded by running a long length of hose to the header location. No improvements were recommended by fuel barge operators.

Freight barges can access and offload via the inlet south of the community. The inlet has a shallow bar (5 to 6 ft deep) at the mouth and then deepens. The freight delivery operations require entering this inlet and then unloading cargo onto shore, across the land to the other side of the spit to a small lagoon and then onto a low draft barge and tug operation, which brings the material to the north end of the lagoon. Then, the cargo is offloaded onto trucks and driven 2 to 3 miles along the road to the community. This offloading operation takes a few hours per load to complete. Freight barge operators advised this is a very costly operation and the only viable recommendation would be to build a road from the community to a location near the entrance of the inlet (similar to the location of the existing winter trail). This has been considered in the past, but the reasons for deciding against it were unknown to the interviewee.

6.1.4 Barrow

Barrow is located on the Chukchi Sea coast, 10 miles southwest of Point Barrow. Barrow is the economic center of the North Slope Borough with a population of about 4,065 in 2006. The climate is arctic with light annual precipitation, averaging 5 inches. Temperatures range from -56 to 78 degrees Fahrenheit (°F) with an average temperature of 40°F during summer. The daily minimum temperature is below freezing 324 days of the year. Prevailing winds are easterly and average 12 miles per hour (mph). The Chukchi Sea is typically ice-free from mid-June through October (DCCED 2008).

The Barrow power plant is fueled by natural gas, which generates and distributes electric power, and piped natural gas for home heating (DCCED 2008). For this reason, large volume fuel deliveries by barge are not needed.

Barrow's airport serves as the regional transportation center for the Borough and cargo deliveries can be made year-round by regularly-scheduled jet service (DCCED 2008). Occasional bulk cargo deliveries are made by barge during summer ice-free season. The barge operators indicate that the landings are weather dependant and they hold position during offloading by nosing in and pushing onto the beach. They reported the landings generally consist of a good gradual beach and mooring points would not be needed.

Freight operators stated they tend to land at a location north of town, near Stevenson Street and Dewline Road, where the landing tends to be very good until the weather comes up. Then, they can go around Point Barrow to Elefson Lagoon for protection to wait out the storm. The USACE completed an evaluation of the feasibility of developing a small harbor there, but it was not found to be feasible due to the channel dredging required to maintain access to the area.

One freight barge operator indicated Barrow has the best opportunity for growing cargo delivery operations due to oil and gas development and suggested a sheet-pile dock located near the baleen "Palm" trees about 2 miles north of town.

6.1.5 Kaktovik

Kaktovik lies on the north shore of Barter Island, on the Beaufort Sea coast, within the Arctic National Wildlife Refuge. The climate is arctic with temperatures range from -56 to 78°F and 5 inches annual precipitation (DCCED 2008).

The population of Kaktovik is about 288 and has remained relatively steady in recent years. Economic opportunities in Kaktovik are limited due to the community's isolation, and the residents are highly dependant on subsistence activities. The North Slope Borough provides all utilities (DCCED, 2008).

Air travel provides the only year-round access. Marine and land transportation provide seasonal access. The City is seeking funds to construct a local dock and boat ramp (DCCED 2008).

Fuel and cargo deliveries are made by barge during the summer ice-free season. Similar to many of the other North Slope coastal communities, the barge operators indicate that landings tend to be weather dependant. They tend to land at the most accessible area on the beach and hold position on the beach during offloading by nosing in and pushing onto the beach. Fuel is offloaded at a marine header. The barge operators indicated strong winds and currents are common at the landing at Kaktovik and mooring points are needed. However, polar bears are known to frequent the area, especially when whale remains are present onshore, and this limits the crew’s willingness to get off the barge to secure moorings. Mooring points installation should consider aggressive shoreline erosion as exemplified by a project to excavate a landfill before it erodes into the ocean.

6.2 Norton Sound/Bering Sea Region

The Norton Sound/Bering Sea Region includes coastal Alaska communities north of the Yukon River Delta in Norton Sound, along the Bering Strait on the Seward Peninsula and Saint Lawrence Island. The Bering Strait is a relatively shallow passage between Saint Lawrence Island and the Seward Peninsula on the west coast of Alaska that is generally less than 100 feet in depth. Norton Sound is southeast of the Bering Strait, and is a 70 mile wide body of water between the Seward Peninsula to the north and the Yukon River delta to the south. The sound is generally navigable from about May to October. Figure 6.2.1 depicts the communities in the Norton Sound/Bering Sea study region.

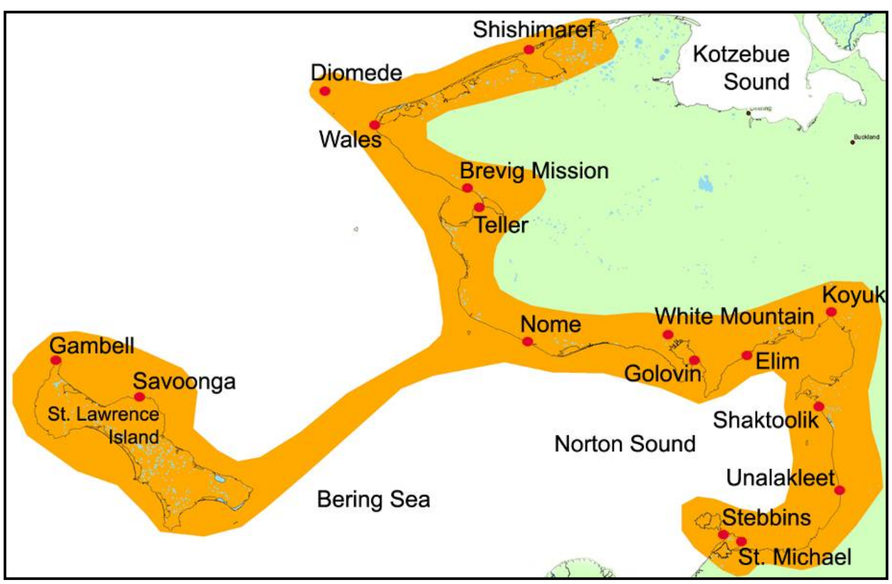

Figure 6.2.1: Norton Sound/Bering Sea Region

6.2.1 Stebbins

Stebbins is located on the northwest coast of Saint Michael Island on Norton Sound. It lies 8 miles north of Saint Michael and 120 miles southeast of Nome. It has a subarctic climate with a maritime influence during the summer and clouds and fog are common. Average summer temperatures are 40 to 60°F; winter temperatures range from -4 to 16°F. Extremes have been measured from -55 to 77°F. Annual precipitation is 12 inches including 38 inches of snowfall. Norton Sound is ice-free from June to November (DCCED 2008).

The current population of Stebbins is about 612, a steady increase compared to 547 residents in 2000 and 400 in 1990. The Stebbins economy is based on subsistence harvests supplemented by part-time wage earnings. The city and schools provide the only full-time positions. The commercial herring fishery has become increasingly important including fishing on the Lower Yukon. Eighteen residents hold commercial fishing permits (DCCED 2008).

Stebbins is accessible by air and sea. There is one road leading to Saint Michael. There is a State-owned gravel runway. A cargo ship brings supplies annually. There is no dock, and lighterage of goods to shore is provided from Nome (DCCED 2008).

There are several barge landing sites at Stebbins. Fuel and freight barges land at a number of locations along the coast that fronts the community. In addition, there is a barge landing facility on the northwest side of Cape Stephens that is used to load rock and gravel from the nearby quarries. This facility includes a causeway and ramp constructed of rock and gravel with armor rock erosion protection. Another landing site is on the beach about ¾-mile east of the cape. A road leads from this landing site, approximately 1.5 miles to town.

Fuel barge operators stated landing at Stebbins is weather dependant. There are three fuel offloading points along the beach on the west side of the community, which is exposed to the open ocean. Fuel is offloaded by floating the hose to shore to avoid the existing submerged rocks located between the Alaska Village Electric Cooperative (AVEC) fuel tanks and the school tanks. Fuel offloading operations would be more efficient if the community had a centralized tank farm and/or marine header location. This centralized location should be sited away from the existing rock hazards to allow barges safe access.

6.2.2 Saint Michael

Saint Michael is located on the east coast of Saint Michael Island in Norton Sound. It lies 125 miles southeast of Nome and 48 miles southwest of Unalakleet. Saint Michael has a subarctic climate with maritime influences during the summer. Summer temperatures average 40 to 60°F; winters average -4 to 16°F. Extremes from -55 to 70°F have been recorded. Annual precipitation is 12 inches, with snowfall of 38 inches. Summers are rainy and fog is common. Norton Sound is ice free from early June to mid-November (DCCED 2008).

The population of Saint Michael is currently about 446, an increase from 368 in 2000 and 295 in 1990. The Saint Michael economy is based on subsistence food harvests supplemented by part-time wage earnings. Most wage positions are found in city government, the IRA council and Village Corporation, schools, and local stores. Six residents hold commercial fishing permits, primarily for the herring fishery (DCCED 2008).

Saint Michael is accessible by air and sea only. One 10-mile road exists to Stebbins. A State-owned gravel airstrip and a seaplane base are available. Saint Michael is near the Yukon River delta and has a good natural harbor and a concrete boat ramp, but no public dock. Lighterage service is provided frequently from Nome in addition to an annual shipment of bulk cargo (DCCED 2008).

There is a private gravel/rock dock at the point of land east of the community, adjacent to a bulk fuel tank farm there. This dock is owned by Crowley Marine Services. Barge operators report there is about 5 ft of water depth available at this dock at high tide. There are rocks, up to 4 ft diameter, in the shallow area in the area at the dock face, which causes barge operators to float offshore when offloading at this dock. Occasionally freight is brought to the community on Crowley's fuel barge. To offload this cargo, they either land briefly at high tide and quickly offload and move offshore, or they float slightly offshore and offload the cargo using a crane. According to a recent public notice for a USACE permit application, there are plans underway to dredge the area in front of the dock, to remove these rocks and provide sufficient depth for barges to land at the face of the dock.

Crowley also owns a dock (formerly Yutana Barge's dock), which consists of a beached/sunken barge on the south beach near the west end of the community. This dock is fairly accessible and often used by construction and freight barges.

An adjacent concrete ramp is east of this facility, and one construction contractor reported that it is sometimes used by small barges/landing craft. It can be covered with sand, but very usable because of the hard surface underneath it and the tie-off points available.

Several barge landing sites at Saint Michael are on the beach along the south side of the community, east of the "barge dock". This beach is fairly protected from weather; however, the offshore area is littered with sharp pointed rocks under the sand. Multiple stops are required to fill the fuel tanks for the local fuel company, the City, AVEC, and the school. They are required to anchor offshore of the beach and float hose into shore to offload fuel at the school and AVEC tanks due to the rock hazards in the near shore area. In addition, they are required to pull a long length (about 600-ft) of hose up the beach and along the road to the school tanks. To reduce environmental risks associated with floating and dragging long lengths of hose, and to increase operational efficiency for fuel offloading, the bulk fuel tanks in this community should be consolidated and/or a marine header(s) provided at a central location that is safely accessible by barge.

6.2.3 Unalakleet

Unalakleet is located on Norton Sound at the mouth of the Unalakleet River, 148 miles southeast of Nome. Unalakleet has a subarctic climate with considerable maritime influences when Norton Sound is ice-free, usually from May to October. Winters are cold and dry. Average summer temperatures range 47 to 62°F; winter temperatures average -4 to 11°F. Extremes have been measured from -50 to 87°F. Precipitation averages 14 inches annually with 41 inches of snow (DCCED 2008).

The population of Unalakleet is 727, compared to 747 in 2000 and 714 in 1990. Commercial fishing and subsistence activities are major components of Unalakleet's economy. One hundred nine residents hold commercial fishing permits. Norton Sound Economic Development Corporation (NSEDC) operates a fish processing plant. There are many government and school jobs. Tourism is increasingly important for world-class salmon fishing in the area (DCCED 2008).

Unalakleet has a State-owned gravel runway and a gravel strip with regular flights to Anchorage. Cargo is lightered from Nome; there is a dock (DCCED 2008). The existing dock is owned by the local Native Corporation.

NSEDC's fish processing plant is at the south end of the community. A sheetpile bulkhead dock is adjacent to the fish plant. NSEDC also has plans to build a marine support center in Unalakleet. The coastline from the fish plant, around the south end of the spit, is lined with gabion baskets for erosion protection.

The near shore area along the shore of Norton Sound at Unalakleet is shallow with sand dunes. Although the beaches consist of soft sand and gravel, the prevailing wind, waves and surf conditions make barge landings along this beach difficult.

Barge operators prefer to enter the Unalakleet River to access the protected barge landing areas on the shoreline of Kouwegok Slough on the east side of the community. The community has one fuel header located on the slough, south of the bridge. There is also a dock and ramp near the mouth of the slough that is owned by the Native Corporation and used by small, shallow draft boats.

Erosion and littoral drift of fine grained sediments along the coast have created sand bars near the mouth of the Unalakleet River. The access to the slough is via a one mile long marked channel that is about 4-ft deep. This has resulted in these barge landing sites becoming accessible only during high tide.

At times, deeper draft barges (greater than 5 or 6 ft) offload cargo on the beach at the north end of the community to avoid grounding in the channel area during lower water conditions. This requires good weather conditions. Freight barge operators report that there is enough room for staging near the landing sites.

When fishermen and/or tenders are required to wait offshore for several hours to wait for high water to reach the fish processing plant, the freshness and the value of the fish is decreased. Timely access to the fish plant is considered necessary to ensure efficient loading/offloading of fish and to ensure the highest quality product.

The recommended solution is to provide protected landing facilities on the Norton Sound coast, such as a gravel ramp with erosion protection and tie-offs. Dredging a navigational channel to allow access into the Slough at all tide cycles is not recommended by resource agencies and the community due to concerns with disturbing fish habitat.

A protected landing on the Norton Sound coast may require construction of a breakwater/harbor area to provide safe access during inclement weather. Alternately, a ramp could be sited in the protected water on the slough; however this would not allow access during all tide cycles. Because any long-term solution is going to require significant time to plan and study the most feasible options for the landing facility improvements at this community, it was not recommended as a Priority Site project. In addition, the USACE is working on a feasibility study for navigation improvements at this community, but has been unable to find a cost-effective solution.

6.2.4 Shaktoolik

Shaktoolik is located on the east shore of Norton Sound. It lies 125 miles east of Nome and 33 miles north of Unalakleet. Shaktoolik has a subarctic climate with maritime influences when Norton Sound is ice-free, usually from May to October. Summer temperatures average 47 to 62°F; winter temperatures average -4 to 11°F. Extremes from -50 to 87°F have been recorded. Average annual precipitation is 14 inches, including 43 inches of snowfall (DCCED 2008).

The population of Shaktoolik is about 214 residents. Shaktoolik’s economy is based on subsistence, supplemented by part-time wage earnings. Thirty-three residents hold commercial fishing permits. Development of a new fish processing facility is a local priority. Reindeer herding also provides income and meat (DCCED 2008).

Shaktoolik is primarily accessible by air and sea. A State-owned gravel airstrip is available. Summer travel is by 4-wheel ATV, motorbike, truck and boat; winter travel is by snowmachine and dog team. Cargo is barged to Nome, and then lightered to shore. The community has no docking facilities (DCCED 2008).

Barges land at several locations on the beach of Norton Sound that fronts the community. Landings are dependent on favorable weather and tide conditions. Wind, waves and surf combined with the long, flat, shallow bottom in the near shore area can quickly cause very shallow conditions at the east end of Norton Sound, which can cause a barge to ground. The beach area consists of sand and gravel. Driftwood collects along the beach and can present a hazard for the barge when landing.

Fuel barge operators usually float the hose to shore. At least two fuel stops are required to fill the Native Corporation fuel tanks and the power company’s fuel tanks. It is recommended that the fuel tanks be consolidated and/or provide a co-located marine fuel header.

Freight is usually lightered to Shaktoolik from Nome on shallower draft barges that can access the beach. Barges nose-in and hold position by pushing the beach. There is poor traction for equipment when crossing the clean gravel beach. Because the area is prone to flooding and erosion, the landing area changes from year to year. A ramp is recommended to provide a dedicated landing and to elevate the landing and provide for a hard surface across the beach. In addition, the community could use a small dedicated staging area. However, because there are plans to relocate this community, accelerated funding for improvements at this site is not recommended.

6.2.5 Koyuk

Koyuk is located at the mouth of the Koyuk River, at the northeastern end of Norton Bay on the Seward Peninsula, 90 air miles northeast of Nome. Koyuk has a subarctic climate with a maritime influence. Average summer temperatures range from 46 to 62°F; winter temperatures average -8 to 8°F. Extremes from -49 to 87°F have been recorded. Annual precipitation is 19 inches, including 40 inches of snowfall. Norton Bay is usually ice-free from May to October and Norton Sound is ice-free generally between mid-June and mid-November (DCCED 2008).

The current population of Koyuk is about 368, an increase from 297 in 2000 and 231 in 1990. The Koyuk economy is based on subsistence, supplemented by limited part-time jobs. There is a small amount of commercial fishing, primarily for herring, and some income is derived from reindeer herding. Thirteen residents hold commercial fishing permits (DCCED 2008).

There are no roads connecting Koyuk with other communities, although according to DCCED, an 18-mile road to Six Mile Point is under construction. There is a State-owned gravel runway that allows air access. Cargo is lightered to shore from Nome. There is no dock in the community, although the City has interest in conducting a small boat harbor feasibility study. A road was recently constructed to access a new gravel source to the north of the community (DCCED 2008).

Barge operators reported that access to Koyuk requires crossing shallow tidal flats in Koyuk Inlet, which is done at high tide. Fuel and freight barges have separate landings at Koyuk. The fuel barge landing is at the west, downriver end of town, south of the City fuel tank farm, at the marine header location. The fuel barge operators are generally satisfied with the landing site.

The deeper draft barges that are used for freight deliveries in this area cannot access the beach directly in front of the community. The primary freight landing is located about one mile east of town. Offloading cargo is difficult due the condition of the road that leads from the landing site to town, which is washed out in many areas. A good sized staging area exists on the east end of the community; however, freight barge operators are required to set the cargo along the beach at the landing site, a mile out of town, and then move it to the staging area in town. They indicate that road improvements are needed to improve worker safety and operational efficiency associated with freight offloading. A small staging area at the landing site may also be beneficial if a large construction project was planned. In addition, mooring points may be helpful.

6.2.6 Elim

Elim is located on the northwest shore of Norton Bay, on the northeast end of Norton Sound on the Seward Peninsula. It is about 96 miles east of Nome. Elim has a subarctic climate with maritime influences. Summer temperatures average 46 to 62°F; winter temperatures average -8 to 8°F. Annual precipitation is 19 inches, including about 80 inches of snow. Norton Bay is usually ice-free from May to October and Norton Sound is ice-free generally between mid-June and mid-November (DCCED 2008).

There are about 300 residents of Elim and the economy is based primarily on subsistence harvests; cash employment is limited to fishing, the city and school. About 39 residents hold commercial fishing permits. The community wants to develop a fish processing plant (DCCED 2008).

Elim is accessible by air and sea. There is a State owned runway as well as a private paved airstrip at Moses Point that is owned by the Elim Native Corporation. There is no dock in the community, so according to DCCED, supplies are lightered to shore by a company operating from Nome (DCCED 2008).

There are two barge landing areas at Elim. The fuel barges land at the header location near the south end of the community, and cargo is offloaded near a small stream outfall along the beach in front of the community. There is a shallow ice ridge in front of the beach that limits access to the beach. Upon reaching the beach, the landing consists of sand and gravel and there is a gentle slope up the beach to the base of a bluff. The community is located on top of the bluff.

Fuel barge operators report that the shoreline area at the landing on the west side of town is rocky so they anchor offshore and float the hose inshore to the marine header. The freight barge operators also report that the rocky coastline on the east side of the community is a hazard, as is a sewer outfall pipe near the middle of the community. Cargo offloaded onto the beach is difficult to get up the steep bank in some areas. In addition, barge operators said the bridge in town is too small to get across with large trucks. The water depths are deep offshore, so a causeway ramp or sheetpile dock is recommended to reach these depths and avoid the existing navigation hazards. However, due to the steep bluffs along the shoreline, a dock or wharf structure may not be practical. A causeway and ramp structure would provide both a deepwater landing and a lower grade up the bluff to access the upland areas. Because the fuel and freight landings tend to be in different locations, an acceptable co-located site was evaluated.

Co-locating an acceptable barge landing site may be difficult at Elim due to a steep bluff and several existing pipelines that exist along the shoreline of the community. The bluff is steepest (about 50-ft high) along the shoreline in front of the school, where a large area of land appears to be undeveloped and potentially available for a new landing facility and staging area, and where it is easily accessible to the existing fuel header. One option may be to develop a co-located ramp landing about 150 to 200-ft east of the header location, where the bluff is only about 20-ft high and there is a small piece of undeveloped land in front of the store. There is not much land available in this area for a dedicated staging area, however.

For this reason, it is recommended a site be chosen where sufficient staging area nearby the landing can be developed. One such option may be to develop a ramp landing site on the east side of town, near a residential development in that area.

This option for proposed improvements at Elim is depicted in Drawing E1 in Appendix E. The bluff in this area is about 30-ft high, but there appears to be sufficient undeveloped land for staging and access to the road system in this area. The disadvantage of this location is that it is not readily accessible to the existing fuel header. It is recommended to also install mooring points at the fuel header landing until the fuel header can be relocated to the new landing site.

6.2.7 Golovin

Golovin is located on a point of land between Golovin Bay and Golovin Lagoon on the Seward Peninsula, about 70 miles east of Nome. Marine climatic influences prevail during the summer when the sea is ice-free. Summer temperatures average 40 to 60°F and winter temperatures average -2 to 19°F with extreme temperatures of -40 to 80°F. Average annual precipitation is 19 inches, with 40 inches of snowfall. Golovin Bay is frozen from early November to mid-May (DCCED 2008).

Golovin has a slightly increasing population—154 in 2006 compared to 144 in 2000 and 127 in 1990. Its economy is based on subsistence activities, reindeer herding, fish processing and commercial fishing. Fourteen residents hold commercial fishing permits. The salmon fishery and reindeer herding offer some potential for cash income to augment subsistence food harvests (DCCED 2008).

Access to Golovin is by air and sea. Scheduled and chartered flights are available from Nome. The airport was recently relocated, and a new State-owned airport runway is available. There is no dock; supplies are lightered from Nome and offloaded on the beach. The City has requested funds for a small boat harbor feasibility study (DCCED 2008).

Fuel barge operators reported the landing is sufficient for their operations and no specific recommendations for improvements were made. Freight barge operators also indicated this is a busy community and the landing has good sand access at the point, although there is noticeable beach erosion and shore protection may be needed. They come here for protection from weather, so holding position during landing is not usually a problem. Mooring points are recommended, although it is not considered a priority by barge operators. One construction barge operator suggested due to the recent high activity at this community and the deep water present, a sheetpile dock should be considered for this site.

6.2.8 White Mountain

White Mountain is located on the west bank of the Fish River, near the head of Golovin Lagoon, on the Seward Peninsula. It is 63 miles east of Nome. White Mountain has a transitional climate with less extreme seasonal and daily temperatures than Interior Alaska. Continental influences prevail in the ice-bound winter. Average summer temperatures range from 43 to 80°F; winter temperatures average -7 to 15°F. Annual precipitation is 15 inches, with 60 inches of snow. The Fish River freezes up in November; break-up occurs in mid to late May (DCCED 2008).

The population of White Mountain is currently about 224 residents, which increased from 203 people in 2000 and 180 in 1990. They depend on subsistence hunting and fishing, and most spend the summer at fish camps. The school, Native store, post office, city, IRA and airline agents provide local employment. Construction outside of town and firefighting provide seasonal employment. Four residents hold commercial fishing permits. Ivory and bone carvings contribute some cash economy and a reindeer farm is run by a local resident (DCCED 2008).

Access to White Mountain is by air and sea. There are no roads. The gravel runway is operated by the State. There is no dock in the community; supplies are lightered from Nome and offloaded on the beach. Cargo barges cannot currently land at White Mountain. Locals are interested in development of a road to Golovin to permit fuel deliveries or the construction of a local barge docking facility (DCCED 2008).

The CDQ representative who was interviewed advised White Mountain should be added to the list of communities in this assessment because this community has expressed a need for barge landing facilities. Navigation to White Mountain is about 8 miles up river from Golovin, and the river in this region is shallow. A shallow draft barge can usually access the community in early spring. In the past, the barges have gotten stuck, so they sometimes use a small lead boat as a guide/pilot vessel. If the road project is a priority for this community, the barge landing facility becomes less of a priority because it would be possible and more reliable to transport cargo by road from Golovin. Regardless, mooring points are needed in the interim to facilitate barge landings until a road or barge landing facilities are constructed. Drawing E2 in Appendix E depicts the proposed locations for the mooring points.

6.2.9 Nome

Nome was built along the Bering Sea, on the south coast of the Seward Peninsula, facing Norton Sound. It lies 539 air miles northwest of Anchorage. January temperatures range from -3 to 11°F; July temperatures are typically 44 to 65°F. Average annual precipitation is 18 inches, including 56 inches of snowfall (DCCED 2008).

The current population of Nome is about 3,540 and has been relatively stable over the past two decades. Nome is the supply, service and transportation center of the Bering Strait region. Government services provide the majority of employment. Sixty residents hold commercial fishing permits. Retail services, transportation, mining, medical and other businesses provide year-round income. Several small gold mines provide some employment. Subsistence activities contribute to the local diet (DCCED 2008).

Nome is a regional center of transportation for surrounding communities. There are two State-owned airports. The Nome Airport has two paved runways. Scheduled jet flights are available, as well as charter and helicopter services. The City field is a gravel airstrip. A port and berthing facilities accommodate vessels up to 18 feet of draft. Lighterage services distribute cargo to nearby communities. The USACE recently constructed a new harbor entrance channel and breakwaters. Local development groups and the City have funded harbor dredging, two seasonal floating docks, and a boat launch. Local roads lead to Teller, Council and the Kougarok River (DCCED 2008).

There are two existing landing facilities at Nome—one for barges and another associated with the small boat harbor. The NSEDC has a fish processing plant at Nome. They are satisfied with the existing facilities available at Nome for landing and loading/offloading their cargo.

Barge operators reported these facilities are sufficient for their purposes. However, they suggested that it may be helpful to aid in navigation to install pilings or posts at the corners of the new breakwaters and to mark the channel through the harbor.

6.2.10 Teller

Teller is located on a spit between Port Clarence and Grantley Harbor, 72 miles northwest of Nome, on the Seward Peninsula. The climate is maritime when ice-free, and then changes to a continental climate after freezing. Average summer temperatures range from 44 to 57°F; winter temperatures average -9 to 8°F. Extremes have been measured from -45 to 82°F. Annual precipitation is 11.5

inches with 50 inches of snowfall. Grantley Harbor is generally ice-free from early June to mid-October (DCCED 2008).

The population of Teller is currently about 256, a slight decrease from 268 in 2000 but increased from 151 in 1990. The Teller economy is based on subsistence activities supplemented by part-time wage earnings. There is a herd of over 1,000 reindeer in the area, and the annual round-up provides meat and a cash product, which is sold mainly on the Seward Peninsula. Over one-third of the households produce crafts or artwork for sale, and some residents trap fox (DCCED 2008).

Teller has a road link to Nome via a 72-mile gravel road, which is open from May to September. Teller is easily accessible by sea and air. There is a State-owned gravel runway with regular flights from Nome. There is a small gravel source near the airport. There is no dock; goods are lightered from Nome and offloaded on the beach. Port Clarence is a natural harbor and has been considered for a deepwater port (DCCED 2008).

Access to the landing sites at Teller is through two natural spits that separate Port Clarence from Grantley Harbor. There are several barge landing sites along the coast of Grantley Harbor, which is protected and very calm. Fuel offloading requires several stops to fill the various fuel tanks farms in this community. A centralized tank farm would increase operational efficiency; however, because the landings are so protected and relatively easy, it is not considered a priority by the barge operators.

The NSEDC stated there is a commercial red salmon fishery at Teller. Fish are bought out of Teller and trucked to Nome for processing and shipping. The vessel landing facilities at Teller are considered sufficient for fish and other cargo loading/offloading.

6.2.11 Brevig Mission

Brevig Mission is located at the mouth of Shelman Creek on Port Clarence, 5 miles northwest of Teller and 65 miles northwest of Nome. It has a maritime climate with continental influences when the Bering Sea freezes. Summer temperatures average 44 to 57°F. Winter temperatures average -9 to 8°F. Annual precipitation averages 11.5 inches and annual snowfall averages 50 inches. Port Clarence is generally ice-free between early June and mid-November (DCCED 2008).

Brevig Mission has a growing population, currently at 324, up from 276 in 2000 and 198 in 1990. The residents have a predominantly subsistence lifestyle. The primary employers are the city and school district. Year-round jobs are scarce, unemployment is high, and seasonal jobs in mining and construction are limited. Arts and crafts provide some cash income (DCCED 2008).

Brevig Mission is accessible by air and sea. A cargo ship stops annually. The State-owned gravel airstrip enables regular year-round access. Teller is 5 miles away by boat. A 72-mile gravel road between Teller and Nome is maintained by the State during the summer (DCCED 2008).

The local Economic Development Corporation said a local boat ramp was recently constructed, and is appropriate for use by the smaller vessels; however, barges generally do not land there. Red salmon is bought out of Brevig Mission and then driven to Nome (via Teller) for processing and shipping.

There is a new, centralized tank farm and marine header at Brevig Mission and the fuel barge landing area is on the beach near the header. The freight barges can land on any accessible part of the beach, which is satisfactory, according to barge operators. However, mooring points may be helpful at two designated locations. One location is at the marine fuel header. The other is at the freight barge landing area located toward the east end of town, west of the runway.

There are upcoming street and water/sewer projects, and installation of mooring points should be included as part of these or other future construction projects.

6.2.12 Wales

Wales is located on Cape Prince of Wales, at the western tip of the Seward Peninsula, 111 miles northwest of Nome. It has a maritime climate when the Bering Strait is ice-free, usually June to November. After the freeze, there is an abrupt change to a cold continental climate. Average summer temperatures range from 40 to 50°F; winter temperatures range from -10 to 6°F. Annual precipitation is 10 inches including 35 inches of snow. Frequent fog, wind and blizzards limit access to Wales (DCCED 2008).

The current population of Wales is about 139, which is somewhat lower than the population of 152 in 2000 and 161 in 1990. The economy of Wales is based on subsistence hunting and fishing, trapping, Native arts and crafts, and some mining. A private reindeer herd is managed out of Wales and local residents are employed to assist in the harvest (DCCED 2008).

Wales is accessed by air and sea only. There is a State-owned gravel airstrip, and the ice on the Straits is frequently used by planes in the winter. There is a 6.5-mile road to Tin City, which allows access to the dock and airport there (DCCED 2008).

Access to the beach at Wales is very shallow. Before the opening of the road to Tin City, freight was delivered by barge and lightered a half mile to shore. Now it is more efficient for barges to deliver freight to Tin City and truck or hovercraft it to Wales.

Fuel deliveries are made directly to Wales (and fuel barge operators also truck fuel from Wales to Tin City). A fuel barge operator reported weather, ice and shoals in this area present a challenge when landing at Wales. Three stops are required to offload fuel at the various tank farms in the community. It is recommended to centralize the tank farms and provide a single marine fuel header location.

6.2.13 Diomede

Diomede is located on the west coast of Little Diomede Island in the Bering Straits, 135 miles northwest of Nome. It is 2.5 miles from Big Diomede Island, Russia and the international boundary lies between the two islands. Summer temperatures average 40 to 50°F. Winter temperatures average from -10 to 6°F. Annual precipitation is 10 inches, and annual snowfall is 30 inches. During summer months, cloudy skies and fog prevail. Winds blow consistently from the north, averaging 15 knots, with gusts of 60 to 80 mph. The Bering Strait is generally frozen between mid-December and mid-June (DCCED 2008).

The population of Diomede is slightly decreasing with a current recorded population of 110. Diomede residents depend almost entirely on their traditional subsistence lifestyle. Employment is limited to the City and school. Seasonal mining, construction and commercial fishing positions have been on the decline. There are many excellent ivory carvers in Diomede; the City serves as a wholesale agent for the ivory. Residents travel to Wales by boat for supplies (DCCED 2008).

Due to constant winds from the north, accessibility is often limited. A State-owned heliport allows for weekly mail delivery. There is no airstrip due to the steep slopes and rocky terrain, so ski planes must land on an ice strip in winter. Few float plane pilots attempt to land on the rough, often foggy open sea during summer. There is an existing breakwater and small boat harbor. Cargo barge stops are irregular, due to sea or ice conditions, but they deliver at least annually. Lighterage services are available from Nome (DCCED 2008).

Fuel and cargo deliveries are made during the summer ice-free season. There are two designated landing areas; one on each side of a breakwater that exists at the southern point of the island, shown in the photograph in Figure 6.2.2. The barge operators indicate that they have difficulty committing to deliveries at Diomede because it often experiences unfavorable conditions for landing. Diomede has a very rocky shoreline, with tidally influenced swell and currents as well as prevailing foggy and windy weather conditions. There is a small weather window when cargo deliveries can be made. The freight barges often wait offshore of the breakwater until they can safely access the shore. One barge operator said that sometimes they have had to wait for as much as two weeks. Then, depending on weather, they decide which side of the breakwater to land on.

Figure 6.2.2: The landing areas at Diomede on either side of the breakwater.

Due to the large rocks on the shoreline, the fuel barge does not land on shore. Instead, they hold offshore and float the hose in to the nearby fuel tanks. Other than a large project to increase the length of the breakwater, the operators had no recommendations for improvements that would facilitate access to these sites.

A feasibility study associated with navigation improvements, including breakwater enhancements at Diomede is already being covered separately by the USACE.

6.2.14 Shishmaref

Shishmaref is located on Sarichef Island in the Chukchi Sea, just north of Bering Strait. Shishmaref is 5 miles from the mainland, 126 miles north of Nome and 100 miles southwest of Kotzebue. The community is surrounded by the 2.6 million-acre Bering Land Bridge National Reserve. The area experiences a transitional climate between the frozen Arctic and the continental Interior. Summers can be foggy with average temperatures ranging from 47 to 54°F; winter temperatures average -12 to 2°F. Average annual precipitation is about 8 inches including 33 inches of snow. The Chukchi Sea is frozen from mid-November through mid-June (DCCED 2008).

The current population of Shishmaref is about 615, an increase from 562 in 2000 and 456 in 1990. The Shishmaref economy is based on subsistence supplemented by part-time wage earnings. Two residents hold a commercial fishing permit. Year-round jobs are limited. Residents rely on subsistence foods. Two reindeer herds are managed from here. Reindeer skins are tanned locally, and meat is available at the community store. The Friendship Center, a cultural center and carving facility, was recently completed for local artisans (DCCED 2008).

Shishmaref's primary link to the rest of Alaska is by air. A State-owned paved runway is available. There are no docking facilities (DCCED 2008). Gravel is locally extracted from the tidal flats at each end of the island.

The community of Shishmaref is affected by high rates of erosion and littoral drift, which tends to shift the island along its longitudinal axis, to the northeastward and southwestward. Several efforts to impede erosion have been constructed including installing armor rock shoreline protection along various stretches of shoreline to protect key public facilities. To date, these methods have been effective for only relatively short periods of time. Because erosion has destroyed and continues to threaten essential public facilities, the community is interested in relocating to a more sheltered location.

The former barge landing area on the north beach, north of the Native Store is no longer used because large armor rock has been placed along this shoreline for erosion protection. Barges now land along either of the channels on the west and east sides of Sarichef Island. These areas are very shallow such that barges cannot get very close to the community. Dredging is not considered a viable option to provide better access because a channel here it is likely to fill in quickly.

Freight barges land near the landfill at the southwest end of the island and truck cargo into town. There are sufficient staging areas.

Fuel barges don’t regularly service Shishmaref because of the difficult landing conditions at the tank farm/header locations. There is one tank farm and two headers in close proximity, but these are located along the shoreline that is protected by armor rock. Due to the rock hazards on shore, safe landing at Shishmaref is very weather dependant. So, barges usually stay offshore and float the hose to the header. Because the community has plans to relocate, barge operators did not recommend providing improvements for landing facilities at Shishmaref.

6.2.15 Gambell

Gambell is located on the northwest cape of Saint Lawrence Island, 200 miles southwest of Nome, in the Bering Sea. The City is 36 miles from the Chukotsk Peninsula, Siberia. Gambell has a maritime climate with continental influences in the winter. Winds and fog are common, and precipitation occurs 300 days per year. Average annual precipitation is 15 inches, including 80 inches of snowfall. The Bering Sea freezes during mid-November, with break-up at the end of May. Average summer temperatures are 34 to 48°F; average winter temperatures are -2 to 10°F. Extremes from -30 to 65°F have been recorded (DCCED 2008).

The population of Gambell is fairly steady, and has a current population of about 643. The economy is largely based upon subsistence harvests from the sea. Sources of cash income include trapping fox and ivory carving (DCCED 2008).

Gambell's isolated location on an island with no seaport, results in heavy dependence upon air transport. The State-owned airport is currently under major improvements; it provides a 4,500 foot long by 96 foot wide asphalt runway. Regular flights from Nome and charters from Unalakleet are available. Lighterage services bring freight from Kotzebue and Shishmaref (DCCED 2008).

Barge operators that were interviewed pointed out the landing at Gambell is weather dependant. Fuel unloading is often done on the north coast, and trucked to various locations in the community. A centralized tank farm is recommended to increase operational efficiency of fuel deliveries at Gambell.

Freight unloading is generally conducted on the west beach near the airport, when possible; although landing can take place anywhere along the long stretch of beach in front of Gambell, which consists of loose pea gravel. This makes for a good landing; but it is difficult to transport cargo across the beach. When typical loads are carried by the bulldozer, they tend to sink and get stuck in the beach gravel. To offload, they use the bulldozer to drag the cargo across the beach. One solution recommended by barge operators is to purchase synthetic load distributing mats (i.e., Dura-Base, Armortec™). Alternately, a gravel or concrete plank ramp with erosion protection is recommended to provide a dedicated landing and a hard graded surface across the beach.

6.2.16 Savoonga

Savoonga is located on the northern coast of Saint Lawrence Island in the Bering Sea, 164 miles west of Nome. It lies 39 miles southeast of Gambell. Savoonga has a subarctic maritime climate with some continental influences during the winter. Summer temperatures average 40 to 51°F; winters average -7 to 11°F. Temperature extremes from -34 to 67°F have been recorded. Average precipitation is 10 inches annually, with 58 inches of snowfall. The island is subject to prevailing winds, averaging 18 mph. Freeze-up on the Bering Sea occurs in mid-November, with break-up in late May (DCCED 2008).

The population of Savoonga is currently about 712, an increase from 643 in 2000 and 519 in 1990. The economy is largely based upon subsistence hunting and some cash income. Eight residents hold commercial fishing permits, and Norton Sound Seafood Products operates in Savoonga. Fox are trapped as a secondary source of income. Islanders are known for their quality ivory carvings. Bird-watching is a source for some tourism (DCCED 2008).

Savoonga's isolated location with no seaport and iced-in conditions during the winter means a dependence on air transport via the State-owned gravel airstrip. There is no dock, so supplies must be lightered from Nome and off-loaded on the beach. The community has requested a small boat harbor and dry dock (DCCED 2008). The USACE is working on an agreement to begin a study for a harbor.

Access to Savoonga is weather dependant due to its exposure to the open ocean. The coastline in front of the community is steep and rocky. The landing can have strong tidally influenced currents and is rocky. Due to the rocky beach and near shore area and prevailing wind conditions, barges usually avoid landing on the beach fronting the community. Fuel barges double anchor offshore and float the hoses to shore to a centralized tank farm. Barge operators did not have recommendations for a cost-effective solution. Rather, it was suggested that a breakwater may be needed to land barges in this area. It may be more cost-effective to construct a centralized fuel tank farm and associated pipeline to the freight barge landing area.

Providing mooring dolphins offshore, near where the fuel barge currently anchors may help alleviate this problem. The feasibility of installing dolphins depends on existing ocean bottom conditions. Although this would facilitate mooring during offloading, it would not alleviate the need to float hose to shore. The current fuel barge offloading location is depicted on Drawing E3A in Appendix E.

Freight barges land in Koolangeeluk Bay, over 2 miles west of the community. This landing area is accessible by a road that follows the coast from town or from the airport runway, as shown in Figure 6.2.3.

The access to this landing area is also rocky and barge operators say that the sea ice moves the rocks around from year to year, which causes greater difficulty in navigating to the landing site. In addition, the beach at the landing area changes from year to year due to erosion. Freight barge operators said they have to arrange to have the landing prepared prior to the barge’s arrival to allow them to come into shore and properly lower their bow ramp. A dedicated landing that is protected from erosion is needed to improve safety and operational efficiency. The freight barge operators suggest adding a sheetpile dock or gravel fill on the shore to raise up the landing and a landing ramp incline at the end of the fill structure. On aerial photography, there appears to be a gravel source less than one mile to the west.

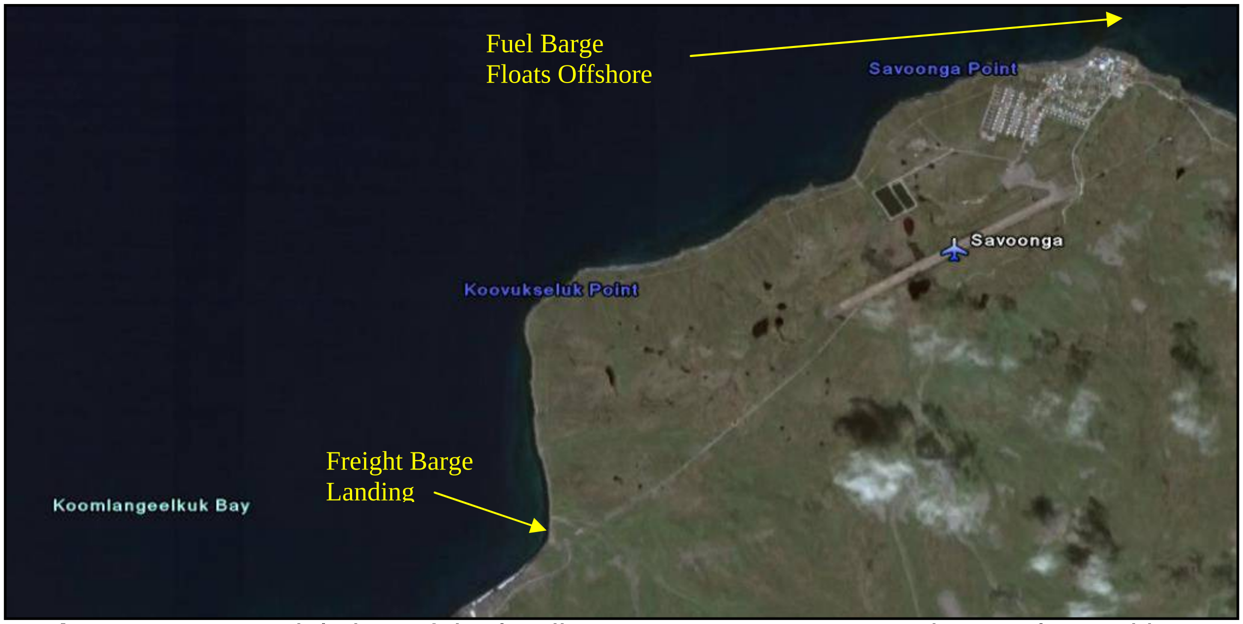

Figure 6.2.3: Aerial view of the landing areas near Savoonga (©Google Earth).

The NSEDC reported they have a fish (halibut) buying station at Savoonga. They recently installed a seasonal small boat ramp. The NSEDC noted the community is interested in constructing a harbor for larger boats, which may also accommodate barge landings. The USACE is working on a feasibility study for a harbor. If the harbor is feasible, then a landing ramp may be accommodated within the harbor.

If a harbor is not found to be feasible, a combination sheetpile dock and ramp with an adjacent staging area is recommended to be located at the freight landing site in Koolangeelkuk Bay. This is depicted on Drawing E3-B in Appendix E.

6.3 Lower Yukon River and Delta Region

The Lower Yukon River and Delta Region includes the communities within the Yukon River Delta and the lower part of the Yukon River from the mouth and upriver to the community of Grayling. This region also includes the community of Shageluk, located on the Innoko River, which eventually drains into the Yukon River near Holy Cross.

The Yukon River, which is the fifth largest river system in North America, empties into the Bering Sea in this large delta area of western Alaska. The Yukon River delta is a broad low-lying tundra area that extends along the coast from Pastol Bay in Norton Sound to the north to the Kuskokwim River delta to the south. The delta is defined by the many small lakes, ponds, rivers, and streams that extend out from the main branch of the river into the Bering Sea. The lower river area from Mountain Village upriver to Grayling and Shageluk is characterized by meandering rivers, floodplains, and oxbow lakes and becomes hillier as you go upriver. Much of the land consists of treeless wetlands, bordered by shrubs and forest and mountainous regions further upriver. The river is generally ice-free from June through October each year. Figure 6.3.1 depicts the communities included in this study which are located in the Lower Yukon River and Delta region.

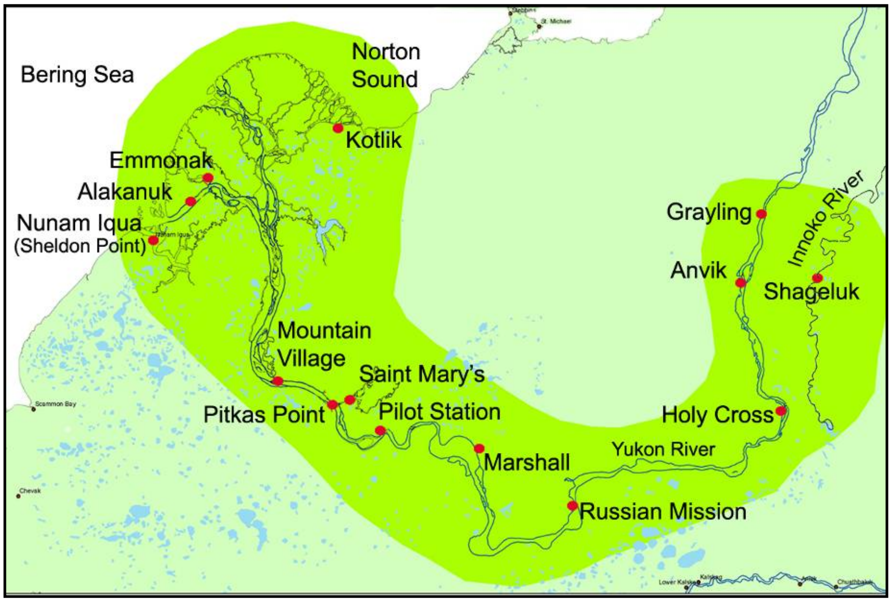

Figure 6.3.1: Lower Yukon River and Delta Region Map.

6.3.1 Nunam Iqua

Nunam Iqua is formerly known as Sheldon Point. It is located on a south fork of the Yukon River, about 9 miles south of Alakanuk and 18 miles southwest of Emmonak on the Yukon-Kuskokwim Delta. It has a maritime climate, averaging 60 inches of snowfall with a total of 18 inches of precipitation per year. Temperatures range from -25 to 78°F. Heavy winds in the fall and winter often limit accessibility. The Bering Sea is ice-free from mid-June through October (DCCED 2008).

The current population of Nunam Iqua is about 201, an increase from 164 in 2000 and 109 in 1990. Commercial fishing is the economic foundation of the community. Twenty-four residents hold commercial fishing permits. There are a few year-round positions with government organizations and the private sector. Subsistence activities and trapping supplement income (DCCED 2008).

Nunam Iqua has easy access by boat and has a State-owned gravel airstrip. Float plane landing sites are available at Kwemeluk Pass and Swan Lake (DCCED 2008).

This community has a dedicated barge landing site on the northern end of the community on the shore of Kwemeluk Pass. There is a centralized tank farm and fuel header location at the landing site. There is a crane available and a dedicated staging area close to the landing area, which makes for efficient offloading of cargo. The staging area is a good size, although it can be wet and muddy at times, as shown in Figure 6.3.2. Some gravel surfacing could be added to the staging area. Mooring points are needed to help hold position at this landing.

Figure 6.3.2: The staging area at Nunum Iqua.

6.3.2 Alakanuk

Alakanuk is located at the east entrance of Alakanuk Pass, the major southern channel of the Yukon River, 15 miles from the Bering Sea. It is part of the Yukon Delta National Wildlife Refuge. It lies 8 miles southwest of Emmonak, approximately 162 air miles northwest of Bethel. The climate of Alakanuk is subarctic, averaging 60 inches of snowfall and 19 inches of total precipitation per year. Temperatures range from between -25 to 79°F. Heavy winds are frequent during the fall and winter. The Yukon River is used as an ice road during freeze-up, from November through May (DCCED 2008).

The population of Alakanuk is currently about 663, an increase from 652 in 2000 and 544 in 1990. Alakanuk experiences a seasonal economy. Seventy-six residents hold commercial fishing permits. Many have gill net permits, and set net fishermen sell their salmon to Seattle fish buyers. Government employment and retail businesses provide limited year-round employment (DCCED 2008).

A State-owned gravel airstrip is available. An airport relocation project is underway, due to erosion encroaching on the original airstrip. Alakanuk is easily accessible from the Yukon River and Bering Sea by barge and riverboat. Most passengers and mail arrive by air (DCCED 2008).

Alakanuk has several accessible barge landing areas. There are three fuel barge landing sites; at the Native Corporation site on the far upriver end of the community, at the school fuel header, and at the beach landing located at the AVEC tank farm fuel header. Freight barges primarily use the landing site near the AVEC header. These landing sites consist of firm fill material that is easily dressed to accommodate barge landings. A short gravel causeway landing with erosion protection and with the end sloped as a ramp may eliminate the need for dressing.

Fuel barge operators pointed out the Native Corporation landing site needs two mooring points, the school fuel header landing needs three mooring points, and the fuel/freight landing near the AVEC header needs two mooring points. This location has a backeddy and the landing area is eroding. There is one existing mooring post located at this fuel/freight landing, but it needs chains on it, and an additional mooring point is needed at this site.

Freight barge operators said that the offloading area at the primary landing is good during dry weather conditions; otherwise, the landing is very muddy and the mud bank is eroding. Adding rock/gravel would minimize the mud and a gravel ramp using heavy geotextile fabric and small armor rock may help prevent the material from eroding.

Another option suggested by barge operators is to use the downriver landing site on City land, which might be better for freight landing. This landing is on the shoreline in front of the City office buildings. On aerial photography, this site appears to have more room for turning the barge around and there is a nearby area that may be good for staging. One freight barge operator indicated the existing freight landing is difficult for his side loading operation and the City land has a better layout for that type of operation. This site likely needs some gravel enhancements in the form of a causeway or ramp. However, it appears that there is less area for staging at this site.

Drawing E4A in Appendix E shows these two options for a gravel causeway/ramp layout. Option A allows utilization of the existing staging area; however, it is located at the cut bank of the river which is more susceptible to erosion and ice plucking of the armor rock protection. Option B shows the alternate site further downriver, where this will be less of an issue. However, development of this site may require construction of a new upland staging area near the landing site. The approximate locations where mooring points are needed at the five landing sites in Alakanuk are shown in Drawing E4-A and Drawing E4-B (Appendix E).

6.3.3 Emmonak

Emmonak is located at the mouth of the Yukon River, 10 miles from the Bering Sea, on the north bank of Kwiguk Pass. It lies 120 air miles northwest of Bethel and 490 air miles from Anchorage, in the Yukon Delta National Wildlife Refuge. A maritime climate predominates in Emmonak. Temperatures range from -25 to 79°F. Precipitation is 19 inches per year, while snowfall is 50 to 60 inches per year. Freeze-up occurs during October; break-up occurs in June (DCCED 2008).

The current population of Emmonak is about 796, an increase from 767 in 2000 and 642 in 1990. The City has a seasonal economy as a center for commercial fishing, purchasing and processing on the lower Yukon River. Yukon Delta Fish Marketing Co-op and Bering Sea Fisheries process and export salmon from Emmonak. One hundred one residents hold commercial fishing permits. Subsistence, trapping and public assistance supplement income (DCCED 2008).

Emmonak relies on air and water transportation. A State-owned gravel airstrip is available (DCCED 2008).

There is a dedicated beach landing area and staging area at the upriver end of the community. The landing consists of soft fine-grained beach soils.

There is a rock revetment along the coast that provides erosion protection. Barges avoid this area due to the large rocks, which present a hazard. The primary landing site is located just upriver of the revetment on the east end of the community. The beach landing consists of firm soils and rock, which can get muddy in wet weather, but remains sufficiently firm underneath so traction is not as problematic at this site. There are erosion issues where the beach is being lost just upriver of the landing. There is sufficient dedicated upland staging area. Two mooring points are needed on the upriver side of the landing. In addition, the landing needs to be graded and gravel added to make an even slope and enhance the wind-eroded side. One barge operator suggested adding a couple feet of gravel that is large enough that it won't wash away with the wave action, but small enough that it won't present a hazard for barges.

Alternatively, barge operators recommended developing a new landing facility to allow expansion and provide a larger, dryer dedicated staging area. Barge operators reported it is about 13 feet deep in front of the shelf, which is about 15 feet out from the beach. Because this is a relatively heavily used site for barges, this site may be appropriate for a new sheetpile bulkhead or other type of dock structure. A detailed study of erosion and sediment transport must be conducted prior to constructing a dock at this location to ensure acceptable downstream effects and to incorporate appropriate features into the design to ensure longevity of the structure. Although there are no gravel pits located in Emmonak, there is a lot of gravel being transported in and out of Emmonak from nearby sources.

There is another landing in front of the store used by fuel barges to offload fuel to the tanks at that location. This landing site needs two mooring points installed. Emmonak is a relatively busy site. This is primarily because the main fish processors are located in Emmonak and the community is used as a staging site for Yukon River construction projects. For this reason, the barge landing facility improvements at this site should be a priority. Drawing E5 in Appendix E illustrates the proposed barge landing facility improvements at Emmonak.

6.3.4 Kotlik

Kotlik is located on the east bank of the Kotlik Slough, 35 miles northeast of Emmonak in the Yukon-Kuskokwim Delta. It lies 165 air miles northwest of Bethel, and 460 miles from Anchorage. The climate of Kotlik is subarctic. Temperatures range between -50 and 87°F. There is an average of 60 inches of snowfall with a total of 16 inches of precipitation annually. High winds and poor visibility are common during fall and winter. Norton Sound and the Yukon are ice-free from mid-June through October (DCCED 2008).

The population of Kotlik is currently about 611, which has steadily increased from 591 in 2000 and 461 in 1990. Kotlik has a seasonal economy. Fishing and fish processing are the primary income generators. Seventy-nine residents hold commercial fishing permits. The community is interested in developing a local seafood processing facility, and an arts and crafts project. Kotlik's residents rely heavily on subsistence foods, and many families have fish camps on the Yukon River (DCCED 2008).

Air transportation of passengers, cargo and mail is provided via the State-owned gravel airstrip. There is no road access, although Kotlik is easily accessible by barge (DCCED 2008).

Barge operators indicated access is by a tidal slough, and there is easy access to a landing site at normal to high water periods. This landing site, shown in Figure 6.3.3., is used by both freight and fuel barges. The mud bank is eroding and now the main landing site is not wide enough and does not stick out into the water far enough. One barge operator suggested grading the landing to a good even slope, widening it to 50 feet and extending it out into the water an additional 20 feet. In addition, two mooring points are needed—one on each side of the landing area.

All of the barge operators who were interviewed agreed that the existing staging area is in bad condition due to the fact that they store materials on the naturally wet and muddy land adjacent to the landing site. This causes it to be difficult to operate equipment, which has poor traction with heavy loads. A dedicated staging area with gravel surfacing was recommended as a priority. The existing area used as staging is a favored location.

Figure 6.3.3: The landing and staging areas at Kotlik.

One construction contractor suggested installing a low sheetpile dock and/or a combination dock and ramp. The Coastal Villages Region Fund (CVRF) agreed that this community would benefit from this kind of barge landing improvement. The existing landing site would be the ideal location for improvements because of its location near the existing fuel tank farm and staging areas. Drawing E6 in Appendix E shows a conceptual layout for the proposed sheetpile bulkhead dock and ramp landing as well as a new upland staging area and improvements and expansion of the existing upland staging area.

6.3.5 Mountain Village

Mountain Village is on the north bank of the Yukon River, approximately 20 miles west of Saint Mary's and 470 miles northwest of Anchorage. It is at the foot of the 500-ft Azachorok Mountain, the first mountain encountered by those traveling up the Yukon. The climate is continental with maritime influences. Temperatures range from -44 to 80°F. Precipitation averages 16 inches, with snowfall of 44 inches per year. High winds and low visibility are common during winter. The Lower Yukon is ice-free from mid-June to October (DCCED 2008).

The current population of Mountain Village is 796, an increase from 755 in 2000 and 674 in 1990. Mountain Village has a seasonal economy based on fishing and subsistence. Ninety-two residents hold commercial fishing permits. There are a few full-time positions with the City, school district, federal government and Native Corporation. Some residents trap for additional income (DCCED 2008).

A summer road links Mountain Village to Pitka's Point, Andreafsky and Saint Mary's. The community is accessible by riverboat or barge. A State-owned gravel airstrip is available, and floatplanes land on the Yukon River. In the winter, passengers, cargo and mail are flown in by plane (DCCED 2008).

The beach is shallow in front of this community. There is a Native Corporation landing site that consists of a gravel causeway. The Native Corporation has a fish processing barge on this landing. Barges can only nose in at this landing location, so it is not as convenient for side offloading of freight. Otherwise it is a good landing and has sufficient staging area nearby. Two or three mooring points are needed at this landing site.

Downriver is the regular barge landing at the “City Dock”, which consists of a natural beach sand/gravel access ramp. There is a shallow bench in front of it. If the barge is drafting over 4 feet, this can be problematic. In addition, the landing area can become very muddy and there is no dedicated staging area. Barge operators thought that this location may be preferred by the community, but the City ramp needs gravel added to raise the landing ramp and to build a dedicated staging area nearby. There is a local Native Corporation gravel pit near the landing site, as well as a road to Saint Mary’s and the gravel pits in that community.

Erosion protection may be required to keep any new material in place. A gravel causeway ramp may be suitable for this site. However, the upland areas near this landing site are already developed and it may be difficult to find a suitable location to build a dedicated staging area above the normal high water elevation. The closest undeveloped land that appears large enough for a staging area exists just east of the AVEC tank farm, about 500 feet up the road from the main barge landing site. The ownership or availability of this land for this purpose has not been investigated.

Barge operators also noted the two existing mooring points at the main landing site need to be replaced.

Ideally, the barge operators would instead like to land at the existing Native Corporation barge landing and move the Native Corporation’s landing upriver. There is sufficient area adjacent to this landing site that could be developed into a staging area that is closer to the landing. However, this is not likely to be the most cost-effective option.

In addition to the Native Corporation landing, the fuel barge stops at the school/AVEC tank farm header, which has its own landing downriver. This landing also needs one or two mooring points installed. Barge operators indicate this landing consists of a smooth shallow beach, and may be considered as an alternate location for a new freight barge landing site.

Drawing E7 in Appendix E depicts the three primary landing sites and the proposed improvements including improving the existing City landing site, a new gravel pad staging area upland of this landing site, and mooring points at each of the three landing sites.

6.3.6 Pitka's Point

Pitka's Point is located near the junction of the Yukon and Andreafsky Rivers, 5 miles northwest of Saint Mary's on the Yukon-Kuskokwim Delta. It lies 3 miles by road east from the Saint Mary's airport. The climate is both maritime and continental. Temperatures range from -44 to 83°F. Precipitation measures 16 inches, with 60 inches of snowfall per year (DCCED 2008).

The population of Pitka's Point is currently estimated at about 109, a decrease from 125 in 2000 and 135 in 1990. Employment is limited to a few year-round enterprises. Subsistence activities provide food sources. Two residents hold commercial fishing permits. All supplies are brought in through Saint Mary's. Electric power is provided by a transmission line from Saint Mary's (DCCED 2008).

The Yukon River allows easy access by water. There is a 17.7 mile road connecting Mountain Village with the Saint Mary's airport and Andreafsky. Saint Mary's dock is less than 5 miles away by road (DCCED 2008).

Barge operators noted there is not a lot of barge traffic at Pitka's Point. Because power is from a transmission line from Saint Mary's, only small volumes of fuel are brought into the community and delivered by road from Saint Mary's or Mountain Village. The landing is primarily used by barges for offloading some cargo and construction materials.

The landing site is narrow and steep and only wide enough to bring a truck down to the barge. If improvements are made at this site, barge operators suggested expanding the landing to 60 ft wide and cutting and grading the access road down to the landing area. It was noted that there is a cemetery just up the hill of the landing that may limit expansion to that side. There are several gravel sites in the community.

More importantly, barge operators recommended installing two or three mooring points at the landing site to aid in tying off the barge during offloading.

6.3.7 Saint Mary's

Saint Mary's is located on the north bank of the Andreafsky River, 5 miles from its confluence with the Yukon River. It lies 450 air miles west-northwest of Anchorage. The City of Saint Mary's encompasses the Yup'ik communities of Saint Mary's and Andreafsky. The climate is continental with a significant maritime influence. Temperatures range between -44 and 83°F. Annual precipitation measures 16 inches with 60 inches of snowfall. The Yukon is ice-free from June through October (DCCED 2008).

The population of Saint Mary's is currently about 551 and has varied from 500 in 2000 and 441 in 1990. The economy in Saint Mary's is seasonal. Sixty-five residents hold commercial fishing permits. A cold storage facility is available, which helps to serve barge companies who use this community as a hub for regional transport of goods. Cash income is supplemented by subsistence activities and trapping. Salmon, moose, bear and waterfowl are harvested. There are two general stores, Alaska Commercial Company and Yukon Traders (DCCED 2008). There is a good gravel source available near Saint Mary's.

Saint Mary's is served by barge and aircraft. The State-owned gravel runway and crosswind strip provide year-round access. A 22-mile road links Saint Mary's to Andreafsky, Pitka's Point and Mountain Village. They are not maintained during winter months, but are used by snowmachines. The Andreafsky River provides the only deepwater dock in the Delta (DCCED 2008).

The existing dock at Saint Mary's is, according to the barge operators, an example of an ideal layout for landing and staging areas for their operations. There is a combined low profile sheetpile bulkhead dock and gravel ramp facility with mooring posts, as shown in Figure 6.3.4, below. This makes it very useful for fuel and freight operations.

Figure 6.3.4: Freight Barge (Landing Craft) at the Ramp of Saint Mary's Dock.

The dock could use some maintenance, however. The sheetpile does not have a pile cap, and the mooring lines that are laid across it can get cut or abraded. This is also a serious concern for fuel barge operators, when fuel hoses are laid across the pile cap to shore. In addition, there are three mooring dolphins on the dock—one on the upriver end of the dock, one at the middle, and one on the downriver end of the dock. The dolphin on the downriver end is bent over and needs to be replaced. Barge operators recommended installing the mooring points closer to the dock face when they are replaced.

The City owns this dock and charges a wharfage fee. Although this is not a Priority Site for the purposes of this study, these maintenance issues should be investigated to determine whether the City has identified and included this item on their list for upcoming maintenance to the facility.

Barge operators also indicated there is a shelf located around mid-dock at about 10 to 15 ft deep which presents a risk of hitting rocks during low water. For this reason, they keep their vessels 10 feet or so off the dock face at low water. One barge operator suggested excavating this shelf during winter.

Just upriver, about 100 feet from the City Dock, there is an L-shaped jetty that forms a harbor for local boats, as shown in the photograph in Figure 6.3.5. The fuel barge sometimes noses in at the outside of the jetty to offload fuel to the AVEC tanks. Two mooring points are needed at the end of the jetty (on each side of outer leg of the "L") to facilitate mooring at this location.

Figure 6.3.5: Aerial View of the St. Mary's Dock (©Google Earth).

About a half mile downriver from the City Dock, there is another fuel header at a landing site that is soft and muddy and considered by barge operators to be a decent landing. However, they historically tie off to trees in this area. This could be prevented if two additional mooring points were installed at this landing site.

6.3.8 Pilot Station

Pilot Station is located on the northwest bank of the Yukon River, 11 miles east of Saint Mary's and 26 miles west of Marshall on the Yukon-Kuskokwim Delta. The climate is maritime, averaging 60 inches of snowfall with 16 inches of total precipitation per year. Temperatures can range from -44 to 83°F. The Lower Yukon is ice-free from mid-June through October (DCCED 2008).

The population of Pilot Station is currently about 574, an increase from about 550 people in 2000 and 463 in 1990. Most of the year-round employment is with the school and City government. Fifty-six residents hold commercial fishing permits. Incomes are supplemented by subsistence activities. Trapping and Bureau of Land Management (BLM) firefighting also provide income (DCCED 2008).

A State-owned gravel airstrip is available. Cargo, passengers and mail arrive by air. Heavy winds of up to 50 mph are common during fall and winter. Pilot Station is easily accessible by river-going vessels. Barges deliver fuel and other bulk supplies during the summer. There are no roads to surrounding communities (DCCED 2008).

The existing barge landing consists of a gravel spit and is located at the preferred site, near the AVEC tank farm fuel header. Locals use this area to park their boats and skiffs. Barge operators suggest this landing area needs gravel added to raise it up somewhat because it gets submerged at high water and because some barges (i.e., 4.5-ft draft) have to land about 80 feet away from the landing. There is a gravel pit available at the school site in this community and the nearby community of Saint Mary’s has a rock pit available.

Barge operators report there is a reverse current in front of the community and almost no current on the upriver side of the landing. Some mooring points have been installed at the landing site, but these need to be replaced with three new mooring points that include chain tie-offs rather than the existing 2-inch cable.

There is a large rock on the down river side of the landing that presents a hazard to barges when landing and it was recommended that this be removed.

6.3.9 Marshall

Marshall is located on the north bank of Polte Slough, north of Arbor Island, on the east bank of the Yukon River in the Yukon-Kuskokwim Delta. It lies on the northeastern boundary of the Yukon Delta National Wildlife Refuge. The climate of Marshall is maritime with temperatures ranging between -54 and 86°F. Average annual rainfall measures 16 inches. High winds in the fall and winter often limit air accessibility. The Lower Yukon is ice-free from mid-June through October (DCCED 2008).

The current population of Marshall is estimated to be 388, which is increased from 349 in 2000 and 273 in 1990. Subsistence and fishing-related activities support most residents. Marshall has a seasonal economy with most activity during the summer. Fishing, fish processing and BLM firefighting positions are available seasonally. Thirty-nine residents hold commercial fishing permits. Trapping provides some income. Subsistence activities supplement income (DCCED 2008).

There are no roads connecting to Marshall, so access is primarily by air or water. A State-owned gravel airstrip was recently completed. The community is serviced by barge during the summer (DCCED 2008).

The shoreline that fronts the community is subject to active erosion. The Native Corporation has a fuel pipeline and header at an undeveloped landing site about midway along the shoreline in front of the community. This landing is at a steep slope, estimated to be about 45 degrees. It is the main fuel stop and the barge needs to be moored very well here. The landing site needs three mooring points, installed up high on the beach to prevent them from being undermined by erosion. One should be located at least 125 feet upstream of the header and another one about 150 feet upstream of that. The third mooring point should be installed about 150 feet downstream of the landing.

The freight landing is located on the downriver end of the community, just upstream of the creek that forms the northern border of the community. This landing site is in an eddy and has a shelf at lower water levels. The barges nose in and use a crane to offload cargo. Barge operators recommend building a gravel slip at this location to get deeper water. Although, they have put in their own deadmen here, new mooring points would be needed for nosing in to a new landing. Some gravel for a new permanent staging area is needed in this area as well.

There can be some operational delays for barges during the busy fish buying season when barges have to wait offshore due to fishers using the landing site. One barge operator suggested building a second landing near the fish processing plant to alleviate the wait.

6.3.10 Russian Mission

Russian Mission is located on the west bank of the Yukon River in the Yukon-Kuskokwim Delta, 25 miles southeast of Marshall. The climate exhibits a significant maritime influence. Temperatures range from -54 to 86°F. Annual precipitation is 16 inches with snowfall of 60 inches. Heavy northern winds often limit air access in the fall and winter. The Lower Yukon is ice-free from mid-June through October (DCCED 2008).

The population of Russian Mission is currently about 329 residents, an increase from 296 in 2000 and 246 in 1990. Employment opportunities are limited to the school, local businesses and fishing. Eleven residents hold commercial fishing permits. Seasonal employment includes BLM firefighting and construction. Some income is earned from trapping, and subsistence activities are prevalent (ADCED, 2008).

Russian Mission's location on the Yukon River allows barge and small boat travel during the summer. Passengers, mail and light goods arrive primarily by air. A gravel airstrip and seaplane landing area are owned and operated by the State (DCCED 2008).

There is a rocky bluff along the river edge, upriver of the community. The main barge landing site is just downriver, and an eddy occurs there. This creates some difficulty with landing—the eddy causes difficulty with mooring, the area silts in and the water level varies a lot, causing muddy conditions. Three mooring points are needed to help hold position at this landing site. Two should be installed upriver and one downriver of the landing. Another mooring point would be good at the end of the airport apron so that area could be used for an alternate landing.

The fuel barge operators land at the upriver end of the landing site and are required to drag the fuel hose from the main landing site up to the tank farm. This is about 800 feet along the beach and another 800 feet up to the tank farm. Providing a marine fuel header at the landing site would improve fuel offloading efficiency as well as reduce the potential environmental risks associated with dragging the fuel hose over long distances.

Freight barge operators land at the downriver end of the landing site and they indicate that it is very muddy most of the year. At high water, they can set the ramp up to the bank and it is not as bad, or after the area dries out in the fall, it is not as muddy. Otherwise, they have difficulty crossing the mud with their equipment and sometimes use composite or expanded steel mats, which they bring with them and move around by hand to allow equipment to travel over the muddy areas. This site could be provided with a gravel ramp and built up with gravel and positioned to eliminate siltation. Alternately, it was suggested that the communities with muddy and erosive landing areas be provided with the expanded steel or synthetic crane mats. In addition, the freight barge operators noted that a larger, dedicated staging area is needed at this landing site.

An upcoming school construction project means significant deliveries of equipment and materials will be arriving in this community. Offloading of these materials will be very difficult unless improvements are made before that time. Alternatively, it is recommended to include the proposed staging area, gravel ramp and mooring points as part of the upcoming projects.

6.3.11 Holy Cross

Holy Cross is located in Interior Alaska on the west bank of Ghost Creek Slough off the Yukon River. It is 40 miles northwest of Aniak and 420 miles southwest of Fairbanks. The climate of Holy Cross is continental. Temperature extremes range from -62 and 93°F. Snowfall averages 79.4 inches with 19 inches of total precipitation per year. The Yukon River is ice-free from June through October (DCCED 2008).

The current population of Holy Cross is about 204, which is a decrease from 227 in 2000 and 277 in 1990. Holy Cross is characterized by a seasonal economy. Nine residents hold commercial fishing permits. Subsistence hunting, fishing, trapping and gardening supplement income (DCCED 2008).

Holy Cross is dependent upon air and boat transportation. The State owns and operates a gravel airstrip. Holy Cross is serviced by barge in the summer (DCCED 2008).

The barge landing area at this community consists of a relatively long, narrow landing area that can be used concurrently by several barges. The fuel header is located at the downriver end of the landing area. Freight is generally unloaded at the upper and middle areas of the landing. Barge operators stated a staging area and landing and access road improvements are needed at this site. One barge operator suggested that the rocky bluff along top of the beach in this area could be blasted to widen the landing area to about 100 feet (beach to shore) and the material used to create the staging area and access road improvements. In addition, it was noted that several mooring points are needed: two or three should be located at the freight landing and another two at the fuel header landing. There are two existing deadmen with cables at the fuel header location, and it was advised that these cables be replaced with chain.

6.3.12 Anvik

Anvik is located in Interior Alaska on the Anvik River, west of the Yukon River, 34 miles north of Holy Cross. The climate of Anvik is continental. Temperatures range from -60 to 87°F. Total precipitation averages 21 inches per year and snowfall averages 110 inches per year. The Yukon River is ice-free from June through October (DCCED 2008).

The current population of Anvik is about 88, compared to 104 in 2000 and 82 in 1990. Anvik is characterized by a seasonal economy. Very few year-round wage-earning positions are available. Residents rely heavily on subsistence activities. Fourteen residents hold commercial fishing permits. Several residents trap or make handicrafts (DCCED 2008).

Anvik is accessible by air or sea. The State-owned gravel airstrip provides year-round access. The Anvik River, west of the Yukon River, allows access during the summer by barge and float plane. The City would like to develop dock and harbor facilities (DCCED 2008). Recent road and runway improvement projects have caused an increase in barge activity.

The primary landing area at Anvik consists of an access road that extends down to the riverbank at the fuel header location. The riverbank in front of the community generally consists of a steep bluff. According to barge operators, the soft materials at the landing site and a low, wind-driven current result in erosion problems at the landing site. If the current is relatively low, heavier gravel materials are more likely to stay in place. Erosion is evident on both sides of the landing area, but the primary area of erosion is between the barge landing at the fuel header and the large culvert that is located about 250 feet east of the landing area. Barge operators report that the water is about 25 ft deep in this area. The landing area is only about 20 ft wide, and fuel barge operators recommended widening it to about 100 ft or provide a dedicated ramp landing. One barge operator reported that there is a rock/gravel source in the Anvik area that could be used for this purpose.

This landing site also needs three mooring points to facilitate barge landing and offloading at the header location.

For freight barges, it is difficult to access the community, which is located along a slough of the Yukon River. There is a freight landing just downstream of the culvert, which is also used by locals for boat mooring. A freight barge operator reported that there is a good gravel base and deadmen are available at this landing area to facilitate mooring. However, it is difficult to unload materials up the steep bluff. Fixing this problem would require a project to cut the bank and build a graded ramp and access road from the landing to the upland area. Constructing this ramp at a different location, near the fuel header may provide a dedicated barge landing area reducing the need to move local boats prior to landing. Drawing E8 in Appendix E depicts the proposed landing facility improvements at Anvik.

6.3.13 Grayling

Grayling is located in Interior Alaska on the west bank of the Yukon River east of the Nulato Hills. It is 18 air miles north of Anvik. The climate of Grayling is continental with long, cold winters and relatively warm summers. Temperature extremes range between -60 to 87°F. Snowfall averages 110 inches with 21 inches of total precipitation per year. The Yukon River is ice-free from June through October (DCCED 2008).

The current population of Grayling is about 174, decreased from 194 in 2000 and 208 in 1990. Grayling's economy is heavily dependent on subsistence activities, and employment is found primarily in seasonal work. Nine residents hold commercial fishing permits (DCCED 2008).

No roads connect Grayling with other communities. The State owns and operates a gravel runway. Barges can access Grayling during summer (DCCED 2008).

The landing site at Grayling consists of a wide, gradually sloping beach with a good access road to the community. Barge operators suggested that several mooring points be installed to facilitate tying-up here. Two new mooring points should be installed at the downriver landing site, just south of the access road. There are three existing cable/deadmen mooring points in the trees at the upriver landing for access to the fuel header. It was suggested that the cable on these deadmen be replaced with chain. Alternately these deadmen could be replaced with new mooring points. Drawing E9 in Appendix E illustrates the approximate location for proposed mooring points at both landing sites.

Note that there are upcoming construction projects planned in Grayling, including airport reconstruction and water system improvements. It would be cost-effective to include installation of the mooring points with these or other upcoming projects.

6.3.14 Shageluk

Shageluk is located on the east bank of the Innoko River, approximately 20 miles east of Anvik and 34 miles northeast of Holy Cross. The Innoko is a tributary of the Yukon River. Shageluk has a cold, continental climate. Summer temperatures average from 42 to 80°F, winters can range from -62 to 0°F. Annual precipitation is 67 inches with average snowfall of 110 inches. The Innoko River is generally ice-free from June through October (DCCED 2008).

The population of Shageluk is about 124, a slight decrease from 129 in 2000 and 139 in 1990. Employment is limited primarily to the City and the school. Summer construction projects provide seasonal employment. Residents rely upon subsistence hunting and gathering and several residents trap and garden (DCCED 2008).

Access to Shageluk is by air or water. A State-owned gravel airstrip is located upriver from the community. There are two fuel header locations. One is near the freight landing site on the downstream end of the community. This site needs three mooring points—two upstream of the landing/access road and one downstream. In addition, rain has washed out the freight landing area and it should be widened to about 60 feet wide by cutting into the upland area.

Freight barge operators indicate that offloading is made difficult due to silty soils, steep grade, and resulting poor traction. Sometimes, it takes several hours to level out the landing and put down mats for traction. This could be improved by providing a gravel or concrete ramp to create a hard bottom at the landing area. In addition, a large (approximately 40,000 square feet) staging area is needed at the freight landing site. One barge operator indicated there are gravel pits at the school and airport that may be available.

The other landing site is upstream, near the bridge that connects the community to the road leading to the airport. This landing is for AVEC tank access and efficiency would be improved by providing a marine header for these tanks at the downriver landing site. Alternately, at least two mooring points are needed—one each on the upstream and downstream side of the creek. This would eliminate the need to tie off to trees in that area. However, it was reported that the land on the opposite side of the bridge is privately owned.

6.4 Middle Yukon River Region

The Middle Yukon River Region, for the purposes of this study, includes the communities along the Yukon River from Kaltag upriver to the community of Tanana, near the confluence of the Yukon and Tanana rivers.

This portion of the Yukon River borders the Innoko and Nowitna National Wildlife Refuges and passes through wet meadows and forested regions. Most of the communities are situated in the lowlands adjacent to the river or tributary, where spring flooding and ice-damming can occur. The adjacent terrain is marked by hills, often less than 2,000 ft elevation. The rivers and creeks that meander through the floodplain and create outside bends, or *cutbanks*, where soils and vegetation are eroded into the river and the inside bends, or *aggragational* banks, are built up through the sediment deposition. Vegetation near the river channels primarily include willow and alders with deciduous and conifer trees typical further upland. This part of the river is generally ice-free from mid-May through mid-October.

Figure 6.4.1 depicts the communities included in this study located in the Middle Yukon River region.

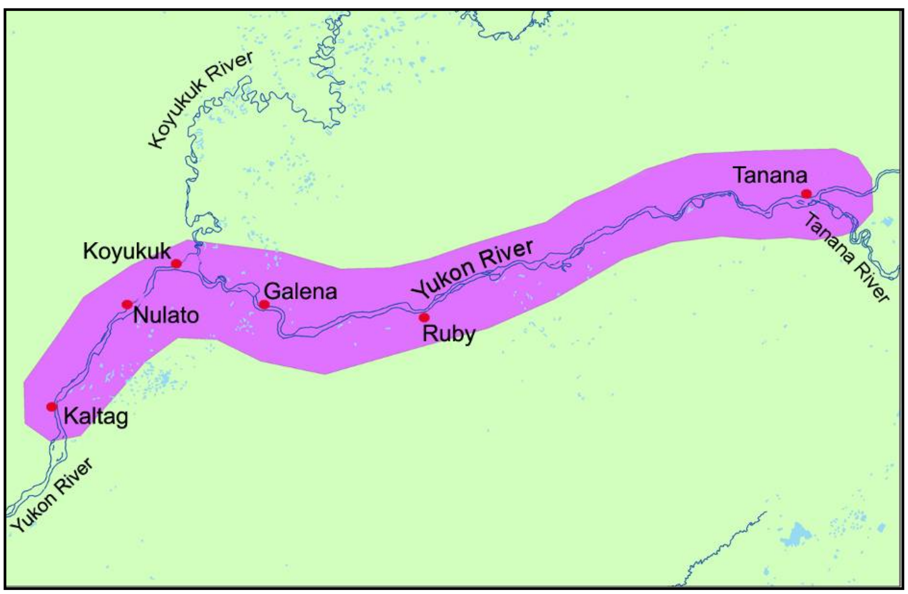

Figure 6.4.1: Middle Yukon River Region.

6.4.1 Kaltag

Kaltag is located on the west bank of the Yukon River, 75 miles west of Galena and 335 miles west of Fairbanks. It is situated on a 35-foot bluff at the base of the Nulato Hills, west of the Innoko National Wildlife Refuge. The area experiences a cold, continental climate with extreme temperature differences. The average daily high temperature during July is in the low 70s; the average daily low temperature during January ranges from 10°F to below zero. Sustained temperatures of -40°F are common during winter. Extreme temperatures have been measured from -55 to 90°F. Annual precipitation is 16 inches with 74 inches of snowfall annually. The river is ice-free from mid-May through mid-October (DCCED 2008).

The current population of Kaltag is 199, a decrease from 230 in 2000 and 240 in 1990. Subsistence is an important part of the local economy. Most cash jobs are with the tribe, school, local government, BLM firefighting, commercial fishing or fish processing. Eighteen residents hold commercial fishing permits (DCCED 2008).

The State-owned lighted gravel airstrip provides Kaltag with year-round air service. Barges typically deliver heavy cargo three times a year (DCCED 2008).

Barge operators who were interviewed agreed that the landing sites in this community need to have mooring points installed. The freight landing and main fuel header are at one landing site, near the north end of the community. It is especially a problem to land at this site in the fall when the water is low, and two mooring points are needed at this location (one on each side of the landing area). There is another landing that is required for offloading fuel to the school's fuel storage tanks via a header at this location. Three mooring points are needed at the school landing site, two on the north/upriver side of the landing and one on the downstream side. There is a third landing site located further upriver, north of the community, near the cemetery. It was recommended that this landing site should be widened to about 60 ft and have three mooring points installed.

6.4.2 Nulato

Nulato is located on the west bank of the Yukon River, 35 miles west of Galena and 310 air miles west of Fairbanks. It lies in the Nulato Hills, across the river from the Innoko National Wildlife Refuge. The area experiences a cold, continental climate with extreme temperature differences. The average daily maximum during July is in the lower 70s; the average daily minimum during January is well below zero. Several consecutive days of -40°F is common each winter. The highest temperature ever recorded is 90°F; the lowest is -55°F. Average precipitation is 15.6 inches with 74 inches of snowfall annually. The Yukon River is ice-free from mid-May through mid-October (DCCED 2008).

The current population of Nulato is about 290, a decrease from 336 in 2000 and 359 in 1990. Most of the full-time employment in Nulato is with the city, tribe, school, clinic and store. During the summer, BLM firefighting positions, construction work and fish processing are important sources of cash. Twelve residents hold commercial fishing permits. Trapping provides an income source in winter (DCCED 2008).

The State-owned lighted airstrip provides year-round access. The river is the primary mode of local transportation—barges deliver cargo during the summer months, and it becomes an ice road during winter for vehicles and snowmachines (DCCED 2008).

The barge landing area at this community is relatively good, according to barge operators. In recent years, the community has built up the main fuel and freight landing site and staging area with gravel, angled a rock/gravel slip into the water, and for erosion protection they installed culverts into the ground on each side of the slip and filled them with sand, which creates a "soft" landing. Three mooring points are needed at this landing site. Another mooring point is needed above the waterline at the upland landing site, which is used to offload fuel to the AVEC tanks. In addition, the fuel barge makes a third stop in front of the school every other year to offload fuel. Mooring points would not be helpful at this location because there is a sand bar in front of this area that changes from year to year. Drawing E10 in Appendix E shows the approximate locations where the mooring points are needed.

A new town site is planned upland from the existing riverside community area. Many residences are already built at this location. As public facilities are moved or constructed at the upland town site, plans for a consolidated marine fuel header location at the main barge landing site should be considered for inclusion in these projects.

6.4.3 Koyukuk

Koyukuk is located on the Yukon River near the mouth of the Koyukuk River, 30 miles west of Galena and 290 air miles west of Fairbanks. It lies adjacent to the Koyukuk National Wildlife Refuge and the Innoko National Wildlife Refuge. The area experiences a cold, continental climate with extreme temperature differences. The average daily high temperature during July is in the low 70s; the average daily low temperature during January ranges from 10°F to below zero. Sustained temperatures of -40°F are common during winter. Extreme temperatures have been measured from -64 to 92°F. Annual precipitation is 13 inches with 60 inches of snowfall annually. The river is ice-free from mid-May through mid-October. The community has experienced severe flooding from the Yukon and Koyukuk rivers (DCCED 2008).

The population of Koyukuk is currently about 88, decreased from 101 in 2000 and 126 in 1990. There are few full-time jobs in the community; the city, tribe, clinic, school and store provide the only year-round employment. BLM firefighting, construction work, and other seasonal jobs often conflict with subsistence opportunities. Two residents hold commercial fishing permits. Trapping and beadwork supplement incomes (DCCED 2008).

The State-owned lighted gravel runway provides year-round transportation. The river is heavily traveled when ice-free, from mid-May through mid-October. Cargo is delivered by barge about four times each summer (DCCED 2008). There is a local rock/gravel material source available at this community.

The landing area at this community can be problematic for barge landings because there is a lot of erosion. The bluff that leads down to the landing area is caving in and the road up the bank is steep and rutted. Barge operators noted there is little current at the landing area, but there is a lot of silt and mud. Three mooring points are needed at the main fuel and freight landing site. Two mooring points are needed at the upriver fuel barge landing, where they currently have to tie off to trees to facilitate mooring.

Mooring points are a most needed for improvements at this site. As a lesser priority, the barge operators advised that the site may also benefit from some grading and access road improvement work or providing mats to facilitate traction up the banks as well as a small dedicated staging area near the main landing. However, because there are plans to relocate this community, accelerated funding of these improvements are not recommended.

6.4.4 Galena

Galena is located on the north bank of the Yukon River, 45 miles east of Nulato and 270 air miles west of Fairbanks. It lies northeast of the Innoko National Wildlife Refuge. The area experiences a cold, continental climate with extreme temperature differences. The average daily high temperature during July is in the low 70s; the average daily low temperature during January ranges from 10°F to below zero. Sustained temperatures of -40°F are common during winter. Extreme temperatures have been measured from -64 to 92°F. Annual precipitation is 12.7 inches with 60 inches of snowfall annually. The river is ice-free from mid-May through mid-October (DCCED 2008).

The population of Galena has been decreasing in recent years: the current population is about 636 compared to 675 in 2000 and 833 in 1990. Galena serves as the transportation, government and commercial center for the western Interior of Alaska. Federal, state, city, school and village government jobs dominate, but Galena has several other jobs in air transportation and retail businesses. Thirty-one residents hold commercial fishing permits. Other seasonal employment, such as construction work and BLM firefighting, provide some income (DCCED 2008).

Galena serves as a regional transport center for surrounding communities. The State-owned Edward G. Pitka, Sr. Airport provides the only year-round access. There is a paved, lighted runway and a gravel ski strip adjacent to the main runway. The rivers allow access by cargo barges from mid-May through mid-October. A small boat launch was recently completed (DCCED 2008).

A COE bank stabilization project was completed in 2006 to provide erosion protection along the Yukon River. The Yukon River is mined for gravel.

A large volume of fuel is delivered to the old town tank farm, near the downriver end of town. There is a fuel header near this landing area. Barge operators indicated there is a bench in front of this landing that has a lot of debris including large pieces of steel that need to be removed. This debris poses a hazard to barges. In addition, one large mooring point is needed at the point, adjacent to the landing area, plus another downstream of the landing and two mooring points upriver of the landing.

A freight barge landing site is located near the downstream end of the runway, near the center of the shoreline that fronts the community. Three mooring points are needed due to the current present at this landing site.

Barge operators noted that there is a public landing at Galena and the City has plans underway to build a sheetpile dock there. This landing site is located toward the upriver end of town and there is a fuel header near the landing. Two mooring posts are needed at this location. It is recommended that mooring bollards be included in the City’s new dock design. Drawing E11 in Appendix E depicts the location of mooring points needed at the other landing sites at Galena.

6.4.5 Ruby

Ruby is located on the south bank of the Yukon River, in the Kilbuck-Kuskokwim Mountains. It is about 50 air miles east of Galena and 230 air miles west of Fairbanks. Ruby lies adjacent to the Nowitna National Wildlife Refuge. The area experiences a cold, continental climate with extreme temperature differences. The average daily high temperature during July is in the low 70s; the average daily low temperature during January ranges from 10°F to below zero. Sustained temperatures of -40°F are common during winter. Extreme temperatures have been measured from -53 to 98°F. Annual precipitation is 17 inches with 66 inches of snowfall annually. The river is ice-free from mid-May through mid-October (DCCED 2008).

The population of Ruby is currently about 183, compared to 188 in 2000 and 170 in 1990. Traditional Athabascan culture and subsistence practices are the focal point of village life. The city, tribe, school, tribal council, Dineega Corporation and clinic are the largest employers. Ruby also has a number of small, family-operated businesses. BLM firefighting, construction work, Native handicrafts and trapping are part-time cash sources. Eight residents hold commercial fishing permits (DCCED 2008).

Ruby is accessible by air and water. A State-owned lighted gravel airstrip is available. Floatplanes land on the Yukon River. There are no docking facilities, but a boat launch and barge offloading area are available. Barges make several deliveries each summer (DCCED 2008).

There are two barge landing areas at Ruby—one for freight and one for fuel. Both consist of a long gravelly beach. The fuel landing site is at the upriver end of the community, near the tank farm. The freight landing includes a small staging area and is at the downriver end of town. There is a big mud shelf in front of the community in this area that can cause some problems. Otherwise, the landings are considered sufficient. The fuel barge often brings some freight cargo to Ruby, so two stops are required. For this reason, it is recommended to consolidate the landings by providing a staging area near the fuel landing site. It was suggested that the rock bluff above the landing be cut and pushed down to the riverbank to create the staging area and improve the landing site.

The fuel and freight landing sites each need to have two mooring points installed to allow proper mooring during offloading of barges.

6.4.6 Tanana

Tanana is located in Interior Alaska about 2 miles west of the junction of the Tanana and Yukon rivers, 130 air miles west of Fairbanks. Tanana experiences a cold, continental climate with temperature extremes. Daily maximum temperatures during July range from 64 to 70°F; daily minimum temperatures during January are -14 to -48°F. Extremes have been measured from -71 to 94°F. Average annual precipitation is 13 inches with 50 inches of snowfall. The river is ice-free from mid-May through mid-October (DCCED 2008).

The population of Tanana is currently about 261 and has varied in recent years: the population was 308 in 2000 and 245 in 1990. Two-thirds of the full-time jobs in Tanana are with the city, school district or native council. There are a number of positions with local businesses and services. BLM firefighting, trapping, construction work and commercial fishing are important seasonal cash sources. Seventeen residents hold commercial fishing permits (DCCED 2008).

Tanana is accessible only by air and river transportation. The City maintains 32 miles of local roads. The City operates a dock on the river; barged goods can be offloaded at a staging and storage area. The State owns and operates the Ralph M. Calhoun Memorial Airport with a lighted gravel runway. Floatplanes land on the Yukon River (DCCED 2008).

Fuel barge operators reported there are several fuel stops for this community and consolidating the fuel header locations would significantly improve operational efficiency at this site. In the meantime, mooring points are needed at each of the three fuel landing sites. Tanana Power has a fuel header at the upriver end of town that needs two mooring points. The AC Store has a small gravel slip at their fuel barge landing site, and that landing needs two mooring points. The Tozitna tank farm, just downriver from the store needs one strong mooring point. They now have to tie to trees to hold position during fuel offloading.

One barge operator reported that in 1980s the community put in a landing at the lower end of town near the airport. Now that area is changed. There is an eddy, swift water, and the bank is now too steep to work. One freight barge operator stated that the landing in front of the store is now the preferred location and the deadmen mooring points have recently been replaced. Other freight barge operators noted that four mooring points are needed along the beach in front of the airstrip. Two landing sites have recently been constructed along this beach in front of the airport, as part of the airport construction project. It was suggested that these landing sites could use mooring points and should be cleaned up to permit future use.

Drawing E12 in Appendix E illustrates the proposed location for the mooring points required at the four main barge landing sites described above.

6.5 Upper Yukon River Region

The Upper Yukon River Region, for the purposes of this study, includes the communities along the Yukon River from Stevens Village upriver to Eagle Village, near the Alaska/Canada Border. This part of the river is generally ice-free from mid-June through mid-September.

The portion of the Yukon River between Stevens Village and Fort Yukon includes an area known as the Yukon Flats, and is notably shallow compared to the lower portions of the river. The Yukon Flats describes the area adjacent to the river, which is surrounded by nearby uplands areas, in the foothills of the Brooks Range and nearby mountains. The Yukon River is the chief drainage for the area and the river drops only 200 feet in elevation along the 300-mile stretch across the Yukon Flats. The communities in this study region are situated in the lowland areas, characterized by shallow lakes, sloughs and braided rivers, which are characterized by cutbanks and aggragational banks and are susceptible to flooding and ice-damming. Adjacent upland areas consist of river terraces, alluvial fans and floodplain deposits that rest on bedrock, and upland rolling hills that rarely exceed 1,500 feet. The upper stretches of the river, between Circle and Eagle Village get into higher mountainous areas in the uplands adjacent to the river, where elevations can exceed 3,000 to 4,000 feet.

Figure 6.5.1 depicts the communities included in this study located in the Upper Yukon River region.

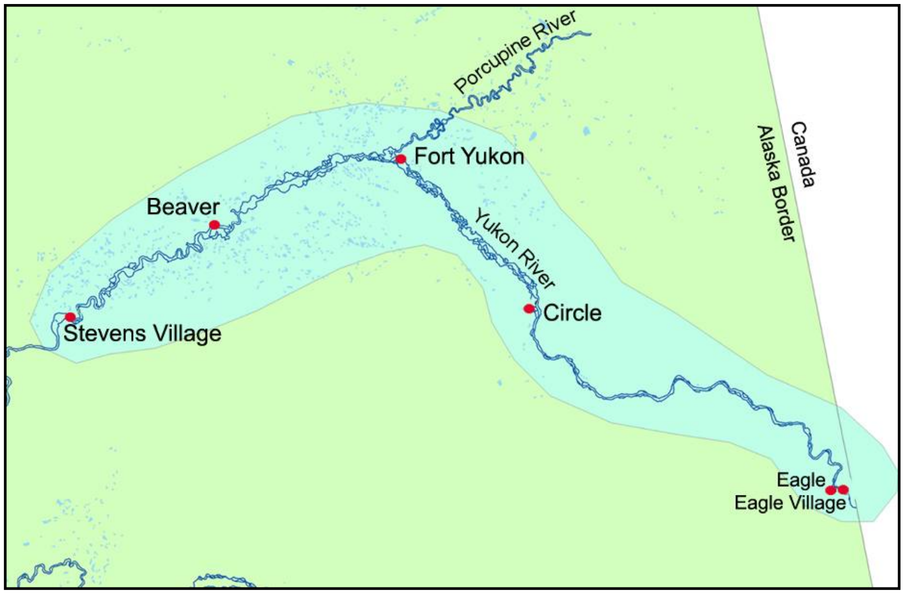

Figure 6.5.1: Upper Yukon River Region Map.

Due to the shallow waters of this region, only small barges/landing craft are able to access this portion of the river. Many operators do not serve these communities for this reason, combined with the fact that the small volume of goods delivered does not make it economical. In addition, the communities of Eagle, Eagle Village, and Circle are located on the Alaska Highway system, which allows more economical delivery of goods by truck.

6.5.1 Stevens Village

Stevens Village is located on the north bank of the Yukon River, 17 miles upstream of the Dalton Highway bridge crossing, and 90 air miles northwest of Fairbanks. Daily minimum temperatures between November and March are usually below 0°F. Extended periods of -50 to -60°F are common. Summer high temperatures run 65 to 72°F; a high of 97°F has been recorded. Total annual precipitation averages 6.58 inches with 43.4 inches of snowfall. The Yukon River is ice-free from the end of May through mid-September (DCCED 2008).

Stevens Village has a decreasing population currently estimated at 63, down from 87 in 2000 and 102 in 1990. The community is heavily dependent upon subsistence activities. There is some seasonal and part-time employment at the school, clinic, village council, stores, BLM firefighting, or construction work. Three residents hold commercial fishing permits (DCCED 2008).

Access to Stevens Village is primarily via the State-owned airstrip. A new airport was recently completed with a lighted gravel runway. Fuel is shipped by barge at least three times each summer (DCCED 2008).

Barge operators report erosion problems along the shoreline in front of the community, although the water is generally slack. This may suggest melting permafrost soils as the primary cause of erosion. The landings are fairly good, gravel beach landings. Historically, there have been problems with the landing sites getting muddy; but according to barge operators, a contractor recently built the landings up with gravel. An upriver landing is used to offload fuel at the fuel tanks and a downriver landing is used for fuel and freight offloading. This area has a small staging area upland of the landing site. The upper and lower barge landings need two mooring points to facilitate barge mooring. Drawing E13 in Appendix E illustrates the approximate location of the proposed mooring points.

6.5.2 Beaver

Beaver is located on the north bank of the Yukon River, approximately 60 air miles southwest of Fort Yukon and 110 miles north of Fairbanks. It lies in the Yukon Flats National Wildlife Refuge. Beaver has a continental subarctic climate characterized by seasonal extreme temperatures. The average high temperature during July ranges from 65 to 72°F. The average low temperature during January is well below zero. Extended periods of -50 to -60°F are common. Extreme temperatures ranging from a low of -70°F to a high of 90°F have been measured. Precipitation averages 6.5 inches. The average annual snowfall is 43.4 inches. The Yukon River is ice-free from mid-June to mid-October (DCCED 2008).

The population of Beaver is slightly decreasing with a current population of 72, compared to 84 in 2000 and 103 in 1990. Almost all Beaver residents rely on subsistence activities. Most wage employment is at the school, post office, clinic and village council. Seasonal wages are earned through BLM firefighting, construction jobs, trapping, producing handicrafts or selling cut firewood (DCCED 2008).

The State-owned lighted gravel airstrip provides daily air service. Fuel, groceries and supplies are shipped to Beaver via airplane or by barge during summer (DCCED 2008).

The barge operators who participated in this study stated that they did not regularly deliver to this community. One barge operator noted that he had been there a few times in recent years and described the landing site as muddy because it tends to become covered with drifting silt each year. They have to cleanup and maintain the landing area upon arrival. Operation efficiency would improve if the community designated someone to clean it out prior to the barge’s arrival. In addition, the landing could be improved by adding gravel to elevate the landing and by installing mooring points.

6.5.3 Fort Yukon

Fort Yukon is located at the confluence of the Yukon River and the Porcupine River, about 145 air miles northeast of Fairbanks. The winters are long and harsh and the summers are short but warm. After freeze-up the plateau is a source of cold, continental Arctic air. Daily minimum temperatures between November and March are usually below zero. Extended periods of -50 to -60°F are common. Summer high temperatures run 65 to 72°F; a high of 97°F has been recorded. Total annual precipitation averages 6.6 inches with 43.4 inches of snowfall. The Yukon River is ice-free from the end of May through mid-September (DCCED 2008).

The population of Fort Yukon appears to be slightly increasing with a current population of about 596, compared to 595 in 2000 and 580 in 1990. City, state, federal agencies and the Native Corporation are the primary employers in Fort Yukon. The school district is the largest employer. Winter tourism is becoming increasingly popular as a destination for viewing the northern lights. BLM operates an emergency firefighting base at the airport. The US Air Force operates a Long Range Radar Station in Fort Yukon. Trapping and Native handicrafts also provide income. Residents rely on subsistence activities. One resident holds a commercial fishing permit (DCCED 2008).

Fort Yukon is accessible by air and river. A State-owned lighted gravel airstrip is available; Hospital Lake, adjacent to the airport, is used by floatplanes. Heavy cargo is brought in by barge from the end of May through mid-September; there is a barge offloading area, but no dock (DCCED 2008).

There are a series of erosion protection structures constructed perpendicular to the shoreline, known as groins, which have been installed at several locations along the riverbank of this community. This has resulted in the channel along the shoreline becoming shallower. There are a few places to land on the beach downriver of this area, but they rarely go upriver as far because the channel is narrow (about 50-feet wide).

The beach just downriver of the erosion protection structures is on private land and barge operators indicate that four mooring points are needed in this area to facilitate mooring. Two should be located upriver and two downriver of the landing area. Fuel barge operators now land in this area, and have to drag the fuel hose about 200-feet upriver to reach the tanks to offload fuel. It is recommended to consider constructing a pipeline and fuel header closer to a site that is more accessible by the barges. In addition, freight barge operators indicate that there is a crane located on the shore, just upriver from where they can access shore. Possibly, the crane should be re-located to the preferred freight offloading area.

Further downriver, there is a concrete boat launch ramp that is used by the locals. This site appears to have a small staging area nearby. One barge operator indicated they could use this ramp as a barge landing if two additional mooring points were installed. However, it is unclear whether the community would allow this use of the ramp or if it is designed for the heavier loads imposed by the barge offloading equipment.

There is a third landing area at the far downriver end of town that is also used for offloading freight. This site needs two mooring points. Drawing E14 in Appendix E illustrates the approximate location of the proposed mooring points at all of the landing areas described above.

6.5.4 Circle

Circle is located on the south bank of the Yukon River at the edge of the Yukon Flats, 160 miles northeast of Fairbanks. It is at the eastern end of the Steese Highway. Circle has a continental subarctic climate, characterized by seasonal extremes in temperature. Summer temperatures range from 65 to 72°F. Winter temperatures can range from -71 to 0°F. Rainfall averages 6.5 inches and snowfall averages 43.4 inches. The Yukon River is ice-free from mid-June through mid-October (DCCED 2008).

The population of Circle is currently estimated at 95 and relatively steady, and may increase during summer months as a result of seasonal residents. Major employers include the school, clinic, Village Corporation, hotel, trading post, and post office. Recreation attracts visitors to Circle seasonally. Two residents hold commercial fishing permits. Almost all residents are involved in subsistence and trapping and making of handicrafts contribute to family incomes (DCCED 2008).

Although, barges do deliver goods via the Yukon River during summer, Circle has direct road access to Fairbanks by way of the Steese Highway. A new State-owned 3,000-foot long by 60-feet wide, lighted gravel airstrip is available and float planes land on the river (DCCED 2008).

The barge operators interviewed did not regularly service Circle, primarily because it is located on the highway system and fuel and cargo deliveries are frequently made by truck. For this reason, barge landing improvements at this community are not considered a priority for the purposes of this study.

6.5.5 Eagle

The cities of Eagle and Eagle Village are located on the Taylor Highway, 6 miles west of the Alaska-Canadian border. Eagle is on the left bank of the Yukon River at the mouth of Mission Creek. The Yukon-Charley Rivers National Preserve is northwest of the area. January temperatures average -22 to -2°F, but can range as low as -60°F; July temperatures average 50 to 72°F. Average annual precipitation is 11.3 inches. Ice fog occurs during long cold spells (DCCED 2008).

The population of Eagle is slightly decreasing, about 110 in 2006 compared to 129 in 2000 and 168 in 1990. Year-round earning opportunities are limited. Retail businesses, the school, mining and seasonal employment such as tourism and BLM firefighting provide the majority of employment. Subsistence activities provide some food sources (DCCED 2008).

Eagle has access to the state road system and Canada only during summer months via the Taylor and Top of the World highways. A State-owned gravel airstrip is available and floatplanes land on the Yukon River. There is no dock, but a public boat landing is available (DCCED 2008). There is a gravel material source in Eagle.

The barge operators interviewed did not regularly service Eagle, primarily because it is located on the highway system and fuel and cargo deliveries are made by truck. For this reason, and because a public landing is already available, barge landing improvements at this community are not considered a priority for the purposes of this study.

6.5.6 Eagle Village

Eagle Village is on the left bank of the Yukon River, 3 miles east of Eagle, on the Taylor Highway. The community is southeast of the Yukon-Charley Rivers National Preserve. January temperatures range from -22 to -2°F; July temperatures range from 50 to 72°F. Average annual precipitation is 11.3 inches. Ice fog is common during the winter (DCCED 2008).

The current population of Eagle Village is relatively steady at 70. Nearly all employment in Eagle Village is seasonal. Subsistence activities provide the majority of food items (DCCED 2008).

The community has access to the state road system and Canada only during summer months via the Taylor and Klondike highways. An airport is available at the nearby city of Eagle.

The barge operators interviewed have not serviced Eagle Village, likely because it is located near the landing at Eagle. Because this community is serviceable by road, barge landing improvements are not considered a priority for the purposes of this study.

6.6 Kuskokwim River Delta and Nunivak Island Region

The Kuskokwim River Delta and Nunivak Island Region, for the purposes of this study, extends from Scammon Bay on the Bering Sea coast, south to the communities along Stolin Strait and the Kuskokwim Delta, to the community of Platinum, on the south side of Goodnews Bay, south of the mouth of the Kuskokwim River. It includes the community of Mekoryuk, which is located on Nunivak Island, on the west side of Stolin Strait. The delta includes the most extensive area of unvegetated intertidal flats among the three segments of the Yukon-Kuskokwim River delta. Most of the communities included in this region are situated in coastal areas with beach landings that are tidally influenced. Nunivak Island lies 20 miles off the coast and is of volcanic origin with several peaks over 1,000 feet. Coastal bluffs range from 100 to 450 feet high with sandy beaches below.

Local construction contractors have said the local gravel sources that may be present in many of the communities in the Lower Kuskokwim River and delta region can have a high content of fine grained materials and may be highly compressible. The source at Platinum is known to be good, however, and is considered one of the primary material sources in this region. Figure 6.6.1 depicts the communities included in this study which are located in the Kuskokwim River Delta and Nunivak Island region.

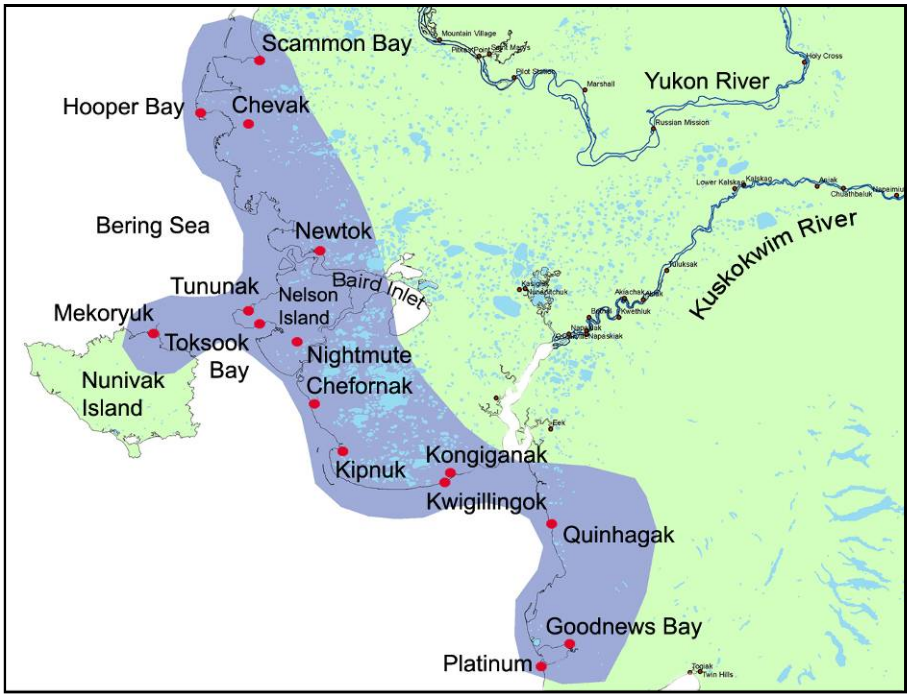

Figure 6.6.1: Kuskokwim River Delta and Nunivak Island Region Map.

6.6.1 Platinum

Platinum is located on the Bering Sea coast, below Red Mountain on the south spit of Goodnews Bay. It lies 11 miles from Goodnews Bay and 123 miles southwest of Bethel. Platinum has a marine climate. Average annual precipitation is 22 inches with 43 inches of snowfall. Summer highs range from 53 to 57°F, winter highs average 6 to 9°F. Extremes have been measured from 82 to -34°F (DCCED 2008).

The population of Platinum is currently estimated at about 35, which is down from 41 in 2000 and 64 in 1990 (the year that the mine closed). Because the community was founded as a commercial center revolved around a former platinum mine, and has always seen an influx of outsiders, local traditions have not been retained as much as in other villages. The economy is primarily cash-based. Commercial fishing, the school, stores and city provide employment. Platinum is a major supplier of gravel to area communities. Nine residents hold commercial fishing permits. Subsistence activities are also an important part of the lifestyle. The community is interested in developing a marine repair facility and dry dock, a specialty seafood venture, or herring roe aquaculture project. CVRF has a fish processing plant at Platinum (DCCED 2008).

The community relies heavily on air transportation for passengers, mail and cargo service. There are two gravel airstrips. One is State-owned and has a crosswind runway. The second is owned by the Platinum Mine. A seaplane landing site is also available. Barge services deliver goods twice a year (DCCED 2008).

Barges land on the north end of the spit, at the entrance to Goodnews Bay, where the water depth is estimated to be about 18 to 20-feet in this area. Knik Construction (Knik) has a dock on the northeast end of the spit and has a large gravel operation that is based in Platinum. Knik allows use of their dock when not being used by them. Knik also has pilings that can be used for mooring, and when barges tie off to the pilings the fuel hoses are floated to shore. The main community is on the Bering Sea coast, about 3 miles south of the dock. Fuel and cargo is trucked via a road that leads from the landing area to the community. Fuel barge operators pointed out that installing a pipeline and header would not be practical, given the relatively small volume of fuel delivered compared to other places.

Currents at the landing site can be fast, so freight is unloaded at high tide. The gravel beach is soft and stable to land on, but because the gravel is very uniform, their equipment sinks into it during offloading. The barge crew places mats or sand to facilitate offloading. Recommendations include providing a dedicated public access, such as a dock or ramp; however, it would be considered a lower priority than other communities because there are other facilities available.

CVRF is planning to open a fish processing plant near the Knik dock on the northeast end of the spit, and plan to construct a dock to support the plant. The plant is intended to initially service several communities and will act as a regional plant in the future. When Knik's barge is moored at CVRF's dock, the channel into Goodnews Bay is impassable. To get adequate draft when accessing the channel, barges and fish tender vessels have to navigate close to the beach as they go around the corner at the end of the spit. Knik's dock is located right at the entrance to the channel. These vessel operators recommended dredging a wider channel.

6.6.2 Goodnews Bay

The community is located on the north shore of Goodnews Bay at the mouth of Goodnews River. It is 116 air miles south of Bethel, 110 miles northwest of Dillingham and 400 miles west of Anchorage. Goodnews Bay is in a transitional climatic zone, exhibiting characteristics of marine and continental climates. Average precipitation is 22 inches with 43 inches of snowfall. Summer temperatures range from 41 to 57°F; winter temperatures are 6 to 24°F (DCCED 2008).

The current population of Goodnews Bay is about 242, compared to 230 in 2000 and 241 in 1990. The city, school, local businesses and commercial fishing provide the majority of the income, supplemented by subsistence activities. Forty-one residents hold commercial fishing permits for salmon and herring roe fisheries. Many residents engage in trapping (DCCED 2008).

A State-owned gravel airstrip is available for chartered or private planes year-round. There are no docking facilities, although locals use boats and skiffs extensively during the summer months. Barges deliver fuel and other supplies during the summer months (DCCED 2008).

There is a narrow, winding channel through the bay from the sand spits that mark the entrance of the bay to the community. The channel ranges in depth from less than 6 feet to over 70 feet deep.

The landing area at Goodnews Bay is at the point near where the Goodnews River enters the bay. The current is strong along the south side of this point. Several mooring points are needed at this landing. The marine fuel header is along the coast in front of the community in an area that is too shallow for the barge to access. The fuel tank farms are in the uplands area and require 800 feet or more of hose to offload fuel from the landing area at the point. It was recommended to relocate the marine fuel header closer to the landing site in order to increase operational efficiency.

The beach at the landing site is fairly wide (and growing). The beach is used for staging freight and equipment. A dedicated upland staging area would be beneficial for this community. There are gravel pits available in Goodnews Bay and nearby Platinum.

The CVRF CDQ group uses a landing craft to go into Goodnews Bay by following a shallow channel from Platinum. The landing craft draws about 6 feet when fully loaded and the channel to the landing site is estimated to be about 5.5-feet deep at high tide. To access Goodnews Bay, a 50-foot long tender is used that only draws 18-inches. They noted that other tenders will stay 2 miles out from the community. Dredging an access channel to the community would improve access to the landing site. Prior to dredging, it is recommended to study the sustainability of dredging and minimizing potential impacts to fish habitat in this highly productive area. This study is recommended for priority funding.

Drawing E15 in Appendix E depicts potential layouts for the proposed staging areas and mooring points at the existing landing area at Goodnews Bay. It is recommended that a dredging study also be initiated as a priority project.

6.6.3 Quinhagak (Kwinhagak)

Quinhagak is on the Kanektok River on the east shore of Kuskokwim Bay, less than a mile from the Bering Sea coast, about 71 miles southwest of Bethel. Quinhagak is located in a marine climate with an average annual precipitation of 22 inches and 43 inches of snowfall. Summer temperatures average 41 to 57°F, winter temperatures average 6 to 24°F. Extremes have been measured from 82 to -34°F (DCCED 2008).

The population of Quinhagak is currently 648 and has shown to be increasing with a population of 555 in 2000 and 501 in 1990. Most of the employment is with the school, government services or commercial fishing (83 commercial fishing permits). Trapping, basket weaving, skin sewing and ivory carving also provide income. Subsistence is also an important part of the livelihood. Coastal Villages Seafood LLC has a plant for processing halibut and salmon in Quinhagak (DCCED 2008).

Quinhagak relies heavily on air transportation for passengers, mail and cargo service. Floatplanes land on the Kanektok River. A harbor and dock are available. Barges deliver heavy goods at least twice a year (DCCED 2008).

Fuel barge operators reported multiple stops are required for fuel offloading and fuel needs to be trucked to the Village Safe Water (VSW) tanks. Providing a marine header for this tank farm, and consolidating all marine fuel headers to one accessible landing area would increase operational efficiency at this community.

There is a dedicated city sheetpile bulkhead dock facility with a staging area at Quinhagak. It is near the main bulk fuel tank farm. Freight barge operators, fuel barge operators, as well as the CDQ fisheries group state the main problem is accessing the dock at Quinhagak. Travel is one mile up a narrow winding river from the mouth of the river to the dock, which can only be done at high tide. There is one channel, about 7 feet off of the bank, which enters a very shallow bay, which is visible in the aerial photograph shown in Figure 6.6.2. The dock is at the far side of this bay, which is now at the very end of the accessible portion of the channel. Locals mark the channel with plastic jugs each year. Barge and fishing vessel operators noted the channel has been filling in over the years, and short term emergency dredging was conducted about 5 years ago and needs to be completed again in order to ensure continued access to this site. Dredging for access to this site was reported by CVRF to be their highest priority for funding. This would ensure continued access to their fish processing plant as well as the community's existing bulk fuel tank farm.

Figure 6.6.2: Aerial view of access to Quinhagak at a low tide (©Google Earth).

Some limited emergency dredging may be necessary to provide barge access for the short term. Maintaining this channel may be more difficult as time goes on because the natural flow of the river appears to have shifted and no longer enters this bay. A detailed dredging study would help to evaluate the long-term feasibility of dredging and maintaining a channel to this site. Option A in Drawing E16 (Appendix E) depicts the area for dredging the proposed channel to access to the existing dock.

Although dredging may be a good short-term solution, it is likely that in the long-term, an alternate barge landing site will need to be developed to provide reliable barge access to this community.

A new landing site should be sited at a location that is not experiencing significant sediment accretion. One possible site may be on the point of land on the northeast side of the "bay" that is filling in. There is an existing road leading to the shoreline in this area. Barge operators indicate this area is wet and may require filling and erosion protection if a permanent dock is constructed here. In addition, it is likely that land ownership issues would need to be resolved to build a facility at this site. The land at the proposed new dock site appears to be residential with existing houses present. At least one existing building would need to be relocated for this option to be feasible.

Option B in Drawing E16 (Appendix E) depicts the possible layout of a new dock facility at this location, including a staging area less than 500 feet from the proposed dock. If this option is chosen, there appears to be a local gravel source available near this community that should be investigated for its suitability for use to construct a dock and enhance the staging area. Ideally, a marine fuel header should be provided nearby any new landing facility.

Another option would be to study the possibility of constructing a new landing facility at a location along an accessible part of the coast or at the end of the existing three mile long Arolik Road, on the bank of Arolik Creek (Figure 6.6.3). It is unclear whether barges are able to access this location; however.

If access is found to be reliable, and a barge landing is created at this location, then the project should include a staging area and fuel pipeline extension and header at this location, otherwise trucking of fuel and supplies, over three miles to the community would be required.

For priority funding, it is recommended to conduct a thorough feasibility study to determine the best solution for long-term access to this site.

Figure 6.6.3: Aerial view (©Google Earth) of the existing road to Arolik Creek. Note: Development of this alternate landing site would require further study to determine accessibility.

6.6.4 Kongiganak

Kongiganak is on the west shore of Kuskokwim Bay, west of the mouth of the Kuskokwim River. It lies 70 miles southwest of Bethel and 451 miles west of

Anchorage. Kongiganak is located in a marine climate. Precipitation averages 22 inches with 43 inches of snowfall annually. Summer temperatures range from 41 to 57°F, winter temperatures are 6 to 24°F (DCCED 2008).

The population of Kongiganak is estimated to be about 411 residents, which is increased from 359 in 2000 and 294 in 1990. About half of the employment is at the school. The remainder is with village services, stores, and commercial fishing. Twenty-eight residents hold commercial fishing permits. Subsistence activities supplement income (DCCED 2008).

A State-owned gravel airstrip is available. There are no docking facilities; barges deliver cargo once or twice each summer (DCCED 2008).

Barge operators indicate that Kongiganak is one of the most difficult sites for unloading cargo. The access is difficult because it is a narrow channel and the barge cannot turn around. Barges are forced to back out of the landing, which is considered a serious risk to the barge and worker safety. The river bank on the opposite shore from the freight landing area is washed out as a result of prop wash resulting from the narrow channel at this location, and the barge needing to push the shore to hold position.

There is a boardwalk along the river edge and overhead power lines that make it difficult to cross when offloading equipment. The existing staging area is too small to offload a full barge load of cargo and is flooded during high water periods. As a result, the staging area can be very muddy and wet resulting in problems when the equipment and freight sink into the mud. Figures 6.6.4 and 6.6.5 are photographs showing the wet, low-lying staging area. A concrete or gravel/rock ramp is needed at a minimum. A ramp may settle and/or silt over somewhat as a result of bank erosion, but this is not considered a problem from the perspective of the barge operators because soft silts with a hard bottom underneath are good for landing.

Figure 6.6.4: Kongiganak, the staging area at the main barge landing site.

Figure 6.6.5: The Kongiganak staging area is often wet, cargo sinks into ground.

Alternately, a sheetpile dock could be considered for this site. With large upcoming school, road, and airport construction projects in this community, the site will see heavy use with a large volume of construction materials being offloaded. Often these projects require installation of a temporary dock to facilitate delivery of these heavy loads. For this reason, installation of a permanent sheetpile dock may be cost-effective at this site.

Fuel barge operators said that they have put in deadmen mooring points at the fuel landing for their own use, but these could be replaced with better ones. The community requires multiple stops to offload fuel and it would be beneficial to have one centralized tank farm or header location. The VSW has three 10,000 gallon tanks at a separate location downriver from the main tank farm, and this causes a 24-hour stop to off load fuel at this community.

The Natural Resources Conservation Services (NRCS) is constructing an erosion protection project during the summer of 2008. In addition, a large school project and a road project are underway in this community. Therefore, staging of equipment will be a challenge unless the staging area is expanded and stabilized with gravel. Because heavy equipment and gravel/rock may be available during these projects, it would be beneficial if the landing improvements were expedited by doing the work concurrently with these projects.

It is recommended that a dedicated gravel staging area and permanent sheetpile dock with downstream ramp be constructed at the freight landing area to facilitate barge access and cargo offloading as well as to mitigate potential issues associated with damage to the existing boardwalks and surrounding environment. The staging area should be located in an upland area as much as practical to avoid flooding. Because this is a very low-lying area, a 300 to 1,000-ft access road may be required to reach an area sufficiently above 0 ft (MLLW) elevation. Because of the fine soils and low topography at this site, the staging areas and access road likely need to be constructed to account for at least 2 feet or more of gravel settlement. A total of four mooring points should be installed at the two downriver fuel barge landing sites. Drawing E17 in Appendix E illustrates the proposed dock and staging area improvements. In addition to these work items, the feasibility of dredging the river basin at the turnaround/washout area should be studied. This item was not included as a priority project item. It should also be noted that there is a project underway to construct a dock as part of a construction project at an alternate location, which may or may not be a permanent solution for freight deliveries. If it is found to be adequate, the landing improvements at the fuel delivery site should be reconsidered.

6.6.5 Kwigillingok

Kwigillingok is on the western shore of Kuskokwim Bay near the mouth of the Kuskokwim River. It is 77 miles southwest of Bethel. The community of Kongiganak is nearby. Kwigillingok is located in a marine climate. Precipitation averages 22 inches with 43 inches of snowfall annually. Summer temperatures range from 41 to 57°F, winter temperatures are 6 to 24°F (DCCED 2008).

The current population of Kwigillingok is estimated to be about 378, an increase from 338 in 2000 and 278 in 1990. Most employment in Kwigillingok is with the school, village government, stores or commercial fishing. Income is supplemented by subsistence activities. Thirty-seven residents hold commercial fishing permits. A local arts and crafts cooperative markets local handicrafts (DCCED 2008).

A State-owned gravel airstrip and a seaplane base are available. There are no docking facilities (DCCED 2008).

In general, barge operators reported that the landing sites in Kwigillingok are wet and mucky and there are problems associated with erosion. The community floods each season as evidenced by the cables installed over the boardwalks to keep them from floating away. The freight barge operators pointed out the beach is a difficult place to work and offload cargo and equipment. They recommend providing a staging area using a thick layer of crushed rock, gravel, or heavy-duty mats. CVRF agreed with the need for a stabilized staging area and added that the staging area should be expanded to be able to accommodate the growing need for storage. The freight landing also needs mooring points.

Figure 6.6.6: A freight offloading and staging area at Kwigillingok.

Because the existing freight landing area is on a piece of lowland confined on all sides by the river or tributary (See photograph in Figure 6.6.6, above), it is recommended to move the freight landing site to a new location that is drier and will allow for expansion of the staging area. Depending on property ownership and existing site conditions, one possible new freight landing and staging area may be at the current bulk fuel tank landing site, at the downriver end of the community.

Fuel barge operators make multiple landings to offload fuel at this community and recommend a centralized tank farm and/or header location to make fuel deliveries more efficient. It is recommended that future fuel tank work in the community include relocating the Native Corporation's fuel header to the main bulk fuel tank landing site. Until this work can be completed, mooring points should be installed at each of the fuel stops. The layout for the proposed staging area and mooring points are depicted in Drawing E18, in Appendix E. Because this community is located in a low-lying area, with potential thaw-unstable permafrost conditions, even with filter fabric and an insulating layer included in the new staging area design, 2 feet or more of gravel settlement should be expected.

6.6.6 Kipnuk

Kipnuk is on the west bank of the Kugkaktlik River in the Yukon-Kuskokwim Delta, 85 air miles southwest of Bethel. It lies four miles inland from the Bering Sea coast. The community is located in a marine climate. Precipitation averages 22 inches with 43 inches of snowfall annually. Summer temperatures range from 41 to 57°F, winter temperatures are 6 to 24°F (DCCED 2008).

The population of Kipnuk is estimated at about 668, an increase from 644 in 2000 and 470 in 1990. Most employment in Kipnuk is in seasonal activities such as commercial fishing and construction. Subsistence activities are a major component of the Kipnuk lifestyle. Ninety-seven residents hold commercial fishing permits. CVRF processes halibut and salmon in Kipnuk. Income is also obtained by trapping. The community is also interested in an arts and crafts marketing cooperative (DCCED 2008).

There is a State-owned gravel airstrip with scheduled air taxi service five times each day. A seaplane base is also available. Although there is no dock, barges from Bethel deliver cargo each summer. It is a local priority to construct docking facilities (DCCED 2008).

Barge operators indicate Kipnuk has relatively good access and landing sites. The approach is via the Kugkaktlik River and the community can be reached at almost any tide stage. Sometimes a skiff/pilot is used to ensure avoiding rocks in the river. The landing area can be very muddy and the staging area is too small and materials often have to be staged along the edge of the road; this is evident in aerial photographs of the community. Figure 6.6.7 shows a photograph of the existing staging area at the beach.

CVRF is planning to construct a new fisheries support center in this community and this may result in increased activity at the freight landing area. They also have a halibut plant in Kipnuk.

There is one fuel header and a centralized tank farm located upriver of the freight landing site. Fuel barge operators consider this landing site a priority for installing mooring points because the current runs swiftly and the landing site is at the outside bend of the river, which makes holding position difficult. Mooring points should be installed sufficiently inland to allow for some protection from erosion.

Recommendations include enlarging the existing staging area and stabilizing it by installing a gravel pad. With anticipated increase in activity at the landing areas at this community, installation of a ramp and/or sheetpile bulkhead dock may be warranted to reduce potential environmental impacts that would be expected from increased usage of an unimproved landing site. Drawing E19 in Appendix E illustrates the proposed layout for a dock, downstream graded ramp, and upland staging area at the freight barge landing site as well as three mooring points at the fuel barge landing site.

Figure 6.6.7: Staging area at Kipnuk.

6.6.7 Chefornak

Chefornak is on the south bank of the Kinia River, at its junction with the Keguk River in the Yukon-Kuskokwim Delta. The community lies within the Clarence Rhode National Wildlife Refuge, established for migratory waterfowl protection. Chefornak is 98 air miles southwest of Bethel and 490 miles southwest of Anchorage. Chefornak is located in a marine climate. Precipitation averages 22 inches with 43 inches of snowfall annually. Summer temperatures range from 41 to 57°F. Winter temperatures range 6 to 24°F (DCCED 2008).

The population of Chefornak appears to be growing, with a current population of 460, compared to 394 in 2000 and 320 in 1990. Other than government positions, most employment in Chefornak is seasonal, supplemented by subsistence activities. Twenty-seven residents hold commercial fishing permits for herring roe and salmon fisheries. Coastal Villages Seafood, Inc., processes halibut and salmon in Chefornak. Trapping is also a source of income (DCCED 2008).

A State-owned gravel airstrip provides air access year-round, and a seaplane base is available during summer (DCCED 2008).

Access to the landing site is made difficult due to the many large rocks in the channel and near shore area as well as on the beach in front of the residential area of the community. The barge landing consists of rock/gravel causeway that juts out into the river and ramps up to an upland staging area. Barge operators report that this facility needs some maintenance. The ice and waves likely takes some of the rock and gravel material away with it each season. They suggested installing sheetpile or small rocks to protect against erosion. According to barge operators, rock that is less than 8 inches is generally considered acceptable for barges to land safely. An evaluation of the site currents, erosion and ice flow would be required to determine whether rock of this size would be sufficient for use as erosion protection armor. However, it is likely that current conditions require larger armor rock to keep the material in place. This could be provided along the sides of the causeway and the end could be sloped down with smaller rock added to allow landing at the end of the ramp. This material could be protected somewhat by extending the ends of each side of the armor rock. The smaller “landing” material may be plucked by ice each year and require regular maintenance. This concept is depicted in Drawing E20 of Appendix E.

Alternately, sheetpile could be installed around the existing causeway, and a protective cap installed on top of the sheetpile on which barges could ground. Geotextiles and concrete planks could also be installed, similar to the sheetpile and concrete plank ramp concept design shown in Drawing 4 of the Concept Drawings in Appendix D, except most of the fill for the ramp is already in place. For this scenario, driving of the sheets would essentially require removing the armor rock, stockpiling it, and possibly using it for scour protection on the upstream side of the sheets.

Cargo offloading is considered relatively easy at this landing site. The landing is connected by road to a small staging area. The staging area is relatively dry and stable, but could be expanded to allow staging of a full barge load of freight.

Fuel barge operators don’t use the dedicated landing because the area in front of it is too rocky. There are some large boulders that present a hazard and they recommended removing these to improve safety. There is one marine fuel header for the community that is located just downstream of the landing. They land at a flat shelf there at high water and then go dry and spend 24 hours there for each fuel delivery.

CVRF has a fish processing plant at Chefornak and they mentioned that the fishing boats also have had problems navigating into the landing because of the exposed boulders. The landing craft that is used to haul fish from the processing plant draws 6 feet when fully loaded. They recommend that any boulder that is higher than this should be removed. Drawing E20 in Appendix E depicts the proposed ramp improvements and boulder removal.

6.6.8 Nightmute

Nightmute is on Nelson Island, in western Alaska. It is 18 miles upriver from Toksook Bay and 100 miles west of Bethel. Nightmute is influenced by a marine climate. Precipitation averages 22 inches with 43 inches of snowfall annually. Summer temperatures range from 41 to 57°F; winter temperatures are 6 to 24°F (DCCED 2008).

The population of Nightmute is currently about 237, which follows an increasing trend from 208 in 2000 and 153 in 1990. The economy is a mixture of subsistence and cash-generating activities. Employment is primarily with the city, school, services, commercial fishing and construction. Trapping and crafts also provide income. Almost all families engage in either commercial or subsistence fishing, and most have fish camps. Thirty-one residents hold commercial fishing permits for herring roe, salmon drift and net fisheries (DCCED 2008).

A State-owned gravel airstrip and a seaplane landing area are available. There are no docking facilities, although many residents use fishing boats or skiffs for local travel. Cargo and supplies must be lightered up the Tuqsuk River (DCCED 2008).

Barge operators indicate that access to Nightmute is challenging because there are a lot of rock hazards in the river for about one mile leading up to the community. Once at Nightmute, there is a good landing and a gravel road leading from the landing to town. However, as seen in Figure 6.6.8, the landing has large rocks on each side of the landing that can present a hazard.

Figure 6.6.8: The barge landing area at Nightmute.

The fuel barge operators come in at high tide with a 160-foot long, 4-foot draft barge and 240-foot tug and still tend to rub the bottom of the river in places. When they arrive at the fuel stops, they double anchor the vessel to avoid the large rocks that line the beach for erosion protection. Then they float the hose in to fill the tanks. There are multiple fuel tank locations, each requiring a separate stop to fill the tanks. The fuel supplier's operational efficiency could be improved if there was a single dedicated landing site or dock at a centralized tank or fuel header location.

Barge operators said the existing staging area is too small and consists of soft fine-grained soils, which can become muddy. Freight barge operators and CVRF, who operates a fish support center in Nightmute, both agree that the community needs a dedicated staging area that is elevated to ensure dry ground.

Prior to dredging the rock hazards in the river, a study should be conducted to determine to determine whether dredging of the rocks would be effective because depending on the nature of the river in that area, ice movements could be pre-disposed to deposit rocks in that area.

6.6.9 Toksook Bay

Toksook Bay is one of three communities located on Nelson Island, which lies 115 miles northwest of Bethel. It is on Kangirlvar Bay across the water from Nunivak Island. Tununak is about 8 miles to the northwest. Toksook is located in a marine climate. Precipitation averages 22 inches with 43 inches of snowfall annually. Temperatures range from 41 to 57°F in summer and 6 to 24°F in winter (DCCED 2008).

The population of Toksook Bay is increasing; currently there are 598 residents, compared to 532 in 2000 and 420 in 1990. Commercial fishing, the school, city and tribal council are the primary income producers. Subsistence activities supplement income and provide essential food sources. Ninety-three residents hold commercial fishing permits for herring roe and salmon net fisheries. Coastal Villages Seafood, Inc., processes halibut and salmon in Toksook (DCCED 2008).

A State-owned gravel airstrip provides service year-round. There are no docking facilities, but boat haul-out services are available. Barges deliver goods during the summer months (DCCED 2008).

The landing site is on the coast, at the south end of town. The beaches are relatively soft and good for landing, but there are some rocks that present a hazard. A construction contractor built a causeway landing that extended out from the shoreline about 100 feet to reach deeper water for a recent project. This temporary structure was built using super-sacks and the owner required them to remove the causeway at the end of the job. This causeway is shown in Figure 6.6.9. The barge operators recommended a similar structure be built as a permanent structure for regular barge landings.

Figure 6.6.9: Former gravel/rock causeway at the barge landing site at Toksook Bay (©Google Earth)

If a causeway/ramp is not built, then barge operators suggest dredging out the rocks, at a minimum. In addition, a City of Toksook Bay representative commented that the existing road from this landing site to the intersection with the main road gets soft under heavy loads. For this reason, they suggest improving this section of the road as part of developing this landing site.

There is a large existing upland gravel source in the community, but one construction barge operator reported it has a high formica content.

There is a staging area located less than 1,000 feet from the landing area. This is the former site of a bulk fuel tank farm that was recently relocated. Fuel barge operators indicate that fuel tanks were recently centralized in this community, with the exception of the clinic. They currently have to truck fuel to the clinic, but there is a possibility that there are plans for the clinic/tanks to be moved in the near future. If the clinic tanks are moved, consideration should be made to consolidate the clinic's tanks with the main tank farm.

The CVRF CDQ group noted their highest fish processing plant producer is in Toksook Bay. Barge operators agree that the activity level in this community seems to be growing. It is used as a small freight hub because of its easy access and protected water. For these reasons, this community should be relatively high on the priority list for barge landing improvements. The proposed conceptual layout for a gravel causeway/ramp at Toksook Bay is depicted on Drawing E21 in Appendix E.

6.6.10 Tununak

Tununak is in a small bay on the northeast coast of Nelson Island, 115 miles northwest of Bethel and 519 miles northwest of Anchorage. The community is located in a marine climate. Average precipitation is 17 inches with annual snowfall of 28 inches. Summer temperatures can range from 42 to 59°F, winter temperatures average 2 to 19°F. Extremes have been recorded from 80 to -35°F (DCCED 2008).

The population of Tununak is currently estimated at about 333, which is increased from 325 in 2000 and 316 in 1990. Employment is primarily with the school district, Village Corporation, stores and commercial fishing. Trapping and Native crafts also generate cash for many families, and subsistence activities are an important contributor to villagers' diets. Fifty-three residents hold commercial fishing permits. CVRF processes halibut and salmon in Tununak (DCCED 2008).

Tununak relies heavily on air transportation for passengers, mail and cargo service. A State-owned gravel airstrip is available. Barges deliver goods two to four times each summer, and goods are lightered to shore (DCCED 2008).

The barge landing site is along the coast in front of the community and is weather dependant. The beach is gravelly and some erosion is evident. Freight barges cannot access the beach because it is too shallow, so freight is lightered to shore. Fuel barge operators noted access to the landing can be made only at high tide. Because there is a centralized tank farm near the landing site, offloading fuel only requires one stop and pump. Mooring points may be helpful at this location.

CVRF reported the fish plant in Tununak is their third highest producer. However, fish is generally flown out rather than taken out by boat. To create reliable access to this site at any tide level, a 2 mile access channel would need to be dredged. However, it is thought that dredging would likely require regular maintenance dredging because of the nearby river, which deposits sediments along the area in front of the community. An alternate solution may be to build a dedicated landing facility at a location away from the sediment deposition area. This would require construction of a 2+ mile road to connect it to the community.

6.6.11 Newtok

Newtok is on the Ninglick River north of Nelson Island in the Yukon-Kuskokwim Delta Region. It is 94 miles northwest of Bethel. Newtok is located in a marine climate. Average precipitation is 17 inches with annual snowfall of 22 inches. Summer temperatures range from 42 to 59°F, winter temperatures are 2 to 19°F (DCCED 2008).

The population of Newtok is currently about 323, compared to 321 in 2000 and 207 in 1990. The school, clinic, village services, and commercial fishing provide employment. Subsistence activities and trapping supplement income. Twenty-seven residents hold commercial fishing permits (DCCED 2008).

A State-owned gravel airstrip provides air access year-round, and a seaplane base is also available. Barges deliver cargo during the summer months (DCCED 2008).

Due to severe erosion, the community plans to relocate to a new site called Mertarvic on Nelson Island. In 2003, Congress passed legislation authorizing an exchange of lands between the US Fish and Wildlife Service and the Newtok Native Corporation to allow residents to relocate (DCCED 2008). A project for constructing a barge landing, dock and related utilities at the new site is underway.

Barge operators indicate that there is no dedicated barge landing or staging at the existing site and the beach is eroding. Because there are plans to move the community, no facility improvements are recommended as a priority for this site. However, this is a good time to plan out the new community, and provide adequate barge landing and staging areas for the new site. One captain of a landing craft for the CVRF CDQ group reported there is one area at the new site that causes them problems with access and, therefore, planning of the location of the new landing site is also important.

6.6.12 Chevak

Chevak is located on the north bank of the Niglikfak River, 17 miles east of Hooper Bay in the Yukon-Kuskokwim Delta. Chevak has a maritime climate. Its location near the Bering Sea renders the area subject to heavy winds and rain. Temperatures range from -25 to 79°F. Snowfall averages 60 inches per year. Freeze-up occurs at the end of October. Break-up occurs in June (DCCED 2008).

Chevak has a growing population, currently at about 908 residents, compared to 765 in 2000 and 598 in 1990. Commercial fishing and subsistence activities are an important part of the local culture. Employment in Chevak is at its peak in the summer months and declines to a few full-time positions during winter. Construction projects and BLM firefighting provide summer employment. Eighteen residents hold commercial fishing permits. Incomes are supplemented by subsistence and handicrafts (DCCED 2008).

A State-owned gravel airstrip is available, although heavy winds and rain can preclude access. Floatplanes land on Chevak Lake/Ninglikfak River. There is no dock; however, a barge landing is available for cargo offloading (DCCED 2008).

Access to Chevak is by way of a narrow winding river. Locals deploy buoys each season to mark the channel. The landing area is located about midway along the shoreline in front of the community, at the end of an access road from town. Barges land by pushing into the mud bank at the base of this road.

There appears to be a relatively large staging area located near the landing site. Barge operators indicate that there is a short sheetpile bulkhead just upriver of the landing site, but that is in poor shape and is not functional for their purposes. Barges usually land on the beach next to the sheetpile, as shown in Figure 6.6.10.

Figure 6.6.10: Freight barge at the landing site at Chevak (Photo © 2006 Sila Thielke)

The beach landing is stable and relatively flat. Currently, a push crew is used to push the barge way up onto the beach to secure the landing. Mooring points are recommended at this landing site. Drawing E22 in Appendix E shows the proposed configuration for these mooring points.

The bank upriver of this area is sloughing. The bluff road that leads from the landing area to town is in poor condition, eroding, and has poor traction, and is not suitable for truck traffic. Figure 6.6.11 is a photograph showing evidence of this erosion. Recommendations for future improvements include improving and stabilizing this access road. However, the road leading to the staging area appears to be in relatively good condition.

Figure 6.6.11: Erosion of the access road and sheetpile dock area at Chevak.

Fuel barge operators indicated that their operational efficiency would improve if this community had a centralized fuel tank farm and/or marine fuel header located at the bottom of the hill from the tank farm. Currently, long hose runs (400 to 600-feet) are required to fill the various tank farms in the community (i.e., AVEC, school, and Native Corporation) and it takes them 24-hours to offload fuel at this community.

6.6.13 Hooper Bay

Hooper Bay is 20 miles south of Cape Romanzof, 25 miles south of Scammon Bay in the Yukon-Kuskokwim Delta. The city is separated into two sections: a heavily built-up town site located on gently rolling hills and a newer section in the lowlands. The climate in Hooper Bay is maritime. The mean annual snowfall is 75 inches with a total precipitation of 16 inches. Temperatures range between -25 and 79°F. Winter ice and winds often promote severe conditions. The Bering Sea is ice-free from late June through October (DCCED 2008).

The population of Hooper Bay appears to be growing; the current population is 1,157, compared to 1,014 in 2000 and 845 in 1990. Most employment is seasonal with little income-producing activity during the winter. Forty-seven residents hold commercial fishing permits. Coastal Villages Seafood, Inc. processes halibut and salmon in Hooper Bay. BLM firefighting offers some employment, and grass baskets and ivory handicrafts are produced for sale. Income is supplemented by subsistence activities. The school employs 50 staff. Hooper Bay is included in the Coastal Villages Region Fund Community Development Quota (CDQ), who promotes fisheries related economic development in western Alaska. There are plans to construct a Fisheries Support Center to provide boat storage and a place to sell fishing related goods. Hooper Bay is included in the Lower Kuskokwim Economic Development Council. AVEC has two year round employees. Local stores account for approximately twenty full and part-time jobs (DCCED 2008).

Residents of Hooper Bay rely on air and water transportation. The paved runway is State owned and operated. Barges deliver fuel and other bulk supplies during summer. A commercial fishing dock is available (DCCED 2008).

The approach to the community is via a shallow channel that is marked from the south up into the small river. The landing site is on the northern shore of Hooper Bay. Alternately, barges can land on the beach on the ocean side of the community.

Barge operators indicate that Hooper Bay is a difficult community to access due to the very shallow water on the river side of the community and the prevalent wind/currents on the coastal side. The runway is along the Bering Sea coast and a 1.5 mile road connects it to the community. Many freight barges cannot access the river side of the community due to their deeper draft. Although rare, if weather conditions are just right, they can land on the beach near the airport, which is about 15-feet deep. More often, the weather causes rough conditions and they tend to land at a more protected site on the back side of a spit, about 5 miles down the beach to the south of the airport landing. Then, cargo is trucked back down the beach and staged in an area near the end of the runway. The staging area is above high tide and sufficiently large; however, it is several miles from town.

The fuel barge landing is located on the river side of the community, which can only be accessed at high tide. The community has channel markers available to assist with navigating the channel, but often they do not get deployed each season. The barges follow a narrow and shallow channel and they cannot turn the barge around upon departure. Barges nose into the muddy bank to hold position while offloading fuel or freight at this location. This area can be dry for a whole day during low tides.

On occasion, the fuel barges have landed at the spit landing site and trucked fuel to the community. There are adequate mooring points and a fuel header available at the fuel barge landings. However, the school is not on the pipeline and the fuel must be trucked to the school’s tanks. Therefore, it is recommended that the school’s tanks be provided with a fuel header located at the fuel barge landing site.

CVRF CDQ and barge operators suggested that long term growth plans should include a breakwater near the airport landing site to ensure protected deeper water access for freight and fuel. Such a landing should include a co-located marine fuel header for all fuel bulk storage tanks within the community.

6.6.14 Scammon Bay

Scammon Bay is on the south bank of the Kun River, one mile from the Bering Sea. It lies to the north of the 2,300-foot Askinuk Mountains on the Yukon-Kuskokwim Delta. The area's climate is maritime. Temperatures range between -25 and 79°F. Annual precipitation is 14 inches with 65 inches of snowfall. Severe easterly winds during the fall and winter limit accessibility. The Bering Sea is ice-free from mid-June through October (DCCED 2008).

Scammon Bay appears to be a growing community. The current population is about 520, which is up from 465 in 2000 and 343 in 1990. Employment is focused on commercial fishing. Firefighting, construction and handicrafts also provide income. Forty-nine residents hold commercial fishing permit (DCCED 2008).

Scammon Bay is accessible by air and water. A State-owned gravel airstrip and city-owned seaplane base on the Kun River serve air traffic. Barges bring in bulk supplies each summer (DCCED 2008).

The barge landing site is easy to access and is relatively firm. However, freight barge operators indicate that a dry, dedicated staging area is needed because they currently stage cargo and equipment along the road that leads from the landing site. Both sides of the road are swampy, as is the upland area between the barge landing and the adjacent airport apron. The barge landing area is shown in Figure 6.6.12, below. One freight barge operator said they have had storage containers that floated away in the past. Providing a dedicated gravel storage pad in an upland area adjacent to the landing site would be beneficial.

Figure 6.6.12: The barge landing area at Scammon Bay, looking east.

Two landings are required for the fuel barge; the main barge landing area, where fuel is offloaded and trucked to AVEC and the school, and another landing to the west that has a header to offload to the tank farm. The road to the school is in poor shape and the banks are “slimy”. Providing a marine header for the AVEC and school tanks at the same location as the existing header would significantly improve the efficiency of fuel offloading at this community. Otherwise, the barge operators indicate that the road leading to the school requires some maintenance and upgrades to facilitate the fuel deliveries.

CVRF has a fish support center in Scammon Bay. One of their vessel operators agreed that the landing site at this community was in relatively good shape, and a dedicated storage area is needed to avoid the problems with staging along the road.

6.6.15 Mekoryuk

Mekoryuk is at the mouth of Shoal Bay on the north shore of Nunivak Island in the Bering Sea. Nunivak Island lies 30 miles off the coast of Alaska. It is 149 air miles west of Bethel and 553 miles west of Anchorage. Mekoryuk is part of the Yukon Delta National Wildlife Refuge. The Bering Sea, which surrounds Nunivak Island, strongly influences the climate of the island. Foggy and stormy weather are frequent. Average precipitation is 15 inches; annual snowfall is 57 inches. Summer highs average 48 to 54°F; winter highs run 37 to 44°F. Extremes have been recorded from 76 to -48 °F (DCCED 2008).

The population of Mekoryuk is currently about 217, an increase from 210 in 2000 and 177 in 1990. Employment by the school, city, Village Corporation, commercial fishing, construction and service industries prevails. The Bering Sea Reindeer Products Co. is a major employer. Trapping and Native crafts, such as knitting qiviut (musk ox under wool), provide income to many families. Fifty-five residents hold commercial fishing permits, primarily for halibut and herring roe. Coastal Villages Seafood, Inc. processes halibut and salmon in Mekoryuk. Almost all families engage in subsistence activities and most have fish camps (DCCED 2008).Mekoryuk relies heavily on air transportation for passenger, mail and cargo service. A State-owned gravel runway allows year-round access. A breakwater protects the shoreline from Bering Sea waves. Barges deliver goods from Bethel once or twice each summer. Boats, snowmachines and all terrain vehicles (ATVs) are used for travel within the community (DCCED 2008).

Freight barge operators indicate that access to Mekoryuk is generally pretty good; the landing is on the Bearing Sea coast and there is a sloping sandy beach landing (Figure 6.6.13.) on the outside of the breakwater (It is too shallow for barge access on the inside of the breakwater). However, there is not enough area for staging. CVRF, who operates a fish processing plant in Mekoryuk, agreed that this community needs a dedicated staging area that is larger than the area that exists here now.

Fuel barge operators noted that their operations would be more efficient if the community had a single centralized tank farm and also noted that there are new tanks in the community that are not currently being used. STG, Incorporated has a contract to construct the new tank farm in the upcoming seasons. Some of the landing sites for fuel offloading are very rocky and steep, so a dedicated landing at a co-located marine header would improve safety as well as operational efficiency.

All of the operators who were interviewed agreed that there is a large boulder on the beach near the middle of the landing area that is considered a hazard at high water. They have tried unsuccessfully to move the boulder with a piece of heavy equipment and recommend blasting the boulder and then using a loader to remove it.

Figure 6.6.13: The landing area at Mekoryuk.
Note the large boulders that can be a hazard for barges.

The harbor area at Mekoryuk is used by locals for smaller boats. One construction contractor recommended dredging the harbor to facilitate larger boats using the area. USACE has a study underway to look into the feasibility of harbor construction work at Mekoryuk.

6.7 Lower Kuskokwim River Region

The Lower Kuskokwim River Region, for the purposes of this study, extends from the upper portion of Kuskokwim Bay at the confluence of the Kuskokwim and Eek channels of the river, and upriver to the community of Tuluksak. It includes the village of Eek, which is located on Eek River. The main branch of the Kuskokwim River, the principal drainage for the hilly region on the north and west side of the Alaska Range, flows southwest into Kuskokwim Bay on the Bering Sea.

The Kuskokwim River empties into the Bering Sea in this large delta area of western Alaska. This low-lying region is defined by the many small lakes, ponds, and meandering rivers and streams. Much of the land consists of treeless wetlands, bordered by shrubs. Forest and hilly uplands can be found further upriver. Because of the prevalent soft, wet soils, the Lower Kuskokwim River communities often utilize wooden boardwalks instead of gravel roads. In these areas, gravel can be expected to settle several feet, and this, combined with the lack of suitable local gravel sources, can result in prohibitively high costs for some road construction. Figure 6.7.1 depicts the communities included in this study which are in the Lower Kuskokwim River region.

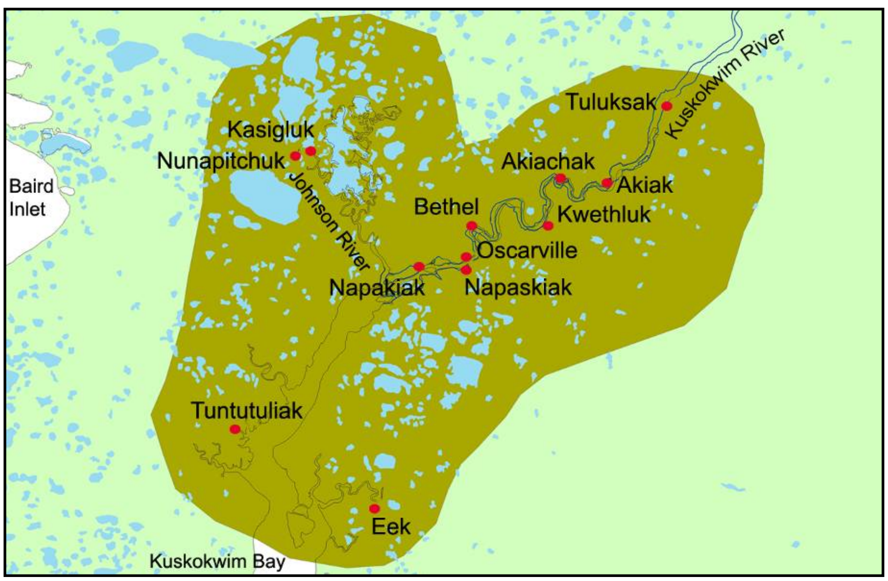

Figure 6.7.1: Lower Kuskokwim River Region Map.

Barges that run up the Kuskokwim River usually draft about 3-feet. Access to the communities further up the Kuskokwim River is shallower and if service upriver is planned, they often transfer cargo to smaller vessels at Bethel. A small push tug and shallow draft barge operation is often used to deliver freight to the upriver communities.

6.7.1 Eek

Eek lies on the south bank of the Eek River, 12 miles east of the mouth of the Kuskokwim River. It is 35 air miles south of Bethel in the Yukon-Kuskokwim Delta, and 420 miles west of Anchorage. Eek is located in a marine climate. Precipitation averages 22 inches with 43 inches of snowfall annually. Summer temperatures average 41 to 57°F; winter temperatures average 6 to 24°F (DCCED 2008).

The population of Eek is currently about 287, an increase from 280 in 2000 and 254 in 1990. Eek's economy is primarily subsistence- and commercial fishing-based. A few full-time positions are available at the school, city, and village office. All families participate in subsistence fishing; 44 residents hold commercial fishing permits (DCCED 2008).

A State-owned gravel airstrip provides air access. A seaplane base is also available on the Eek River. Barges deliver fuel and supplies during the summer months. A small boat dock is available (DCCED 2008).

Access to Eek by barge is up the Eek Slough from the main Kuskokwim River. Fuel barge operators indicate that two fuel stops are required for Eek. One is co-located with the freight landing, as seen in the photograph in Figure 6.7.2, below. Offloading fuel must be planned around the tides in order to prevent having to wait for a tide cycle. It was recommended to run a pipe from the other tank farm to this location so that only one fuel stop is necessary. In addition, fuel and freight barge operators would like to see more gravel placed at the landing to raise it up and further into the water to get the barge clear of the rocky bottom. Freight barge operators indicated the staging area is in good condition but needs to be bigger to store the large volume of cargo and construction supplies that are being delivered to this community.

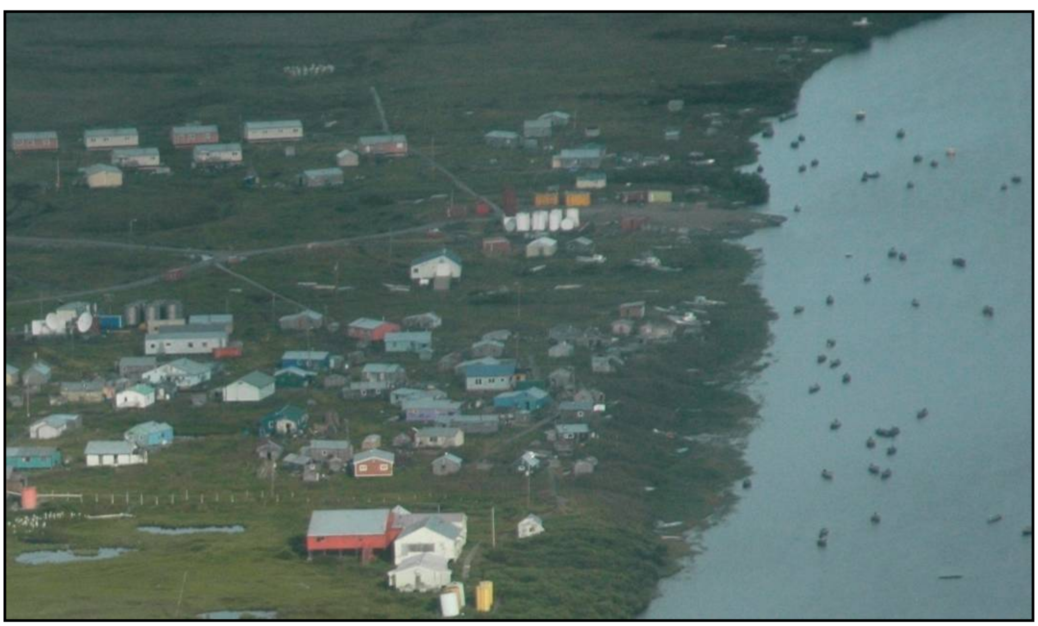

Figure 6.7.2: Main fuel and freight landing site at Eek.

CVRF stated that there is a fish support center in this community and the fishermen also use the landing site. They said the landing is generally good, but they have problems with the loader sinking into the mud and agree that adding some gravel to create a firm ramp up to the road system would help with this problem. In addition, they mentioned that a larger staging area would also be beneficial for their interests.

It may be possible to construct a ramp at the landing site, out into the river approximately 75 to 100-feet from the existing shoreline to reach adequate depths for freight barges. Such a structure would require erosion protection and mooring points to facilitate mooring further into the channel of the river. There appears to be vacant land that may be appropriate for a new staging area, just upland and west of the landing site. These proposed improvements are depicted in Drawing E23 in Appendix E.

6.7.2 Tuntutuliak

Tuntutuliak is on the Qinaq River, approximately 3 miles from its confluence with the Kuskokwim River, about 40 miles from the Bering Sea coast. It lies 40 miles southwest of Bethel and 440 miles west of Anchorage. Tuntutuliak's summer temperatures average from 42 to 62°F, winter temperatures average -2 to 19°F. Extremes have been recorded from 86 to -46°F. Annual precipitation averages 16 inches with snowfall of 50 inches (DCCED 2008).

Tuntutuliak has a current estimated population of 407, an increase from 370 in 2000 and 300 in 1990. The main economy is via a fishing and subsistence lifestyle. Employment is mostly by the school, services, commercial fishing and fish processing. Trapping, basket weaving, skin-sewn products and other Native handicrafts also provide cash. Fifty-one residents hold commercial fishing permits for salmon net and herring roe fisheries (DCCED 2008).

Tuntutuliak relies heavily on air transportation for passengers, mail and cargo. A State-owned gravel runway is available, and float planes land on the Qinaq River. Barge services deliver goods approximately six times a year (DCCED 2008). CVRF noted a fisheries support center is planned for this community.

Access to the community via the Qinaq River is shallow, but there is a channel all the way. The barge companies indicated the landing at this community is relatively good, although there is some active erosion and the community tends to flood each year. The fuel barge operators said mooring points are needed at two landing areas. One fuel stop is at the main tank farm at the upstream side of town, and the other is at the school. Providing a centralized tank farm or centralized marine header location would help improve fuel offloading efficiency.

Another issue that slows operations for fuel and freight barges is the fact that the locals use the landing areas to moor their skiffs, which requires barges to wait offshore for the skiffs to be moved before they can land. A community effort to move skiffs prior to the barge’s arrival and/or providing a dedicated mooring area for the skiffs or dedicated barge landing would also improve operational efficiency.

One construction contractor noted this community could use a sheetpile, bulkhead dock. The contractor recently built up the landing at the new airport location, which was recommended as the preferred site for a dedicated barge landing area. The old runway has gravel that might be available for reuse.

6.7.3 Nunapitchuk

Nunapitchuk is located on both banks of the Johnson River, 22 miles northwest of Bethel in the Yukon-Kuskokwim Delta. The area averages 16 inches of precipitation with snowfall of 50 inches. Summer temperatures range from 62 to 42°F; winter temperatures run from 19 to -2°F (DCCED 2008).

Nunapitchuk has a growing population currently at about 547, an increase from 466 in 2000 and 378 in 1990. Residents are involved in commercial fishing and subsistence activities. The school, local businesses and the city provide most employment in Nunapitchuk. Commercial fishing and subsistence activities are a focal point of the culture. Fifty-eight residents hold commercial fishing permits for salmon and herring roe net fisheries and roe on kelp (DCCED 2008).

A State-owned gravel airstrip provides year-round access. A dock, small boat harbor, and seaplane landing are available on the Johnson River (DCCED 2008).

Figure 6.7.3 shows an aerial view of the community: the river in the foreground is generally too shallow for freight barge access and the shoreline on the opposite side of the community (background in photo) is accessed regularly by fuel barges.

Figure 6.7.3: Aerial view of Nunapitchuk.

Freight barge operators say that because barge access to some parts of the community is too shallow, they usually land near the runway and use the end of runway as a staging area. Figure 6.7.4 is a photograph of this freight barge landing site near the runway. From this landing area, hovercraft or small boats transport goods across river to the other parts of town, or locals leave cargo until freeze up, then move it across. However, barge operators reported that the Alaska

Department of Transportation and Public Facilities (ADOT&PF) does not want them to use this site. Also, there is not sufficient turnaround area at this landing site. Freight barge operators reported only a small volume of goods is delivered to this community each year. Some barge operators advised that improvements, such as adding some gravel and/or a ramp, at the fuel header landing site could allow co-locating the fuel and freight barge landings there.

It would be ideal to find an acceptable landing site with sufficient depth available for freight barge access on the same side of the river as the main part of the community. Option A in Drawing E24-A (Appendix E) presents one possible landing site configuration in that area, including a gravel causeway/ramp and an upland gravel staging area. In addition to land availability, and site-specific investigation, development at this site would require additional site investigation to ensure sufficient depth and suitability for freight barge access.

The existing landing site at the airport is known to be accessible and is currently used. There is a fuel barge landing site near the airport landing site that could be expanded for development of a dedicated barge landing and staging area. Option B in Drawing E24-B (Appendix E) illustrates a proposed layout for development of this landing site. This site appears to be very low ground and susceptible to flooding and would require significantly more gravel fill to create a dry staging area. However, this site is not connected to the main part of the community—although in aerial photography, there appears to be a boardwalk connecting it to the western part of the community, located on the opposite shore of the river.

Figure 6.7.4: The freight barge landing site, across the river from Nunapitchuk.

6.7.4 Kasigluk

Kasigluk is on the Johnson River in the Kuskokwim River Delta, 26 miles northwest of Bethel. The community is comprised of Old and New Kasigluk, surrounded by the Johnson River and a network of lakes. The area's precipitation averages 16 inches annually with 50 inches of snowfall. Summer temperatures range from 62 to 42°F; winter temperatures are 19 to -2°F (DCCED 2008).

The population of Kasigluk is fairly steady at about 542. The school, commercial fishing, retail businesses and village government provide the majority of employment in Kasigluk. Subsistence activities contribute significantly to livelihood. Forty-six residents hold commercial fishing permits, mainly for salmon set net and herring roe fisheries (ADCED, 2008).

A State-owned gravel airstrip provides year-round air access. Although there are no docking facilities, barges from Bethel deliver fuel and supplies during summer months (DCCED 2008).

Kasigluk is about 30 miles up the Johnson River from its mouth at the main Kuskokwim River. The Johnson River is very shallow. Fuel barges may enter the lake on the opposite side of the community in order to make deliveries on that side. This requires waiting at the lake entrance for high water before crossing. Otherwise, they can use a long run of hose to access these tanks. The landing sites appear to be wet, lowland, beach landings that are typical in this region, as depicted in the aerial view photograph in Figure 6.7.5.

Figure 6.7.5: Aerial View of Kasigluk.

In general, barge operators did not have suggestions for improving the landing sites at Kasigluk. One construction contractor stated a dedicated landing site would be desirable at Kasigluk because the existing landing for offloading freight is on ADOT&PF land, who reportedly do not approve of operators storing materials and goods on the property or altering the landing to meet the barge requirements.

6.7.5 Napakiak

Napakiak is on the north bank of the Kuskokwim River, 15 miles southwest of Bethel. It is on an island between the Kuskokwim River and Johnson's Slough. It lies 407 miles west of Anchorage. Napakiak is influenced by storms in the Bering Sea and also by inland continental weather. Average annual precipitation is 16 inches with 50 inches of snowfall. Summer high temperatures average 59 to 62°F and winter highs average 11 to 19°F. Extremes from 86 to -46°F have been recorded. The Kuskokwim River is typically ice-free from June through October (DCCED 2008).

The city wants to relocate all public facilities and homes to a bluff across Johnson's Slough because the sandbar on which the city was built is eroding.

The population of Napakiak is currently about 370, an increase from 353 in 2000 and 318 in 1990. Napakiak's primary employers include the school and local, state, and federal governments. Seasonal commercial fishing, construction projects, trapping and crafts also provide income. Forty-three residents hold commercial fishing permits, primarily for herring roe and salmon net fisheries. Subsistence foods provide an estimated 50 percent of the local diet (DCCED 2008).

A State-owned gravel runway and seaplane landing area provide air transportation for passengers, mail and cargo. Barges from Bethel deliver goods during the summer. Electricity is transmitted by overhead lines from Bethel. There are no docking facilities. The community is interested in construction of a 9-mile road to Bethel (DCCED 2008).

The landing area is on the bank of the Kuskokwim River that fronts Napakiak. There is no dedicated landing facility. Barge operators said that it has eroded away due to the swift current that comes right along the shore. The bank along this area is steep and about 10-feet high. The road going up the bank is narrow, making it difficult to get cargo through. Barge operators recommend widening the access road and providing a larger dedicated staging area to facilitate freight barge offloading.

Fuel barge operators noted there is a single header that is close to the beach allowing for efficient offloading of fuel. They push the barge to the beach, which is sufficient for secure mooring because there is little current at this site; therefore, mooring points are not needed. Because the community receives power from Bethel, fuel delivery volumes by barge are relatively small.

Construction of a dedicated landing such as a dock and/or ramp with erosion protection is recommended for this community. It should be investigated whether investment in such a permanent structure is warranted at this time. If the community plans to move their public facilities across Johnson Slough, funds may be better spent planning a new docking facility at the new town site location. Also, if there are plans to construct a road from Napakiak to Bethel, a less expensive landing facility option may be more appropriate for the expected decrease in use that would result from the ability to transport goods via road.

6.7.6 Napaskiak

Napaskiak is located on the east bank of the Kuskokwim River, along the Napaskiak Slough, 7 miles southeast of Bethel. Napaskiak is strongly influenced by storms in the Bering Sea and also by inland continental weather. Average annual precipitation is 16 inches with 50 inches of snow. Summer temperatures range from 42 to 62°F, winter temperatures are -2 to 19°F (DCCED 2008).

The population of Napaskiak appears to be growing; the current population is about 464, compared to 390 in 2000 and 328 in 1990. The school, local businesses and some commercial fishing provide employment. Thirty-nine residents hold commercial fishing permits for salmon drift netting. Subsistence activities are a part of the culture and supplement cash earnings (DCCED 2008).

A State-owned gravel airstrip and seaplane landing area west of the community provides air access year-round. Although there are no docking facilities, barges deliver goods during the summer months (DCCED 2008).

Barge operators indicated that the former barge landing area, at the upstream end of Napaskiak, has filled in and there is now a sand bar in front that precludes access. Now, the airport landing site is the primary barge landing area. This landing area is very shallow and the downstream side is filling in somewhat, such that access is difficult. Barges now have to pass the area and turn back to land, rather than coming straight into the landing. Dredging this area was recommended to maintain access and facilitate turning at this landing site. However, the slough in the area in front of town appears to be eroding and depositing sediments in the area in front of the landing site. This seems to indicate that dredging may require regular maintenance dredging. A detailed study of erosion and sediment deposition at this site would help to determine the feasibility of dredging this area.

Option A in Drawing E25 (Appendix E) shows possible improvements to the existing landing area. It includes a gravel ramp with erosion protection and dredging of the washout area on the opposite bank of the river. In addition, the existing staging area adjacent to the end of the runway tends to get wet. This area needs to be expanded and gravel added to create a dry dedicated staging area.

Alternatively, a new landing site could be developed downstream (500 feet or more) of the airport landing or possibly at a site upstream of the former landing site at the east/upstream end of town. Existing roads currently exist at least partway towards each of these areas. Developing a new landing site away from the areas of heavy sediment accretion would minimize the need for future dredging.

Option B in Drawing E25 (Appendix E) illustrates a possible layout for a new ramp and upland staging area just downstream of the airport landing site. This location may be more challenging for mooring due to the possibility of experiencing swifter currents from the main branch of the Kuskokwim River. If this option is chosen, installation of three mooring points is recommended.

Prior to proceeding with either option, conducting a feasibility study to determine the best long-term solution for this site is recommended.

6.7.7 Oscarville

Oscarville is located on the north bank of the Kuskokwim River, directly across the river from Napaskiak, and 6 miles southwest of Bethel. The weather is influenced by storms in the Bering Sea and also by the inland continent. Average precipitation is 16 inches and snowfall is 50 inches. Summer temperatures average 42 to 62°F, winter temperatures average -2 to 19°F. The Kuskokwim River is typically ice-free from June through October (DCCED 2008).

The current population of Oscarville is estimated to be about 64, which is up slightly from 61 in 2000 and 57 in 1990. The school and health clinic are the only permanent sources of employment. One resident holds a commercial permit.

Trapping and handicrafts provide some income. Subsistence activities provide most food sources (DCCED 2008).

Oscarville relies on nearby Napaskiak for passenger, mail and cargo services. Residents use the post office and airstrip at Napaskiak. Residents use skiffs to pick up mail, across the river in Napaskiak or to shop in Bethel. An electrical transmission line from Bethel supplies power. Barge services deliver goods once a year (DCCED 2008).

Barge operators indicate that there is no dedicated landing site in Oscarville. CVRF stated it has eroded away. Barges land anywhere they can along the beach in front of the community. It is a very small community and not a lot of cargo is delivered here. Because power is supplied from Bethel, the fuel delivery volume is also relatively small.

A dedicated landing area or ramp would facilitate barge landings at Oscarville. However, barge landing site improvements in Oscarville are not considered to be a high priority for this program because of the overall small volume of cargo and fuel delivered and the availability for access to the Napaskiak landing site, directly across the river from Oscarville.

6.7.8 Bethel

Bethel is located near the mouth of the Kuskokwim River, 40 miles inland from the Bering Sea. It lies in the Yukon Delta National Wildlife Refuge, 400 air miles west of Anchorage. Precipitation averages 16 inches a year in this area and snowfall averages 50 inches per year. Summer temperatures range from 42 to 62°F. Winter temperatures range from -2 to 19°F (DCCED 2008).

The current population of Bethel is about 5,812, an increase from 5,471 in 2000 and 4,674 in 1990. Bethel serves as the regional center for 56 communities in the Yukon-Kuskokwim Delta. Food, fuel, transportation, medical care, and other services for the region are provided by Bethel. Fifty percent of the jobs are in government positions. Commercial fishing is an important source of income; 200 residents hold commercial fishing permits, primarily for salmon and herring roe net fisheries. Subsistence activities contribute substantially to villagers' diets (DCCED 2008).

The State-owned Bethel Airport is the regional transportation center, and is served by a number of passenger airlines, cargo carriers, and numerous air taxi services. Bethel is the third busiest state-owned airport in Alaska. Two floatplane bases are nearby. The Port of Bethel includes a small boat harbor, dry land storage, and up to 5,000 feet of transient moorage on the seawall. A barge service based in Bethel provides goods to the Kuskokwim communities (DCCED 2008).

Bethel has a large city dock that is used by barges. It is considered a major hub for consolidating and distributing fuel and freight cargo to upriver communities by barge. In addition, Bethel has centralized tank farms that are suitably located for efficient and safe offloading of bulk fuel. In general, barge operators stated, from their standpoint there are no significant barge landing improvements needed at Bethel.

However, because many large upcoming construction projects are planned for Bethel (i.e., airport, roads, schools) the availability of equipment, materials and labor in the area should be considered when determining the possibility of projects happening upriver.

6.7.9 Kwethluk

Kwethluk is located 12 air miles east of Bethel on the Kwethluk River at its junction with the Kuskokwim. The community is the second largest along the Lower Kuskokwim River, following Bethel. Kwethluk's precipitation averages 16 inches with snowfall of 50 inches. Summer temperatures average from 62 to 42°F; winter averages are 19 to -2°F. Extremes have been recorded from 86 to -46°F. The Kuskokwim is typically ice-free from June through October (DCCED 2008).

The current population of Kwethluk is about 721, an increase from 713 in 2000 and 558 in 1990. The largest employers are the school district, Village Corporation, store and health clinic. Sixty-one residents hold commercial fishing permits. Subsistence activities play a central role in the lifestyle (DCCED 2008).

Kwethluk is dependent on air transportation for year-round movement of freight and passengers. A State-owned gravel airstrip is available and seaplanes land on the river. Barge services deliver cargo during the summer. There are no docking facilities (DCCED 2008).

Barge operators reported the landing site is generally pretty good at this community. The soils are such that they can drive around on the beach to get up to the staging area without much difficulty. Erosion is occurring along the riverbank; therefore, a different landing site may be used from year to year. The staging area could be expanded to accommodate the growing storage needs of this community. A dedicated dock facility might also be considered.

Fuel landing sites are considered acceptable; however, there appears to be three or four fuel header locations and a centralized tank farm and fuel header location would be beneficial at this site. Barge operators were unsure whether recent work has been done to accomplish this.

6.7.10 Akiachak

Akiachak is located on the west bank of the Kuskokwim River, on the Yukon-Kuskokwim Delta. It lies 18 miles northeast of Bethel. The area averages 16 inches of precipitation with snowfall of 50 inches. Summer temperatures range from 42 to 62°F. Winter temperatures range from -2 to 19°F (DCCED 2008).

Akiachak residents have a fishing and subsistence lifestyle. The population appears to be increasing, currently at 633 residents compared to 585 in 2000 and 481 in 1990. The majority of year-round employment is in education and other public services. The Yupiit School District headquarters are located in the community. Residents rely on seasonal employment such as commercial fishing, construction and firefighting. Seventy residents hold commercial fishing permits, and some work at canneries in Bristol Bay. The community is developing a fish processing plant and freezer (DCCED 2008).

A State-owned gravel airstrip and public seaplane facilities provide year-round access. Barges deliver bulk fuel and supplies during the summer (DCCED 2008).

Fuel barge operators indicated Akiachak has good access with very little current at the landing area. They deliver fuel by landing and running hose to the tank farms, which are located on the southwest end of the community. One bulk fuel tank farm is near the landing site. However, other smaller tanks are located up to 1,000-feet away and require long hose runs.

Fuel barge operators advised installing mooring points at the landing would eliminate the need to push onto the beach while offloading. Additionally, centralizing all tanks in the community to avoid long hose runs and/or providing a marine fuel header near the landing area would increase operational efficiency.

Freight barges land either at this landing or at an alternate landing site on the beach just upriver. There is sufficient upland staging area in the vicinity of both landing sites. On occasion, for airport projects, a landing area at the end of the airport runway may be used. Mooring points are needed primarily at the co-located fuel and freight barge landing site. Drawing E26 in Appendix E depicts the two primary landing sites and shows approximately where these mooring points should be located.

6.7.11 Akiak

Akiak is located on the west bank of the Kuskokwim River, 42 air miles northeast of Bethel, on the Yukon-Kuskokwim Delta. Precipitation averages 16 inches in this area with snowfall of 50 inches. Summer temperatures range from 42 to 62°F. Winter temperatures range from -2 to 19°F (DCCED 2008).

Akiak has a slightly growing population, currently at 367 residents, compared to 309 in 2000 and 285 in 1990. There is a reliance on subsistence and fishing activities in Akiak. The majority of the year-round employment is with the city, schools or other public services. Commercial fishing and firefighting provide seasonal income. Twenty-seven residents hold commercial fishing permits. The community is interested in developing a fish processing plant and tourism. The gravel runway allows for year-round air access. There are no docking facilities (DCCED 2008).

Fuel barge operators reported there is no designated landing area or marine fuel headers at Akiak. The barges land at several good spots along the beach. Two landings are required to offload fuel at the main tank farm and at the school tanks. A hose run to the tanks is required. Installation of marine header(s) at a single location would improve operational efficiency in fuel deliveries. In addition, installation of mooring points would be helpful.

Freight barge operators noted the landing is good all along the beach in front of Akiak. Figure 6.7.6 is a photograph showing a freight barge landing and preparing to offload at the beach. There are some upland areas nearby that are cleared where they offload and stage cargo; however, a larger, dedicated cargo staging area would be beneficial at this site. Mooring points would also be helpful near this landing site.

Figure 6.7.6: Freight Barge Landing at Akiak.

6.7.12 Tuluksak

Tuluksak lies on the south bank of the Tuluksak River at its junction with the Kuskokwim River. The community is 35 miles northeast of Bethel. Precipitation averages 16 inches in this area with snowfall of 50 inches. Summer temperatures range from 62 to 42°F; winter temperatures can be 19 to -2°F (DCCED 2008).

The population of Tuluksak is currently estimated at 493, compared to 428 in 2000 and 358 in 1990. The primary employers are the school, village government, and services. Some commercial fishing also occurs; 29 residents hold commercial fishing permits. Subsistence activities provide most food sources (DCCED 2008).

It can be accessed by a State-owned gravel airstrip year-round. There are no docking facilities, although cargo barges deliver goods during the summer (DCCED 2008).

Barge operators said they utilize a barge landing site near the airport. They offload freight in this area, but there is no dedicated staging area. An upland gravel storage pad was recommended by one barge operator, who noted that the existing alders could be cleared on the bank to make additional room for this purpose. No other recommendations for improvements at this site were made during the interviews.

6.8 Middle Kuskokwim River Region

The Middle Kuskokwim River Region, for the purposes of this study, extends from Lower Kalskag upriver to the community of Stony River located near the confluence of the Kuskokwim and Stony rivers. The Kuskokwim River is generally ice-free from mid-June through October. The downriver portion, from Lower Kalskag to Aniak is primarily marked by low-lying wetlands areas similar to the Lower Kuskokwim River Region. Upriver from Aniak there are more uplands, forests, and hilly/mountainous areas. Here, the Kuskokwim River is the primary drainage for the Kuskokwim Mountains, which include peaks as high as 2,000 to almost 3,000 feet. The river becomes shallower further upriver.

Figure 6.8.1 depicts the communities included in this study which are located in the Middle Kuskokwim River region.

In order for barges to meet the draft of the river, cargo is generally consolidated in Bethel and then lightered on smaller vessels to these upriver communities. The river conditions past Sleetmute tend to be too shallow and fast for the larger freight barges.

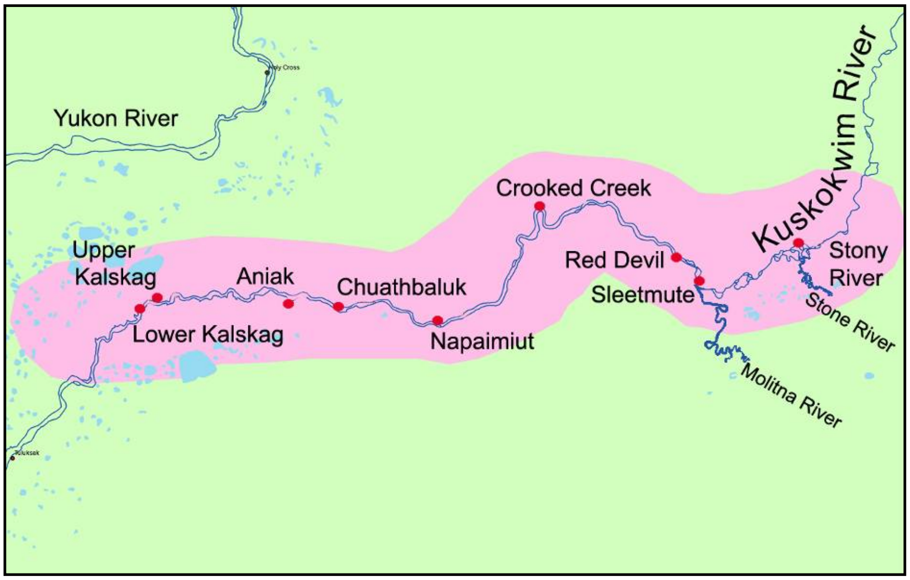

Figure 6.8.1: Middle Kuskokwim River Region Map.

6.8.1 Lower Kalskag

Lower Kalskag is on the north bank of the Kuskokwim River, 2 miles downriver from Kalskag. It lies 26 miles west of Aniak and 89 miles northeast of Bethel. The climate is semi-arctic with maritime influences from the Bering Sea. Precipitation averages 19 inches with 60 inches of snowfall. Temperatures range between -55 and 87°F. The Kuskokwim River is ice-free from mid-June through October (DCCED 2008).

The current population of Lower Kalskag is about 269, compared to 267 in 2000 and 291 in 1990. Lower Kalskag's economy is predominantly based on subsistence activities. Year-round employment is limited to the school district, the Association of Village Council Presidents (AVCP), the Yukon-Kuskokwim Health Corporation (YKHC), and the community of Lower Kalskag. Three residents hold commercial fishing permits. Fire fighting can provide some income (DCCED 2008).

A State-maintained 4.2-mile gravel road connects Lower and Upper Kalskag. Commercial barge lines deliver fuel and other bulk supplies in the summer. Passengers and other freight arrive by air year-round, through scheduled daily air services. The State-owned gravel airstrip is shared by Upper and Lower Kalskag (DCCED 2008). One construction barge operator said there is a good gravel source available nearby that is accessible by road. Large rock is not available.

The barge landing site is at the end of an access road that leads to the central part of the community. It consists of a long, wide beach. There is a sufficient staging area nearby. The fuel tanks are centralized, and located about 700-feet upland from the landing area. Barge operators suggested mooring points would be beneficial to help tying off. Otherwise, no other recommendations for landing improvements were identified during the interviews.

6.8.2 Upper Kalskag

Upper Kalskag (Kalskag) is on the north bank of the Kuskokwim River, 2 miles upriver from Lower Kalskag. It lies 30 miles west of Aniak, 99 miles northeast of Bethel and 348 miles west of Anchorage. The climate in Kalskag is semi-arctic with influences from the Bering Sea. Snowfall averages 60 inches with total precipitation of 19 inches per year. Temperatures range from -55 to 87°F. The Kuskokwim is ice-free from mid-June through October (DCCED 2008).

The current population of Kalskag is about 271, an increase from 230 in 2000 and 172 in 1990. Most cash income in Upper Kalskag is derived from employment at the school, city or clinic. Some trap or work as BLM firefighters. Three residents hold commercial fishing permits. Subsistence activities provide most food sources (DCCED 2008).

A State-maintained 4.2-mile gravel road connects Upper and Lower Kalskag. The State-owned gravel airstrip is shared by Kalskag and Lower Kalskag. Daily scheduled air services deliver passengers, mail and other cargo year-round. Barges deliver cargo and bulk fuel during the summer (DCCED 2008). There is a good gravel source nearby that is accessible by road. A construction contractor stated this source it is not as good as the source at Platinum and there is no rip rap/armor rock available.

The main barge landing area at Upper Kalskag consists of a 70-feet wide ramp of gravel and rock material that has been pushed out into the river from the beach about 40-feet from the shoreline. This leads to an adjacent 10,000 square feet staging area. Another landing area is located upriver about a third of a mile, and is used for offloading fuel. Barge operators indicated the landings at Kalskag are sufficient, except for the fact that they have to tie the barge off to trees. Installing mooring points at both landings is recommended. Drawing E27 in Appendix E depicts the approximate location of the proposed mooring points.

6.8.3 Aniak

Aniak is on the south bank of the Kuskokwim River at the head of Aniak Slough, 59 miles southeast of Russian Mission in the Yukon-Kuskokwim Delta. It lies 92 air miles northeast of Bethel and 317 miles west of Anchorage. The climate is maritime in the summer and continental in winter. Temperatures range between -55 and 87°F. Average yearly precipitation is 19 inches and average yearly snowfall is 60 inches. The Kuskokwim is ice-free from mid-June through October (DCCED 2008).

The population of Aniak is currently about 512, which is down from 572 in 2000 and 540 in 1990. The economy of Aniak is based on government, transportation and retail services. As the largest city in the area, Aniak is a service hub for surrounding communities. Subsistence activities supplement part-time wage earnings, and some commercial fishing occurs. Fourteen residents hold commercial fishing permits. The school district, Kuskokwim Native Association, Bush-Tell Inc., and the Aniak Sub-regional Clinic provide most year-round employment (DCCED 2008).

Access to Aniak is limited to air and water. The State-owned airport has an asphalt runway that is lighted and is equipped for instrument approaches. Floatplanes can also land on Aniak Slough. Fuel and supplies are brought in by barge during the summer; other goods are delivered by air year-round. There is no road connection to other communities (DCCED 2008).

Because this is a small hub for this area, the amount of fuel and freight offloaded can be relatively large. Currently, barges can land at several places along the beach in this area. The beach in front of the runway is relatively wide and good landing for freight barges. Fuel barges land on the beach, close to Yukon Fuels and the power plant. They pull into the beach at 45 degrees to the shoreline and hold by keeping power. At a minimum, barge operators indicate that two mooring points should be installed upstream of each landing area and spaced about 60 to 100 feet apart.

The community is interested in a permanent dock structure and upland staging area for freight. Because this is a small hub, this is considered a priority project that would also benefit nearby communities. The freight barge landing area discussed previously may be a good location for developing a new dock and upland staging area. There appears to be sufficient vacant land available for this purpose.

Drawings E28A and E28B in Appendix E illustrate the proposed dock, staging area, and mooring points at Aniak. Future bulk fuel system work in the community should consider co-locating the fuel barge landing to the new dock by providing a fuel header nearby.

6.8.4 Chuathbaluk

Chuathbaluk is on the north bank of the Kuskokwim River, 11 miles upriver from Aniak in the Kilbuk-Kuskokwim Mountains. It is 87 air miles northeast of Bethel. A continental climate prevails in Chuathbaluk. Snowfall averages 85 inches per year with a total precipitation of 17 inches per year. Temperatures range from -55 to 87°F. Heavy winds can cause flight delays in the fall. The Kuskokwim River is ice-free from mid-June through October (DCCED 2008).

The population of Chuathbaluk is relatively steady, currently at about 99 residents. Chuathbaluk's economy is heavily dependent on subsistence activities. Employment is primarily through the school, tribal government, city, clinic, or seasonal firefighting for BLM. One resident holds a commercial fishing permit. Local artisans produce fur garments, beadwork, mukluks, kuspuks and ulus (DCCED 2008).

The Kuskokwim River serves as the major carrier for supply barges from Aniak and Bethel, skiffs and floatplanes. A State-owned gravel airstrip is one mile north of the community (DCCED 2008).

The river access to Chuathbaluk is very shallow and small vessels are used to lighter cargo to this community. This is sufficient, though, because there is a relatively small volume of fuel and freight delivered to this community. The freight barge landing is along a long section of beach near the store. The beach provides for good firm landing and barge operators indicate that there is enough space for staging just upriver from the landing site. On aerial photography, the staging appears to be within cleared areas among a few houses. Fuel barges also land here to offload fuel to the school and store. Another fuel barge landing is located upriver, to offload fuel to the city tanks.

The community has expressed interest in constructing a dedicated barge landing facility. The area recommended by barge operators is near the existing freight landing. There are existing roads to the beach in this area and sufficient upland space that would be good for creating a staging area. There is a small local gravel site about 2 miles upriver that may be suitable for this purpose. Both landing sites would benefit by having mooring points installed.

Alternately, there appears to be sufficient space for building a ramp landing and dedicated storage area near the fuel landing site, located upriver. Construction of a landing at this site would require more earthwork and construction of an access road to the community.

6.8.5 Napaimute

Napaimute is on the north bank of the Kuskokwim River, 28 miles east of Aniak in the Kilbuck-Kuskokwim Mountains. The climate is continental with temperatures ranging from -55 to 87°F. Average annual precipitation is 20 inches with 85 inches of snow (DCCED 2008).

Napaimute historically was a trading post site in the early 1900s, consisting of a community of Natives and non-Native trappers and miners. By the early 1950s, most residents had moved to nearby communities. Today, Napaimute is no longer occupied by permanent residents; however, it is used seasonally as a subsistence fish camp (DCCED 2008).

Napaimute is easily accessible by riverboat. In the summer months all passengers, cargo and mail arrive in the community by boat. A cargo barge stops several times during the summer (DCCED 2008).

None of the fuel or freight barge operators had any suggestions for improvements of barge landing facilities at Napaimute. Because it is not a permanent community, it is not considered a priority for barge landing improvements in the context of this study.

6.8.6 Crooked Creek

Crooked Creek is on the north bank of the Kuskokwim River at its junction with Crooked Creek. It lies in the Kilbuk-Kuskokwim Mountains 50 miles northeast of Aniak, 141 miles northeast of Bethel, and 275 miles west of Anchorage. A continental climate prevails in the area. Snowfall measures 85 inches per year with total precipitation averaging 17 inches per year. Temperatures range from -59 to 94°F. High winds often cause flight delays in the fall and winter. The Kuskokwim is ice-free from mid-June through October (DCCED 2008).

The current population of Crooked Creek is estimated at 122, compared to 137 in 2000 and 106 in 1990. The economy is focused on subsistence activities. There are a few year-round positions at the school and store. Some residents trap and sell pelts. The Calista Corporation, Kuskokwim Corporation, and Placer Dome US have signed an exploration and mining lease for Donlin Creek, north of Crooked

Creek to develop a gold mine, which is expected to provide some additional local employment (DCCED 2008).

A State-owned and operated gravel airstrip is southwest of the community with scheduled weekday air services. A suspension bridge over Crooked Creek connects the upper and lower communities with the airport. Skiffs and barges provide cargo in summer (DCCED 2008).

The river access to Crooked Creek is shallow and it gets shallower and more difficult upriver from this point. There are two main barge landing sites; one on each side of Crooked Creek, which runs through the community. The beach along this area is narrow with a steep bank leading to the uplands. The freight landing and the associated staging areas are small, and barge operators suggested constructing a larger landing ramp and a dedicated upland staging area.

There is one fuel header in the upland area near the upriver landing. The fuel barge stops at a downriver landing site to offload fuel to the power plant. Fuel barge operators indicated a centralized tank farm and marine fuel header is needed at this community. In addition, mooring points are needed at each of the landing sites.

6.8.7 Red Devil

Red Devil is on both banks of the Kuskokwim River at the mouth of Red Devil Creek. It lies 75 air miles northeast of Aniak, 161 miles northeast of Bethel, and 250 miles west of Anchorage. The climate in Red Devil is continental with temperatures ranging between -58 and 90°F. Annual snowfall averages 85 inches with total precipitation of 20 inches. High winds often cause flight delays in fall and winter. The Kuskokwim River is ice-free from mid-June through October (DCCED 2008).

The population of Red Devil is estimated at about 29, decreased from 48 in 2000 and 53 in 1990. Since the closure of the mercury mine in 1971, employment opportunities have been limited. Income is supplemented by subsistence activities, BLM firefighting, or work in the commercial fishing industry (DCCED 2008).

The Kuskokwim River serves as a major transportation link and supply route for bulk supplies and fuel oil during the summer. In the winter the frozen river is used by snowmachines for travel to neighboring communities. A gravel airstrip provides year-round air access. It is owned and operated by the State (DCCED 2008).

The barge landing area is at a point or bend in the river, near the end of the runway apron. The access to the landing is very shallow, such that barges can only come in to this community during high water periods. Cargo is consolidated in Bethel and lightered to Red Devil. Once there, the landing area is generally considered good. It consists of a natural beach and offloading is not too difficult. The fuel tanks are in a central location, about 650-feet from the landing site. A fuel header closer to the landing site may be helpful, but is not considered a priority because the volume of fuel delivered is relatively small and this is a fairly quick pump operation, regardless of the hose run.

Freight barge operators indicate that they currently stage their cargo along the street at an intersection of two roads, about 500-feet from the landing. A small dedicated staging area near the landing site is needed for this community. It was recommended that some land located east of the landing site could be used for this purpose.

6.8.8 Sleetmute

Sleetmute is on the east bank of the Kuskokwim River, 1.5 miles north of its junction with the Holitna River. It lies 79 miles east of Aniak, 166 miles northeast of Bethel, and 243 miles west of Anchorage. The climate in Sleetmute is continental with temperatures ranging from -58 to 90°F. Snowfall averages 85 inches with total precipitation of 22 inches per year. High winds often cause flight delays in the fall and winter. The Kuskokwim is ice-free from mid-June through October (DCCED 2008).

The current population of Sleetmute is estimated at 91, which is slightly decreased from 100 in 2000 and 106 in 1990. Most cash income in Sleetmute is derived seasonally from BLM firefighting, trapping, or from cannery work in other communities. The school is the primary employer. One resident holds a commercial fishing permit. Most foods are derived from subsistence activities. Many residents travel to fish camps during the summer (DCCED 2008).

The Kuskokwim River provides barges and boats transportation in the summer, and snowmachines are used on the frozen river in the winter. The gravel airstrip is owned and maintained by the State (DCCED 2008).

Access to Sleetmute is very shallow, such that barges can only come up the river this far during high water periods. For some barges, Sleetmute is the limit of their service because the river gets shallower further up. There are no dedicated docking facilities in Sleetmute. Barges land anywhere along the beach in front of the community. The main landing is at an access road that leads to the beach from the tank farm and store. The landing area is considered sufficient for the volume and type of goods delivered to Sleetmute.

Fuel barge operators stated the landing area is satisfactory, and there are short hose runs to the tank farms located near the landing area. Cargo is generally consolidated in Bethel and then they run with lighter barges to the upriver communities to meet the draft of the river. They currently stage freight and equipment at the airport site, about 800-feet upland from the landing. The barge operators would like to see a dedicated staging area developed at the landing site.

6.8.9 Stony River

Stony River is on the north bank of the Kuskokwim River, 2 miles north of its junction with the Stony River. The community is 100 miles east of Aniak, 185 miles northeast of Bethel, and 225 miles west of Anchorage. The climate is continental with temperatures ranging from -58 to 90°F. Snowfall averages 85 inches with total precipitation of 22 inches per year. High winds often cause flight delays in the fall and winter. The Kuskokwim is ice-free from mid-June through October (DCCED 2008).

Approximately 75 people lived in the community in the 1960s, ‘70s and ‘80s. The population has since declined somewhat, with a current estimated population of about 53. Residents depend heavily on subsistence foods. There are few income opportunities including firefighting, which can provide seasonal income (DCCED 2008).

The Middle Kuskokwim Electric Co-op provides power from Chuathbaluk to Stony River. The gravel airstrip is State owned and operated. Scheduled weekday air services deliver mail and other cargo. Barges deliver small volumes of cargo and bulk fuel (DCCED 2008).

Because power is provided from Chuathbaluk, the volume of fuel delivered is relatively small. In addition, because the river is very shallow and fast upriver of Sleetmute, typical freight barges have difficulty accessing this community. Most cargo that is delivered to Stony River consists of small volumes that are carried by the fuel barge.

The landing area near the end of the runway consists of a beach landing at the end of an access road. The landing area is considered sufficient for the volume and type of goods currently delivered to Stony River. Barge operators had no comments or suggestions regarding improvements of the barge landing facilities.

6.9 Upper Kuskokwim River Region

The Upper Kuskokwim River Region, for the purposes of this study, includes the communities of McGrath and Nikolai, located on the South Fork Kuskokwim River, just upriver from the main branch of the Kuskokwim River. This region is at the confluence of the tributaries which makeup the headwaters in the Alaska Range. The river in this region is very shallow and the currents are strong, which limits the ability for typical, deeper draft freight barges to access this region. Barges that do deliver to this region generally do so by transferring the cargo at Bethel to smaller draft lightering vessels and timing the trip to coincide with high water.

Figure 6.9.1 depicts the communities included in this study which are in the Upper Kuskokwim River region.

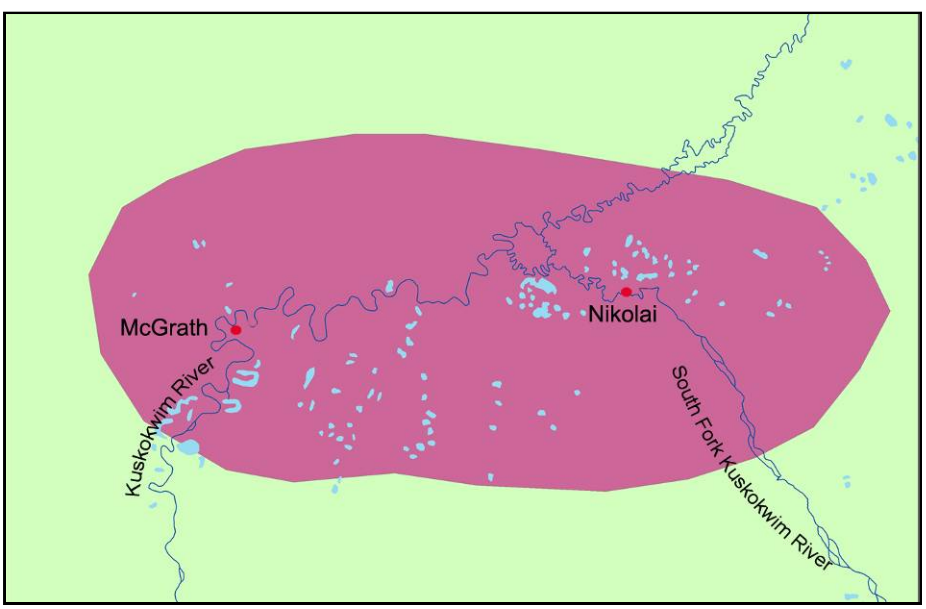

Figure 6.9.1: Upper Kuskokwim River Region Map.

6.9.1 McGrath

McGrath is 221 miles northwest of Anchorage and 269 miles southwest of Fairbanks in Interior Alaska. It is adjacent to the Kuskokwim River directly south of its confluence with the Takotna River. The McGrath area has a cold, continental climate. Average summer temperatures range from 62 to 80°F, winters temperatures can range from -64 to 0°F. Precipitation is light, averaging 10 inches per year, including an average snowfall of 86 inches. The Kuskokwim River is generally ice-free from June through October (DCCED 2008).

The population of McGrath is currently about 321; down from about 401 in 2000 and 528 in 1990. As a regional center, McGrath offers a variety of employment opportunities, but subsistence remains an important part of the local culture. About ten families in town have dog teams, which they enter into the Iditarod, Kuskokwim 300, and Mail Trail 200 sled dog races. McGrath functions as a transportation, communications, and supply center in Interior Alaska. It has a diverse cash economy, and many families rely upon subsistence (DCCED 2008).

There are no road connections to McGrath. Residents rely on winter trails, air service, and barges to deliver cargo. Air facilities include a State-owned asphalt runway with a crosswind landing strip, and a seaplane base on the Kuskokwim River. There is no dock; however, a local boat launch ramp is available (DCCED 2008).

Typical freight barges do not deliver to the areas upriver past Sleetmute due to the shallow, fast water. Most cargo delivered to McGrath consists of small volumes that are carried by the fuel barge. Or, supplies destined for McGrath are delivered to Bethel and the recipient finds another way to get their cargo to McGrath. Barges that do deliver fuel to these communities will lighter smaller draft vessels from Bethel and time the trip to coincide with high water.

The landing area at McGrath consists of two or more beach landing sites, where a road leads to the beach. Each of these has a nearby staging area.

Barge operators had no comments or suggestions regarding improvements of the barge landing facilities at McGrath. The community has expressed the need for a dedicated landing area. A gravel causeway and ramp could be installed at the primary barge landing area, near the end of the runway, where sufficient staging area exists nearby. This location is preferred from a design perspective because it is on the inside bend of the river where the river energy and erosion potential is the lowest. Drawing E29 in Appendix E illustrates the proposed layout for a ramp and associated mooring points.

6.9.2 Nikolai

Nikolai is in Interior Alaska on the south fork of the Kuskokwim River, 46 air miles east of McGrath. Nikolai has a cold, continental climate with relatively warm summers. Average summer temperature range from 42 to 80°F, winter temperatures range from -62 to 0°F. Precipitation is light, averaging 16 inches per year, including an average snowfall of 56 inches. The river is ice-free generally from June through October (DCCED 2008).

Nikolai has a steady population, currently about 98 people. Residents rely on subsistence food-gathering. Employment peaks during the summer when construction gets under way. City, state and federal governments provide the primary year-round employment. Residents rely heavily on subsistence activities for food and wood for heat. Trapping and handicrafts also provide income (DCCED 2008).

Access to Nikolai is by air or water. A State-owned gravel airstrip is available. Barges supply fuel and heavy equipment (DCCED 2008).

The river in this area is very shallow and swift, which limits the ability for typical freight barges to access the community. Most cargo that is delivered to Nikolai consists of small volumes that are carried by the fuel barge. Fuel barges lighter smaller draft vessels from Bethel and time the trip to coincide with high water. Barge operators had no comments or suggestions regarding improvements of the barge landing facilities at Nikolai.

6.10 Bristol Bay Region

Bristol Bay is the eastern-most arm of the Bering Sea and is between the southwest part of the Alaska mainland to the north, and the Alaska Peninsula to the southeast. The Bristol Bay Region, for the purposes of this study, includes coastal Alaska communities along the coast of Bristol Bay from Togiak in the north, south to Nushagak Bay, Kvichak Bay and to Egegik, as well as Ekwok and New Stuyahok on the Nushagak River.

Bristol Bay is home to the world's largest sockeye salmon fishery as well as strong runs of chum, silver and king salmon, each occurring seasonally. For this reason, commercial and recreational interests in the fishing industry are strong. Navigation in this region can be especially challenging due to the extreme tidal ranges, which can exceed 30-feet, combined with prevailing strong winds and a multitude of uncharted sandbars and shoals. Bristol Bay and the Nushagak River are generally ice-free from June through mid-November.

Figure 6.10.1 depicts the communities included in this study which are in the Bristol Bay region.

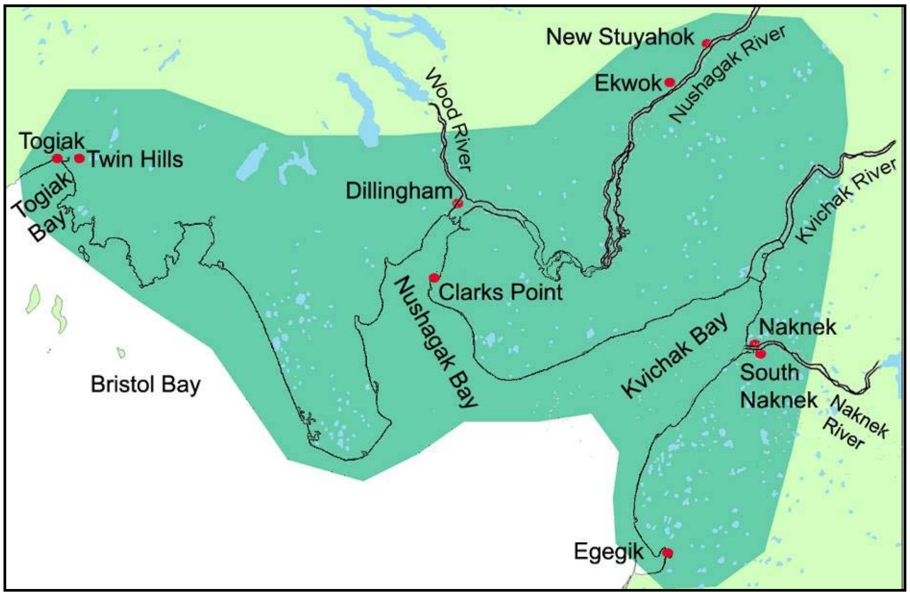

Figure 6.10.1: Bristol Bay Region Map.

6.10.1 Togiak

Togiak is at the head of Togiak Bay, 67 miles west of Dillingham. It lies in Togiak National Wildlife Refuge, and is the gateway to Walrus Island Game Sanctuary. Togiak is in a climatic transition zone; however, the Arctic climate also affects this region. Average summer temperatures range from 37 to 66°F; winter temperatures average 4 to 30°F. Precipitation is 20 to 26 inches annually. Fog and high winds are prevalent during the winter. The bay is ice-free from June through mid-November (DCCED 2008).

The population of Togiak is currently at about 783 residents. Togiak's economic base is primarily commercial salmon, herring, and herring roe-on-kelp fisheries. Two hundred forty-four residents hold commercial fishing permits. Fishermen use flat-bottom boats for the shallow waters of Togiak Bay. There is one onshore fish processor and several floating processing facilities near Togiak. The entire community depends heavily on subsistence activities (DCCED 2008).

A State-owned lighted gravel airstrip with a crosswind airstrip and navigation aids is available. Freight is brought in by air or barge and lightered to shore. There are no docking facilities (DCCED 2008).

There is a long gravel beach along the community and barge landing can occur at any number of places where roads are present to unload cargo. High tide is needed to land.

Fuel barge landings were reported to be good; however, each landing requires a high tide to offload fuel. Only shallow draft freight barges/lightering vessels can land at Togiak. Barges push the beach to land and mooring points may be helpful to avoid disturbing soft bottom sediments, and mounding behind the vessel while pushing the beach.

6.10.2 Twin Hills

Twin Hills is near the mouth of the Twin Hills River, a tributary of the Togiak River, 386 miles southwest of Anchorage. The area experiences a transitional climate, primarily maritime, although the Arctic climate also affects this region. Average summer temperatures range from 37 to 66°F; winter temperatures average 4 to 30°F. Precipitation ranges from 20 to 26 inches annually. Fog and high winds are prevalent during winter months. The Togiak River is ice-free from June through mid-November (DCCED 2008).

The population of Twin Hills is about 77. Steady employment is limited to those working for the Village Council and post office. Fifteen residents hold commercial fishing permits, primarily for salmon, herring, herring roe on kelp or sac roe. Fishermen use special flat-bottomed boats for the shallow waters of Togiak Bay. Togiak Fisheries and other cash buyers provide a market for fishermen. The community depends heavily on subsistence activities for various food sources (DCCED 2008).

Twin Hills is primarily accessible by air and water. There is a State-owned lighted gravel runway on a ridge east of the community. Most cargo is delivered by air. There is a boat landing but no docking facilities; bulk goods must be lightered to shore. Residents drive along the beach to access the Togiak Fisheries cannery (DCCED 2008).

Access to the community is by the East Channel Togiak River. The main barge landing area is downriver of the community, near the propane and fuel tank farms. There is a good sized staging area at this location and a road that leads to other parts of town. Freight barge operators reported they do not regularly service Twin Hills, and that shallow draft (< 4-feet) vessels are used for accessing this site. Cargo can be brought in on the fuel barge, but must be lightered to shore.

There is an existing 2.5 mile road that leads south from the airport runway to the shore of Togiak Bay. A small landing area exists at the end of this road. Because this road could be used to access the community if siltation in the river worsens, dredging to improve access on the East Channel Togiak River is not recommended. If this alternate landing site becomes the preferred barge landing in the future, then improvements such as a staging area and mooring points may be considered. In addition, a fuel header should be provided at this location if this site were to become a primary landing site. Until that time, the existing barge landing facilities are considered sufficient.

6.10.3 Dillingham

Dillingham is at the extreme northern end of Nushagak Bay in northern Bristol Bay at the confluence of the Wood and Nushagak Rivers. It lies 327 miles southwest of Anchorage. The primary climatic influence is maritime; however, the Arctic climate of the Interior also affects the Bristol Bay coast. Average summer temperatures range from 37 to 66°F. Average winter temperatures range from 4 to 30°F. Annual precipitation is 26 inches and annual snowfall is 65 inches. Heavy fog is common in July and August. Winds of up to 60 to 70 mph may occur between December and March. The Nushagak River is ice-free from June through November (DCCED 2008).

The current population of Dillingham is about 2,397, compared to 2,466 in 2000 and 2,017 in 1990. Dillingham is the economic, transportation and public service center for western Bristol Bay. Commercial fishing, fish processing, cold storage and support of the fishing industry are the primary activities. Icicle, Peter Pan, Trident and Unisea operate fish processing plants in Dillingham. Two hundred seventy-seven residents hold commercial fishing permits. During spring and summer, the population doubles. The city's role as the regional center for government and services helps to stabilize seasonal employment. Many residents depend on subsistence activities and trapping provides some cash income (DCCED 2008).

Dillingham can be reached by air and sea. There is a 23-mile ADOT&PF-maintained gravel road to Aleknagik. The State-owned airport has a paved runway and Flight Service Station, and regular jet flights are available from Anchorage. A seaplane base is available 3 miles west at Shannon's Pond; it is owned by the BLM's Division of Lands. A heliport is available at Kanakanak Hospital. There is a city-operated small boat harbor with 320 slips, a dock, barge landing, boat launch, and boat haul-out facilities. It is a tidal harbor and only for seasonal use. Two barge lines make scheduled trips from Seattle (DCCED 2008).

Access to Dillingham can be challenging due to some prominent shoals and currents near the landing site; however these are recognized by the barge operators who are able to navigate around them. Barge operators indicate that access to Dillingham is good and the city dock is satisfactory and in good condition with the exception of some missing fenders and cleats. Cranes are available at the dock. There is also a good beach for landing, which is a soft, flat, muddy area. The dock and beach landing areas are tidal and will go dry at low tides. There may be some broken fender piles and other material that protrudes above the mudline in the landing area that could present a problem at low water. The city should consider removing these potential hazards as part of their maintenance program.

According to the DCCED community database, there are plans to build an All-Tides Dock with partial funding by the Economic Development Administration (EDA). Because adequate dock facilities exist at Dillingham, additional facility improvements are not recommended for the purposes of this study.

6.10.4 Clark's Point

Clark's Point is on a spit on the northeastern shore of Nushagak Bay, 15 miles from Dillingham. Clark's Point is in a climatic transition zone. The primary influence is maritime, although the Arctic climate also affects the region. The community has a history of severe erosion. Most residents have relocated to higher ground in the past few decades. Average summer temperatures range from 37 to 66°F. Average winter temperatures range from 4 to 30°F. Annual precipitation is 20 to 26 inches and annual snowfall is 82 inches. Fog and low clouds are common during winter months. The Nushagak Bay is ice-free from June through mid-November (DCCED 2008).

The current population of Clark's Point is about 69, compared to 75 in 2000 and 60 in 1990. The population increases by about 300 in summer months due to the commercial fishery based here. The economic base in Clark's Point is primarily commercial fishing. Trident Seafoods operates an onshore facility. Sixteen residents hold commercial fishing permits. Everyone depends on subsistence to some extent (DCCED 2008).

Air transport is the primary method of reaching Clark's Point. Regular flights are available from Dillingham. There is a State-owned gravel runway, and floatplanes land on Nushagak River. Freight is brought by barge to Dillingham, and then flown or lightered to the community. The only boat moorage is an undeveloped spit dock owned by the city; boats land on the beach. Trident Seafoods owns a private dock for fish processing (DCCED 2008).

Barge operators reported they land on the beach at Clark's Point. The beach consists of good, flat hard sand and the landing is considered satisfactory for the volume of goods delivered to this community. In addition, there is a large staging area at the end of the old gravel runway, adjacent to the beach. Periodically, construction barges will use the fishery dock, which the operators say is in good condition. For these reasons, barge landing improvements are not considered a priority for this community.

6.10.5 Naknek

Naknek is on the north bank of the Naknek River, at the northeastern end of Bristol Bay. It is 297 miles southwest of Anchorage. The climate is mainly maritime, characterized by cool, humid and windy weather. Average summer temperatures range from 42 to 63°F; average winter temperatures range from 29 to 44°F. Extremes from -46 to 88°F have been recorded. Total precipitation is 20 inches annually, including 45 inches of snowfall. Fog is common during summer months (DCCED 2008).

The current population of Naknek is about 577, compared to 678 in 2000 and 575 in 1990. The economy is based on government employment, salmon fishing and processing. Naknek has a seasonal economy as a service center for the huge red salmon fishery in Bristol Bay. One hundred fifteen residents hold commercial fishing permits, and several thousand people typically flood the area during the fishing season. Millions of pounds of salmon are trucked over the Naknek-King Salmon road each summer, where jets transport the fish to the Lower 48. Trident Seafoods, North Pacific Processors, Ocean Beauty and other fish processors operate facilities in Naknek. Naknek is also the seat of the Bristol Bay Borough (DCCED 2008).

Naknek is accessible by air and sea, and connects to King Salmon via a 15.5-mile road. The Tibbetts Airport has a lighted gravel runway. The State-owned Naknek Airport is one mile north of Naknek. It has a lighted gravel runway and a 2,000-foot floatplane landing area. Jet services are available at King Salmon. The Borough operates the cargo dock at Naknek, which is the Port of Bristol Bay. No commercial docking facilities are available at the canneries, although the development of a fishermen's dock, freight dock and industrial park are regional priorities (DCCED 2008).

Freight barge operators indicate that Naknak is a large hub, and has one of the nicest landing facilities. They regularly haul sockeye from Naknek to Dutch Harbor and Pribolof crab goes through here from St. Paul and Dutch Harbor. In addition, they move a large amount of cargo, up to 12,000 containers, through Naknek.

There are several docks at Naknek, including a public dock and several private docks that are associated with the fisheries at Naknek. The existing public dock is a timber pile supported, concrete panel dock, with about 800-feet of berthing space, fenders, and several cranes available. Barge operators noted there is a 20-foot tide change at the dock, such that access is only at high tide and they have to work around the tides to ensure that the barge doesn’t go dry. There is a pocket near the dock that they can float in, but they feel that some annual dredging is needed to ensure full tide access to the dock.

Barge operators reported the existing public dock at Naknek is sufficient; however, it was noted that the dock needs renovation work. Barge operators think the dock cannot safely support the weight that moves across it.

A complete condition assessment of the above and below-water portions of the dock should be completed approximately every 5 to 10 years to ensure continued safe operations at the facility. In addition, the owner of the dock should have a maintenance plan in place to ensure that adequate funding and resources are in place to complete projected maintenance and upgrades for the next 10 or more years, and ensure continued safe and productive use of the dock.

6.10.6 South Naknek

South Naknek is on the south bank of the Naknek River on the Alaska Peninsula, 297 miles southwest of Anchorage. It lies just west of the Katmai National Park and Preserve. The climate is mainly maritime, characterized by cool, humid, and windy weather. Average summer temperatures range from 42 to 63°F; average winter temperatures range from 29 to 44°F. Extremes from -46 to 88°F have been recorded. Total precipitation is 20 inches annually, including 45 inches of snowfall. Fog is common during summer months (DCCED 2008).

The current population of South Naknek is about 74, which has decreased from 137 in 2000 and 136 in 1990. Commercial fishing and salmon processing are the mainstays of South Naknek's economy. Forty-three residents hold commercial fishing permits. Trident Seafoods operates in South Naknek. Most other employment is in public services. A few people trap, and most residents depend on subsistence hunting and fishing (DCCED 2008).

South Naknek is accessible by air or sea. There are two State-owned lighted gravel runways. The PAF Cannery airport lies 3 miles to the southeast. It has a dirt strip and a crosswind strip. A 3,000-foot designated stretch of the Naknek River is used by floatplanes. There is an un-maintained dirt road to New Savonoski. The Borough operates a mid- and high-tide cargo dock at South Naknek with 200-feet of berth space to accommodate barges (DCCED 2008). On aerial photography, there appears to be a small gravel source at the end of a road that leads northeast of the community.

There are several docks at South Naknek, which are associated with the fisheries/canneries. Similar to Naknek, the large tidal range at the mouth of the river results in the docks in this area being accessible only during mid to high tide levels. Figure 6.10.2 depicts a vessel resting on the bottom while docked during a low tide. The bottom is flat, shallow and muddy at the dock and barge operators generally consider 8-feet maximum allowable draft at the dock during high water.

Barge operators reported the existing public dock at South Naknek is sufficient for their needs; however, they commented that the dock needs some maintenance work.

A complete condition assessment of the above and below-water portions of the dock should be completed approximately every 5 to 10 years. In addition, the owner of the dock should have a maintenance plan in place to ensure that funding is in place to complete projected maintenance and upgrades over a 10-year time frame.

Figure 6.10.2: A dock at South Naknek, dry at low tide levels.

6.10.7 Egegik

Egegik is on the south bank of the Egegik River on the Alaska Peninsula, 100 miles southwest of Dillingham. Egegik's predominantly maritime climate is characterized by cool, humid and windy weather. Summer temperatures range from 44 to 65°F; winter temperatures range from -24 to 40°F. Annual precipitation is 20 to 26 inches with 45 inches of snow (DCCED 2008).

The current population of Egegik is about 76, which is decreased from 116 in 2000 and 122 in 1990. The economy is based on subsistence harvest, commercial fishing and fish processing. During the commercial fishing season, the population swells by 1,000 to 2,000 fishermen and cannery workers. Forty-five residents hold commercial fishing permits. Five onshore processors are on the Egegik River, three on the north shore and two on the south shore, including Woodbine Alaska Fish Company, Big Creek Fish Company, Clark Fish Company and Alaska General Seafoods. Numerous floating processors participate in the Egegik fishery. Subsistence hunting and fishing activities are an important part of the lifestyle and local diet (DCCED 2008).

The community is accessible by air and water. A city-owned lighted gravel runway with crosswind airstrip is 2 miles northwest of Egegik. There is a public dock and a boat harbor that accommodates up to 150 vessels. A boat haul-out is available. Two privately-owned docks and marine storage are also available. Barge services are provided from Anchorage and Seattle (DCCED 2008).

Access to Egegik requires waiting for higher water to get close to the community; however, there is good anchorage and protection from weather leading up to the site. The channel is narrow and boat traffic is high during the fishing season. The existing public dock at Egegik is a pile-supported dock that is about 600 feet upriver from the private fisheries docks. There’s a big rock pile along the upriver end of the dock that can present a hazard.

Barge operators stated this dock is sufficient for their needs; however, the dock needs some maintenance work. A complete condition assessment of the above and below-water portions of the dock should be completed approximately every 5 to 10 years and a maintenance plan should be in place to ensure continued and safe operations of the facility.

Fuel offloading requires several stops, and removal from rocks off of the beach is required prior to landing at the beach landings. Installation of mooring points may be helpful at these fuel landings.

6.10.8 Ekwok

Ekwok is along the Nushagak River, 43 miles northeast of Dillingham. Ekwok is in a climatic transition zone. The primary influence is maritime, although a continental climate also affects the weather. Average summer temperatures range from 30 to 66°F; winter temperatures average from 4 to 30°F. Precipitation averages 20 to 35 inches each year. Extremely strong winds are common during winter months. Fog is prevalent during summer months. The river is ice-free from June through mid-November (DCCED 2008).

The current population of Ekwok is 111, compared to 130 in 2000 and 77 in 1990. Ekwok residents have a fishing and subsistence lifestyle. A few residents trap. Most residents are not interested in participating in a cash economy. Six residents hold commercial fishing permits in Ekwok. The village corporation owns a fishing lodge two miles downriver. Gravel is mined near the community (DCCED 2008).

Air transport is most frequently used to reach Ekwok. Regular and charter flights are available from Dillingham. There is a State-owned gravel runway. Floatplanes land on the Nushagak River. Cargo is brought in during ice-free months from Dillingham. There are no docking facilities, but a barge offloading area exists (DCCED 2008).

The barge landing area is downriver of the community, near the centralized fuel tank farm. There is a wide landing area at the beach that is directly adjacent to the upland staging area. The staging area is a good size for this community. Freight barge operators advised the landing area needs some work. There is a short gravel causeway that juts out into the river that likely changes shape from year to year. Barge operators are able to work with this, but in the future, erosion protection for the exiting causeway or some type of permanent ramp structure would help to improve landings at this community.

6.10.9 New Stuyahok

New Stuyahok is on the Nushagak River, about 12 miles upriver from Ekwok and 52 miles northeast of Dillingham. The community has been constructed at two elevations -- one 25 feet above river level, and one about 40 feet above river level. New Stuyahok is in a climatic transition zone. The primary influence is maritime, although a continental climate affects the weather. Average summer temperatures range from 37 to 66°F; winter temperatures average 4 to 30°F. Annual precipitation ranges from 20 to 35 inches. Fog and low clouds are common during the summer; strong winds often preclude access during the winter. The river is ice-free from June through mid-November (DCCED 2008).

The current population of New Stuyahok is about 472, which has increased from 471 in 2000 and 391 in 1990. Residents practice a fishing and subsistence lifestyle. The primary economic base in New Stuyahok is the salmon fishery; 43 residents hold commercial fishing permits. Many trap as well (DCCED 2008).

Air transport is most frequently used to reach the community. Regular and charter flights are available from Dillingham. The State-owned gravel airstrip is lighted. It is located on a hilltop and windy conditions often preclude landing. There appears to be two local gravel pits available in the community. There are no docking facilities. Goods are lightered to New Stuyahok on a regular basis during the summer (DCCED 2008).

According to barge operators, river access to the community is challenging and shallow. Freight barge operators noted sometimes it is not economical to deliver cargo because the small volumes delivered is not worth the cost of the trip up the river to this community.

There are two landing areas used by fuel barges, one for the AVEC tank farm and one for the school. The latter is also used by freight barges. Offloading freight is difficult because there is no dedicated landing area or staging area. The shoreline in front of the community consists of a bluff to the river, except for one beach area, which is used by locals for parking boats. There is not enough room for barges to land and this area is not easily accessible. The community in this area is built up close to the shore with a road and several private buildings. Barge operators suggested creating a dedicated barge landing site, access to the river and a staging area further downriver, possibly in front of the school property where there is more room. A concrete plank ramp may be an appropriate landing facility for this site.

There is sufficient room in this area for a larger staging area—10,000 to 20,000 square feet is appropriate for this mid-sized community. A narrow right-of-way exists along the north edge of the sewage lagoons. This would need to be widened and extended to the east to provide road access to the proposed new landing/staging area. Drawing E30 in Appendix E illustrates the proposed ramp, staging area, and road improvements.

6.11 Kotzebue Sound Region

Kotzebue Sound is an arm of the Chukchi Sea in northwestern Alaska, north of the Seward Peninsula. The Kotzebue Sound Region, for the purposes of this study, includes the communities of Deering on the south coast of Kotzebue Sound; Buckland on the Buckland River which empties into Kotzebue Sound; Selawik near the mouth of the Selawik River where it enters Selawik Lake/Kotzebue Sound; Kotzebue on the northern tip of the Baldwin Peninsula; and Kivalina to the north.

Several rivers dump into the sea in this region, notably including the Noatak, Kobuk, Selawik, and Buckland rivers. The communities are primarily coastal, marked by tidal influence, coastal bluffs and sandy beaches, and offshore sandbars. Kotzebue Sound is usually ice-free from early July until early to mid-October.

Figure 6.11.1 depicts the communities included in this study which are in the Kotzebue Sound region.

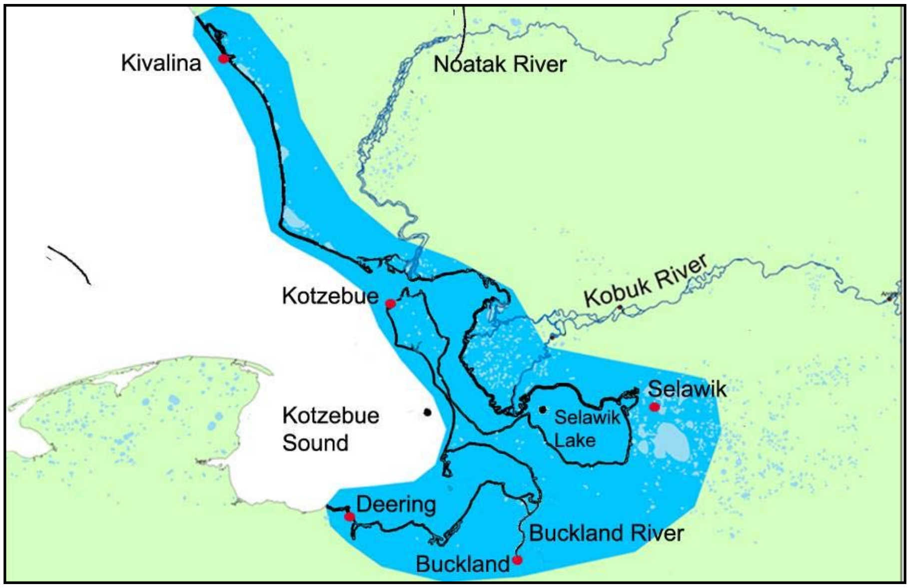

Figure 6.11.1: Kotzebue Sound Region Map.

6.11.1 Deering

Deering is on Kotzebue Sound at the mouth of the Inmachuk River, 57 miles southwest of Kotzebue. It is built on a flat sand and gravel spit that is about 300 feet wide and a half-mile long. Deering is in the transitional climate zone, which is characterized by long, cold winters and cool summers. The average low temperature during January is -18°F. The average high during July is 63°F. Temperature extremes from a low of -60 to a high of 85°F have been measured. Snowfall averages 36 inches, and total precipitation averages 9 inches per year. Kotzebue Sound is ice-free from early July until mid-October (DCCED 2008).

The population of the community is currently about 138, compared to 136 in 2000 and 157 in 1990. Deering's economy is a mix of cash and subsistence activities. The Karmun-Moto reindeer herd of 1,400 animals provides some local employment. A number of residents earn income from handicrafts and trapping. The community is interested in developing a craft production facility and cultural center to train youth in Native crafts. The school, city, Maniilaq Association, stores, and an airline provide the only year-round jobs. Some mining occurs in the Seward Peninsula's interior. Three residents hold commercial fishing permits. The community wants to develop eco-tourism, including a 38-mile road to Inmachuk Springs for tourists (DCCED 2008).

Deering is accessible year-round by plane. A State-owned gravel airstrip, with a gravel crosswind strip, enables flights by several Kotzebue air services. Barges deliver fuel and goods from Kotzebue each summer (DCCED 2008).

The barge landing area is on the beach of Kotzebue Sound, which borders the community. The beach is sandy with little or no large rocks. Barge operators indicate here are no significant issues associated with storm surges and flooding and erosion is slow. There is a very wide shallow shelf, or flats, in the near shore area that imposes restrictions on deliveries to Deering. Barges come in at a high tide and either makes a very quick delivery, or must wait until the next high tide before they can depart. Fuel barges only have one stop to deliver fuel, so this is often achievable for them.

According to freight barge operators, the southeast end of the beach is the deepest and most desirable area for landing and offloading freight. It was suggested that a 100-feet rock/gravel causeway, approximately 8 to10 feet high, above the waterline, would provide access for a longer period of time between tides. However, because this beach is exposed to Kotzebue Sound, it is likely that a ramp placed at this location would experience high wave and surf conditions that may make it undesirable to land without more robust coastal protection, such as a breakwater.

The beach itself provides for good, soft landing; although the loose beach sand makes for difficult traction when driving a forklift or loader across it to reach the upland area. The beach is gently sloping, and is approximately 15-feet from the waterline to the top of the beach. This could be rectified by installing a gravel or concrete ramp from the shoreline (or top of the causeway structure, described above) across the beach to the upland area.

Several barge operators reported that a staging area is needed at Deering. They currently store supplies below the high tide line. Looking at aerial photography of the area, it may be a challenge to find a sufficient dry staging area near the preferred landing site, although there appears to be a small area (about 5,000 square feet) of vacant land available near the outlet of the Inmachuck River. Barge operators indicate storage above the high tide line is mostly private residential property.

There is a gravel source available about 17 miles from the community, but the road needs major improvements.

6.11.2 Buckland

Buckland is on the west bank of the Buckland River, about 75 miles southeast of Kotzebue. Buckland is in the transitional climate zone, which is characterized by long, cold winters and cool summers. Temperatures range from -60 to the 85°F. Annual precipitation averages 9 inches and annual snowfall averages 40 inches. Crosswinds can restrict flying during the winter (DCCED 2008).

The population of Buckland is currently about 457, which has increased from 406 in 2000 and 318 in 1990. Subsistence activities are an important focus of Buckland’s economy. Employment is primarily with the school, city, health clinic and stores. Some mining also occurs. One resident holds a commercial fishing permit (DCCED 2008).

Buckland's major means of transportation are plane, small boat, barge and snowmachine; there are no roads outside of the community. Buckland has a State-owned gravel airstrip. There is a nearby gravel pit, about 5 miles from the community. Barges deliver fuel and lighterage companies deliver cargo and supplies each summer (DCCED 2008).

Access to Buckland by barge is at high tide only. Barge operators pointed out there are big rocks in the water and some barge operators will hire a local pilot to help navigate around them. The area floods each spring.

Barge operators indicate that landing at the community is made more difficult because they sometimes have to wait for the local boat owners to relocate their boats, which are moored all along the beach at the landing site. It would help to increase their operational efficiency if there was a landing site that was dedicated for the barge landing and kept available for their sole use. In addition, freight barge operators suggested the community could benefit from a dedicated staging area.

Fuel barge operators said that there is a marine fuel header, but they don't land in front of the header location due to the many rock hazards in front of it. Instead, they land upstream at the point of land, where there is a bend in the river, and pull a long hose run up the beach to access the header. The landing site at the point is also used by freight barges. This location can be difficult to hold position because the river narrows in this area and a 250-foot barge almost takes up the entire width of the river. Mooring points may be helpful, otherwise barge operators had no recommendations for improving the landing facilities at Buckland. However, if this community continues to grow a dedicated barge landing and upland staging area are needed. Ideally, a co-located landing site should be developed to facilitate fuel and freight offloading.

Drawing E31 in Appendix E depicts a proposed gravel ramp and two possible upland staging area options located at a new landing site closer to the existing marine fuel header. It is unclear whether this area is accessible by barges or whether potential rock hazard exist and can be easily removed or avoided by extending a causeway out to deeper water. As with any new development, a site assessment is needed to confirm existing site conditions prior to final design. If site conditions find that development of a landing near the fuel header is not feasible, mooring points should be installed at the existing landing area and relocating the marine header should be considered.

6.11.3 Selawik

Selawik is at the mouth of the Selawik River where it empties into Selawik Lake, about 90 miles east of Kotzebue. The city is near the Selawik National Wildlife Refuge, a key breeding and resting spot for migratory waterfowl. The community is in the transitional climate zone. Temperatures average -10 to15 °F during winter; and 40 to 65°F during summer. Temperature extremes have been recorded from -50 to 83°F. Snowfall averages 35 to 40 inches, with 10 inches of total precipitation per year. The Selawik River is navigable from early June to mid-October (DCCED 2008).

The population of Selawik is about 841, an increase from 772 in 2000 and 596 in 1990. Inhabitants of Selawik rely on subsistence activities for food sources. The primary employers in the community include the school, city, the IRA, the Maniilaq Association, and three grocery stores. Handicrafts are made and sold locally and at gift shops in larger cities. Seasonal work is also found outside of Selawik at the Red Dog Mine, BLM firefighting or in lighterage operations. Three residents hold commercial fishing permits (DCCED 2008).

Selawik is accessible by plane and barge. The Roland Norton Memorial Airport provides a gravel runway owned by the city. The State also owns a gravel airstrip with a crosswind strip. Docking facilities and a barge landing area exist; freight is shipped upriver from Kotzebue each summer (DCCED 2008).

Access to the barge landing area is via the Selawik River, which barge operators report is shallow at the mouth, but sufficiently deep once in the main part of the river. The primary barge landing area consists of a gravel access road that leads to the river and a 60-foot wide beach landing area. This can be seen in the photograph in Figure 6.11.2, below. This landing site is upriver from the community, and there is a road that leads from this area to the tank farm, the school and the runway. Boardwalks are used for travel throughout the rest of the community. Fuel barge operators indicated in addition to the tank farm landing, there is a fuel header located under the bridge near the school.

Figure 6.11.2: The main barge landing and staging area at Selawik.

There are existing deadmen at the main barge landing, which consist of mooring posts buried in the ground with cables and eyes attached at the end. One is located on each side of the landing area. Some barge operators reported that a wider landing area would be helpful to provide more room for unloading operations.

Barge operators noted this community needs a dry dedicated staging area. There appears to be a small gravel pad nearby, where the old tank farm is located. This area could be expanded to use as a dedicated staging area for freight. Any new staging area would require an associated gravel road access. In addition, freight barge operators reported the road from the landing area needs upgrading to allow safe passage for heavy equipment.

There is no gravel material pit in the community. In the past, they have hauled gravel to the area from the foothills, 13 miles away via ice and tundra roads. Otherwise, gravel would need to be imported.

6.11.4 Kotzebue

Kotzebue is on the Baldwin Peninsula in Kotzebue Sound, on a 3-mile-long spit, which ranges in width from 1,100 to 3,600 feet. It is near the discharges of the Kobuk, Noatak and Sezawick rivers, 549 air miles northwest of Anchorage and 26 miles above the Arctic Circle. Kotzebue is in the transitional climate zone, which is characterized by long, cold winters and cool summers. The average low temperature during January is -12°F; the average high during July is 58°F. Temperature extremes have been measured from -52 to 85°F. Snowfall averages 40 inches with total precipitation of 9 inches per year. Kotzebue Sound is ice-free from early July until early October (DCCED 2008).

The current population of Kotzebue is about 3,104, an increase from 3,082 in 2000 and 2,751 in 1990. Kotzebue is the service and transportation center for all communities in the northwest region. It has a healthy cash economy, a growing private sector, and a stable public sector. Due to its location at the confluence of three river drainages, Kotzebue is the transfer point between ocean and inland shipping. It is also the air transport center for the region. Activities related to oil and minerals exploration and development have contributed to the economy. The majority of income is directly or indirectly related to government employment, such as the school district, Maniilaq Association, the city and Borough. The Cominco Alaska Red Dog Mine is a significant regional employer. Commercial fishing for chum salmon provides some seasonal employment. One hundred twenty-eight residents hold commercial fishing permits. Most residents rely on subsistence to supplement income (DCCED 2008).

Air is the primary means of transportation year-round. The State-owned Ralph Wien Memorial Airport supports daily jet service to Anchorage and several air taxis to the region's communities. It has a main paved runway and a crosswind gravel runway. A seaplane base is also operated by the State. The shipping season lasts from early July to early October, when the Sound is ice-free. Due to river sediments deposited by the Noatak River, 4 miles above Kotzebue, the harbor is shallow. Deep draft vessels must anchor 12 miles out, and cargo is lightered to shore and warehoused. Shallow draft barges to deliver cargo to area communities. The City wants to examine the feasibility of developing a deep water port, since the cost of cargo delivery is high with the existing transportation systems. A USACE project is underway to investigate the feasibility and/or construct a new harbor (DCCED 2008). Gravel and riprap is usually brought to this area from the Nome area.

Crowley owns a sheetpile dock at Kotzebue, which is used by most of the major freight barge companies. Barge operators reported this dock is sufficient for their purposes. The freight barges lower their ramp at the dock and use RO-RO and pass-pass operations, and they have a nearby storage area available. The volume of cargo to be delivered determines if they lighter from Nome or unload from a barge anchored offshore of Kotzebue.

There are proposed plans within the community to construct sheetpile bulkhead and armor rock along the shoreline with boat ramps located approximately every 600-feet, which would provide additional options for vessel access to the community. Due to the shallow water (about 2 to 3 feet deep) that fronts the shoreline south of the existing dock, where this sheetpile bulkhead is proposed, this access would be limited to shallow draft vessels. It is unclear whether the ramps will be designed to accommodate lighter vessels for landing, mooring and offloading.

Currently, the larger barges stop at a bench, about 12 miles offshore, and lighter cargo into the Crowley dock. A local barge operator says that this sandy bench is about 6-feet deep and 500 to 600 feet across and then the water gets deeper from there to the dock. The bench consists of silty sand, and some barge operators recommended that this bench be dredged to provide access. Barge landing improvements that aim to provide access for the larger barges to reach Kotzebue would significantly increase the operational efficiency of shipping operation to this community and the region.
Alternatively, there has been interest by the city to develop a deepwater port, airport and support facilities at nearby Cape Blossom, which barge operators think would not require dredging.

6.11.5 Kivalina

Kivalina is at the tip of an 8-mile barrier reef between the Chukchi Sea and Kivalina River. It lies 80 air miles northwest of Kotzebue. Kivalina lies in the transitional climate zone, which is 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 to 85°F. Snowfall averages 57 inches with 8.6 inches of precipitation per year. The Chukchi Sea is ice-free and open to boat traffic from mid-June to the first of November (DCCED 2008).\

The current population of Kivalina is about 391, an increase from 377 in 2000 and 317 in 1990. Kivalina's economy depends on subsistence practices. The school, city, Maniilaq Association, village council, airlines and local stores provide year-round jobs. The Red Dog Mine also offers some employment. Six residents hold commercial fishing permits. Native carvings and jewelry are produced from ivory and caribou hooves (DCCED 2008).

Due to severe erosion and wind-driven ice damage, the city intends to relocate to a new site (DCCED 2008). Plans are underway to construct continuous armor rock protection along the shoreline adjacent to existing bulk fuel storage facilities and the school to protect these critical facilities in the interim.

The major means of transportation into the community are plane and barge. A State-owned gravel airstrip serves daily flights from Kotzebue. Barges deliver goods from Kotzebue during July and August (DCCED 2008).

Access to Kivalina is weather dependant. The armor rock erosion protection that lines portions of the shoreline presents a hazard and barges avoid landing in these areas. The sandy beaches are preferred for barge landing; however, these areas move around from year to year due to erosion and littoral drift. Also, the deep water areas change depending on the weather conditions. Barges tend to nose in wherever they can. In general, barge operators reported that the water is fairly deep right up to the beach. The new tank farms are at the end of the spit, where the channel is located, and there is a higher rate of erosion. Fuel deliveries require

a short hose run. They stated the new armor wall is making it difficult to barge fuel into the tank farms. Barges try to land and get off the beach quickly.
Because there are plans to move the community to a new site, barge landing improvements at Kivalina are not recommended for the purposes of this study.

6.12 Kobuk River Region

The Kobuk River, located in the Arctic region of northwestern Alaska, is about 280 miles long and drains into Kotzebue Sound in the Chukchi Sea. For the purposes of this study, the Kobuk River Region includes the Kobuk River Valley from the community of Kobuk downriver to the mouth. This portion of the Kobuk River follows along the southeastern portion of the western Brooks Range in a wide valley. It has a current speed of 3 to 5 mph in this region. The Kobuk River in this region is meandering marked by oxbow bends and sloughs. Topography along the river basin ranges from low-lying wetlands to low rolling mountains to gently sloping uplands.

The communities of Kobuk, Shungnak, and Ambler are in the valley upriver from its confluence with the Ambler River. Between Ambler and Kiana, the river passes between the Baird and Warring mountains, traverses Kobuk Valley National Park. The river delta begins about 10 miles southwest of Kiana, where it branches into several channels. Noorvik is on the Nazuruk Channel of the Kobuk River.

The middle and lower reaches of the Kobuk River is notably shallow and marked by braided channels, wide meander bends, large floodplains, alluvial fans, and oxbow lakes. The river has become shallower over the years due to sediment deposition; the source of which is largely from the nearby Kobuk Sand Dunes.

Figure 6.12.1 depicts the communities included in this study which are located in the Kobuk River region.

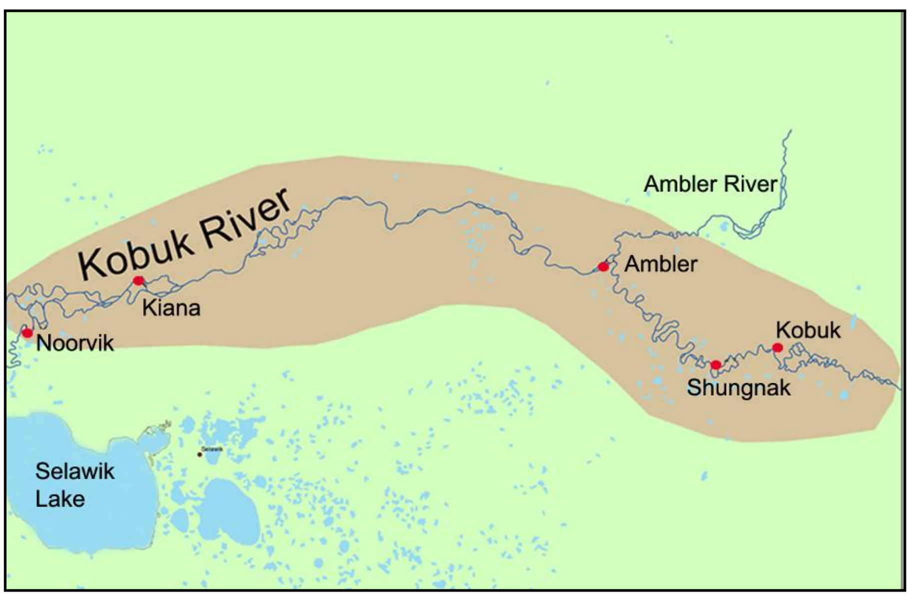

Figure 6.12.1: Kobuk River Region Map.

6.12.1 Noorvik

Noorvik is on the right bank of the Nazuruk Channel of the Kobuk River, 33 miles northwest of Selawik and 45 miles east of Kotzebue. The community is downriver from the 1.7-million acre Kobuk Valley National Park. The community is in the transitional climate zone. Temperatures average -10 to 15°F during winter and 40 to 65°F during summer. Temperature extremes have been recorded from -54 to 87°F. Snowfall averages 60 inches with 16 inches of total precipitation per year. The Kobuk River is ice free from early June to mid-October (DCCED 2008).

The current population of Noorvik is 636, an increase from 634 in 2000 and 531 in 1990. Noorvik residents have a subsistence lifestyle. The primary local employers are the school district, the city, the Maniilaq health clinic, and two stores. Seasonal employment at the Red Dog Mine, BLM firefighting, or work in Kotzebue supplement income (DCCED 2008).

Noorvik is accessible by plane and by shallow-draft vessels. There are no roads linking the community to other areas of the state. One 7-mile road leads to the local material site. The relatively new State-owned airport has a lighted gravel runway. Barges deliver fuel and supplies during the summer (DCCED 2008).

Access to Noorvik is considered relatively good, because the water levels in this channel of the Kobuk River are usually sufficient for barge access. There are several barge landing sites identified along the shoreline of the community, consisting of low lying beach. These areas are prone to spring flooding, which results in soft mucky ground and poor traction for cargo offloading. Locals use much of the beach area for boat storage and this can cause delays, when barge operators have to locate the boat owners to move the boats before they can land. One barge operator suggested providing a dedicated landing area that is designated specifically for barges and is inconvenient for the smaller fishing skiffs may help to prevent this problem.

Mooring points may be helpful at all of these landing sites. The main freight barge landing area is at the downriver end of the community, at a wide section of beach where the road connects to the new airport. This site is preferred by freight and construction barge operators because there is more area for staging equipment and supplies. Staging is currently along the brush as far back on the beach as possible, although this is below the high water mark. Barge operators recommended that the landing area be elevated and a gravel ramp be constructed to provide a hard surface for crossing the beach with heavy equipment. However, if it is a priority to provide a dedicated barge landing that is inconvenient for skiff landing, an alternate location or an elevated pile-supported dock structure may be another option.

In addition to improving the landing site, barge operators suggested that a dedicated staging area be constructed in the uplands area. Gravel should be added to the staging area to elevate it and create a dedicated dry storage pad. One construction contractor informed that although there is a local gravel source about 7 miles out of town, there may be a possibility of using some of the gravel from the old runway for this purpose.

There are multiple stops required by the fuel barge to offload fuel to the several fuel tank farms in the community. There is one large tank farm and fuel header near the upriver end of the community, and this would be an ideal location for co-locating the other tanks in the community.

Drawing E32 in Appendix E illustrates the gravel ramp, staging area, and access road proposed for the landing facility improvements at the downriver freight barge landing site as well as approximate locations for mooring point needed at the other fuel barge landing sites in Noorvik.

6.12.2 Kiana

Kiana is on the north bank of the Kobuk River, 57 air miles east of Kotzebue. Kiana is in the transitional climate zone. Temperatures average -10 to 15°F during winter and 40 to 60°F during summer. Temperature extremes have been recorded from -54 to 87°F. Snowfall averages 60 inches with 16 inches of total precipitation per year. The Kobuk River is ice free from the end of May to early October (DCCED 2008).

The population of Kiana is currently about 401, which is slightly higher than the population of 388 in 2000 and 285 in 1990. The economy depends on traditional subsistence activities, augmented by a cash economy. The school, city, and Maniilaq Association provide the majority of year-round jobs. The Red Dog Mine also offers area employment. Kiana has three general stores. Two residents hold commercial fishing permits; seasonal employment also includes work on river barges, BLM firefighting and jade mining (DCCED 2008).

The major means of transportation are plane, small boat and snowmachine. The State-owned airport has a lighted gravel runway. Barges deliver fuel and supplies each summer, and local store owners have large boats to bring supplies upriver. A road extends along the river to Kobuk Camp, and a network of old trading trails exists (DCCED 2008).

Some barge operators said that over the last 5 to 7 years there is only a 50 percent chance that they can get into Kiana due to the narrow and shallow river access. One landing that is used for freight offloading is on the main channel of the Kobuk River, where it intersects with the Squirrel River and another fork of the Kobuk River. Barge operators indicate that access to this landing is challenging because they need to be careful of the water levels and strong currents where the three rivers meet. One construction barge operator suggested that this could be facilitated by moving the landing up further into the Squirrel River, so that they only would have to deal with one current. Regardless, mooring points are needed.

The community is on a bluff and there are steep roads from the upriver/freight landing to the community. The road is not wide enough for cargo to pass up the road. Either widening the road to facilitate transporting cargo or a dedicated staging area nearby the landing site is needed to improve freight offloading operations. If a new landing site is built upriver, there appears to be vacant land nearby that may be appropriate for constructing a dedicated staging area.

Fuel barge operators said two stops are required to offload fuel. One stop is at the landing site described above, and the other is downriver, at the end of an access road to the beach where a gravel landing juts out into the river somewhat. Mooring points are needed at both landings. Providing a co-located marine fuel header would speed up fuel offloading operations.

In addition, barge operators noted landing at the community is made more difficult because they sometimes have to wait for the local boat owners to relocate their boats, which are moored at the landing sites. It would help to increase their operational efficiency if there was a landing site that was dedicated solely for the barge landing and kept available for their sole use.

To accomplish this, one recommendation is to create a dedicated landing site just upriver, in the Squirrel River, which would be used by fuel and freight barges. There appears to be a spit of land present there that may be appropriate for this use. Construction of an upland staging area, access roads, and mooring points would allow use of this site for this purpose. Mooring points should also be installed at the lower landing for fuel offloading there. Drawing E33 in Appendix E illustrates the proposed landing facility improvements at Kiana.

In the future, the tanks that are filled from the lower landing site should be relocated or consolidated with the other tanks to allow a single fuel stop.

6.12.3 Ambler

Ambler is on the north bank of the Kobuk River, near the confluence of the Ambler and the Kobuk Rivers. It lies 45 miles north of the Arctic Circle, 138 miles northeast of Kotzebue, 30 miles northwest of Kobuk and 30 miles downriver from Shungnak. Ambler is in the continental climate zone. Temperatures average -10 to 15°F during the winter and 40 to 65°F during the summer. Temperature extremes have been recorded from -65 to 92°F. Snowfall averages 80 inches and precipitation is 16 inches total per year. The Kobuk River is ice free from early July to mid-October (DCCED 2008).

Ambler has a slightly decreasing population, current at about 277 residents, compared to 309 in 2000 and 311 in 1990. Subsistence is a major part of the local economy. Cash employment is limited to the school, city, clinic, and local stores, and some mining occurs. Five residents hold commercial fishing permits. Sale of native crafts also provides some income (DCCED 2008).

Ambler's major means of transportation are by barge, plane, small boat and snow machine. There are no roads linking the city to other parts of the state. A State-owned lighted gravel airstrip, with a two gravel crosswind airstrip, is 1-1/2 miles from the city (DCCED 2008).

Many barge operators reported they do not serve the upper Kobuk River communities, including Ambler because the water levels in the river are usually too shallow. Of the barges that do serve Amber, some said the access is difficult and the community can only be accessed approximately every other year.

The landing area at Amber is on the beach. There is a cliff that drops 30 to 40-feet down to the beach and then a low lying gradual beach to the water. The landing areas flood each year. The fuel barge landing is downriver, near a marine fuel header. Mooring points would facilitate holding position and fuel offloading at this location.

The freight landing area is at the upriver end of the community, between Franklin Street and Brooks Street (on community map), and equipment is staged as high up on the beach as possible. Mooring points and a dry dedicated staging area at the upriver landing site would facilitate the barge landing and offloading operations. There is a gravel pit nearby and a road that runs from the airport runway to the gravel pit. One construction barge operator noted the gravel source contains natural asbestos and is no longer used.

6.12.4 Shungnak

Shungnak is on the west bank of the Kobuk River about 150 miles east of Kotzebue. The community is in the transitional climate zone. Temperatures average -10 to 15°F during winter and 40 to 65°F during summer. Temperature extremes have been recorded from -60 to 90°F. Snowfall averages 80 inches with 16 inches of total precipitation per year. The Kobuk River is ice free from the end of May to mid-October (DCCED 2008).

The population of Shungnak is currently about 260, a slight increase from 256 in 2000 and 223 in 1990. Shungnak subsists mainly on fishing, seasonal employment, hunting and trapping. Most full-time employment is with the school district, city, Maniilaq Association, two stores and a lodge. BLM provides seasonal employment in firefighting, hiring over 30 residents each year. The sale of arts and crafts also provides income (DCCED 2008).

Shungnak is accessible by plane, small boat or barge. There is a State-owned lighted gravel runway (DCCED 2008).

Due to the shallow river conditions, barge access to Shungnak is difficult and barge operators indicate that they never know if they will be able to get to the community and estimate that they are able to reach Shungnak approximately every other year.

There is a 70-foot cliff along much of the shoreline of the community, except at the barge landing areas, where there is an elevated bench and a10-foot bank that drops down to the beach and then a low lying gradual beach to the water. The landing areas are on this bench, which floods each year. At the upriver end of this bench, there is a marine fuel header, which marks the primary barge landing area. There is another barge landing at the downriver end of the community, where there is a gravel causeway/ramp that extends out into the river. This area has a sand bar in front of it, and can only be accessed during very high water periods. Barge operators indicate that mooring posts and a dedicated staging area are needed in this community.

6.12.5 Kobuk

Kobuk is on the right bank of the Kobuk River, about 7 miles northeast of Shungnak and 128 air miles northeast of Kotzebue. Kobuk is in the transitional climate zone. Temperatures average -10 to 15°F during winter and 40 to 65°F during summer. Temperature extremes have been recorded from -68 to 90°F. Snowfall averages 56 inches with 17 inches of total precipitation per year. The Kobuk River is ice free from the end of May through October. Ice jams on the river cause high water and flooding each year (DCCED 2008).

The current population of Kobuk is about 135, an increase from 109 in 2000 and 69 in 1990. The economy of Kobuk is based on subsistence. Cash employment is limited to the school, city and Maniilaq clinic. Seasonal construction and BLM firefighting provide some income (DCCED 2008).

Kobuk Valley Electric Co-op purchases power from AVEC over the Kobuk-Shungnak intertie. Kobuk's major means of transportation are barge, plane, small boat and snowmachine. A State-owned lighted gravel airstrip is served by scheduled air carriers. Floatplanes land on the Kobuk River. Barges deliver fuel and supplies during the spring or fall when high water stages occur (DCCED 2008).

Barge operators indicate that access to Kobuk is very shallow and only accessible during above average water levels in the river, using shallow draft lightering vessels. Construction contractors interviewed reported access to Kobuk is often too shallow for their barges and they can only get in to Kobuk approximately every 5 years.

The primary barge landing area is on the upriver end of the community, where the airport road comes into town. Another landing area is on the wide beach, about 1,000 feet downriver of the main landing site. These landing sites are in decent condition, according to barge operators. The upriver landing site could be widened somewhat and mooring points are needed. Construction of a dedicated staging area would facilitate offloading of equipment and supplies. This would be especially important if a large construction project were planned in Kobuk. Land suitable for this purpose may be available in the upland area adjacent to the upriver landing site.

6.13 Aleutians Region

The Aleutians Region for the purposes of this study includes the southwestern portion of the Alaska Peninsula, south and west from Pilot Point and including the Aleutian Islands chain. This region separates Bristol Bay and the Bering Sea on the north from the Gulf of Alaska and the Pacific Ocean to the south.

The Alaska Peninsula extends from mainland Alaska south toward the Aleutian Islands. The Aleutian Islands are a chain of rocky volcanic islands stretching about 1,200 miles into the Pacific Ocean from the end of the Alaska Peninsula. The islands consist of a partially submerged continuation of the Aleutian Mountain Range and are distinguished by volcanic peaks and valleys, and rock and gravel beaches. Upland areas are mostly treeless with vegetation consisting mainly of grasses, bushes, and sedges. Navigation in the Aleutians is made difficult due to limited safe harbors and numerous offshore reefs.

Included in this study are the communities of Pilot Point, Chignik Lagoon and Chignik Lake on the Alaska Peninsula and Akutan and Atka on the Aleutian Islands. Figure 6.13.1 depicts the Aleutian Region and the location of these communities.

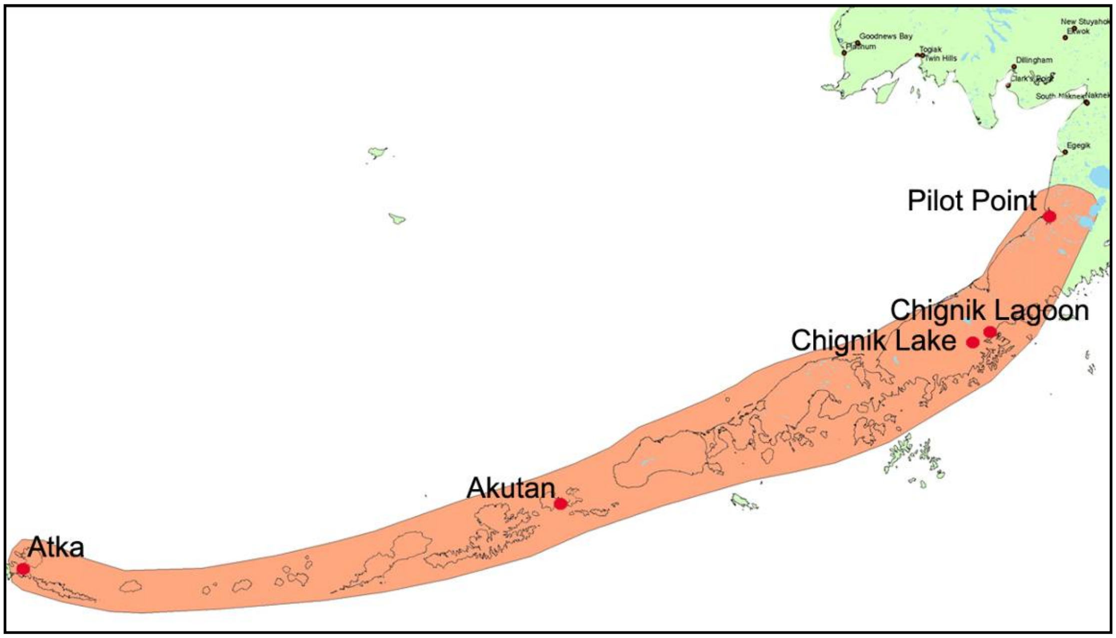

Figure 6.13.1: Aleutians Region Map.

6.13.1 Atka

Atka is on Atka Island, 1,200 air miles southwest from Anchorage and 350 miles west of Unalaska. Atka lies in the maritime climate zone. Temperatures range from 20 to 60°F. Precipitation averages 60 inches per year and snowfall averages 61 inches per year. There are frequent winds and severe storms in the winter and calm, foggy weather in summer (DCCED 2008).

The current population of Atka is about 73, compared to 92 in 2000 and 73 in 1990. The economy is primarily based on subsistence living and wages earned from the halibut fishery. A small local fish processing plant, Atka Pride Seafoods, operates seasonally to serve the local fleet. Nine residents hold commercial fishing permits. A number of offshore fish processors carry out crew changes through Atka. Year-round income opportunities in the village are limited to education and government related work (DCCED 2008).

Atka has a State-owned lighted asphalt runway. Barges deliver fuel and freight between May and October. A dock and port facility, operated by the city, is located 5 miles from town (DCCED 2008).

Barge operators who were interviewed stated access to Atka is very weather dependant, due to the prevalent high winds, open seas and fog. Once there, fuel barges can work the beach at any stage of the tide or freight barges use the existing dock for mooring and offloading their cargo. They report that the existing facilities are in good condition, and there are no recommendations for improvements for the purposes of this study.

6.13.2 Akutan

Akutan is on Akutan Island in the eastern Aleutians, one of the Krenitzin Islands of the Fox Island group. It is 35 miles east of Unalaska and 766 miles southwest of Anchorage. Akutan is in the maritime climate zone with mild winters and cool summers. Mean temperatures range from 22 to 55°F. Annual precipitation averages 28 inches. High winds and storms are frequent in winter and fog is common in summer (DCCED 2008).

The current census population for Akutan is 741, compared to 713 in 2000 and 589 in 1990. Approximately 75 persons are considered permanent residents; the majority of the population is transient fish processing workers that live in group quarters. Commercial fish processing dominates Akutan's cash economy and many locals are seasonally employed. Trident Seafoods operates a large processing plant west of the city. Seven residents hold commercial fishing permits (DCCED 2008).

Boats and amphibious aircraft are the only means of transportation into Akutan. Akutan has no airstrip due to the steep terrain; however, a seaplane base is available and open to the public. Daily air service is provided from nearby Unalaska. High waves may limit accessibility during winter months. The State ferry operates from Kodiak bi-monthly between May and October. A 200-foot dock and a small boat mooring basin are available. Plans are underway to develop a large boat harbor. Cargo is delivered weekly by freighter from Seattle and the city owns and operates a landing craft (DCCED 2008).

The existing dock at Akutan is shown in the aerial photograph in Figure 6.13.2. Barge operators who were interviewed reported the existing dock at Akutan is in good condition and is sufficient to meet their landing and offloading requirements. For this reason, no barge landing improvements are recommended for the purposes of this study.

Figure 6.13.2: Aerial view of the Akutan dock (©Google Earth).

6.13.3 Chignik Lagoon

Chignik Lagoon is on the south shore of the Alaska Peninsula, 450 miles southwest of Anchorage. It lies 180 air miles south of King Salmon, 8.5 miles west of Chignik and 16 miles east of Chignik Lake. The community experiences a maritime climate, characterized by cool summers and relatively warm, wet winters. Thick cloud cover and heavy winds are prevalent during winter months. Summer temperatures range from 39 to 60°F. Winter temperatures range from 21 to 36°F. Precipitation averages 127 inches annually with an average annual snowfall of 58 inches (DCCED 2008).

The population of Chignik Lagoon is currently about 70 residents, compared to 103 people in 2000 and 53 people in 1990. Fishing is the mainstay of the economy in Chignik Lagoon, and the area serves as a regional fishing center. The economy is dependent on the success of the salmon fleet. Twenty-nine residents hold commercial fishing permits. Two on-shore processors operate out of nearby Chignik. The primary year-round employers are the village council, electric plant and school. Subsistence activities contribute to food sources (DCCED 2008).

Chignik Lagoon is accessible by air and sea. There are no roads connecting it to other communities. There is a strong regional interest in constructing roads between Chignik, Chignik Lagoon, Chignik Lake and the landfill. There is a State-maintained gravel airstrip and public small boat harbor and seaplane base. A cargo ship brings supplies annually, and goods are lightered to shore (DCCED 2008).

Access to the community by barge is via the south shore of the lagoon and is tide-dependant. The fuel barge landing site at Chignik Lagoon is on the beach in front of the centralized tank farm. Freight barge operators indicate that they access this area approximately every 2 to 3 weeks to service the fish processing plants. The annual cargo delivery is by a large barge and goods are lightered to shore.

The beach in front of the community area is rocky. Barge operators report the landing facilities at Chignik Lagoon are sufficient for the volume of goods delivered. Additionally, the community plans to develop a road to the nearby community of Chignik, which would provide access to the docking facilities available in Chignik. For these reasons, this site is not considered a priority for the type of improvements covered by this study.

6.13.4 Chignik Lake

Chignik Lake is on the south side of the Alaska Peninsula next to the body of water of the same name. It lies 13 miles from Chignik, and 265 miles southwest of Kodiak. The maritime climate of Chignik Lake is characterized by cool summers and relatively warm, rainy winters. Summer temperatures range from 39 to 60°F. Winter temperatures range from 21 to 50°F. Extreme temperatures, ranging from a low of -12 to a high of 76°F, have been recorded. Precipitation averages 127 inches annually with an average annual snowfall of 58 inches (DCCED 2008).

The population of Chignik Lake is currently about 120, compared to 145 people in 2000 and 133 in 1990. Fishing is the mainstay of Chignik Lake's economy. Some residents leave the community during summer months to commercial fish or work at the fish processors at Chignik. Eight residents hold commercial fishing permits. The people depend heavily on subsistence hunting and fishing (DCCED 2008).

Chignik Lake is primarily accessible by air. There is a State-owned gravel airstrip and seaplanes may land at Chignik Lagoon. Goods are lightered to Chignik Lake via Chignik Lagoon, weekly during the summer and monthly during winter, and transported over land. The State ferry provides service to Chignik Lagoon four times per year. There is no harbor, dock, barge access or boat haul-outs. There is a strong regional interest in constructing roads between Chignik, Chignik Lagoon and Chignik Lake (DCCED 2008).

Access to the community by boat is via Chignik Lagoon and the Chignik River. The river leading to the community is very shallow. The fuel barge operators who were interviewed stated fuel is flown into this community. Freight is lightered to the community from Chignik Lagoon to Chignik Lake.

The community's plan to develop a road to the nearby community of Chignik would provide access to the docking facilities available there. This is believed to be the most economical long-term solution to the high cost of delivering fuel and supplies to this community. For this reason, this site is not considered a priority for the type of improvements covered by this study.

6.13.5 Pilot Point

Pilot Point is on the northern coast of the Alaska Peninsula, on the east shore of Ugashik Bay. The community lies 84 air miles south of King Salmon and 368 air miles southwest of Anchorage. Pilot Point's maritime climate is characterized by cool, humid and windy weather. Average summer temperatures range from 41 to 60°F; average winter temperatures range from 20 to 37°F. Low cloud cover and fog frequently limit travel. Precipitation averages 19 inches per year with 38 inches of snowfall (DCCED 2008).

The population of Pilot Point is currently estimated at about 66 residents. The residents depend upon commercial fishing for the majority of their cash income. Twenty-one residents hold commercial fishing permits. Up to 700 commercial boats fish in the district. Subsistence is an important part of the community lifestyle, and trapping is a source of income during the off-season (DCCED 2008).

Pilot Point is accessible by air and water. A State-owned gravel airstrip is available. There is a second gravel airstrip 10 miles southeast at Ugashik, owned by BLM. There is an existing local gravel pit in Pilot Point. Barge service is provided from Seattle in the spring and fall, and barges are chartered from Naknek. Dago Creek serves as a natural harbor; a dock is available (DCCED 2008).

Barge access to the community is via the beach on Ugashik Bay. There is a sand bar at the entrance to the river that can present a challenge; although experienced operators are familiar with it and are able to navigate it.

Fuel barge operators stated that there is one stop at Pilot Point to fill the tank farm. They indicated access to the landing site there is at high tide only, and they push the barge onto the beach while offloading the fuel delivery. The beach is wide and consists of sand and gravel, with no known hazards and is considered good for barge landing. This requires a 24 hour stop at Pilot Point.

A project is underway to provide a new centralized tank farm. It is recommended for this project to include a marine fuel header and two mooring points to facilitate barge tie-up at the new header. Drawing E34 in Appendix E depicts the approximate layout for the proposed mooring points.

6.14 Cook Inlet Region

The Cook Inlet Region, for the purposes of this study, includes Cook Inlet and Kachemak Bay including the community of Tyonek in the northwest and Port Graham in the south.

The Cook Inlet water body is a large estuary stretching 180 miles from the Gulf of Alaska, north to Anchorage—the largest city in Alaska. It separates the Kenai

Peninsula from mainland Alaska and branches into the Knik Arm and Turnagain Arm at its northern end, almost surrounding Anchorage. Most of the region is forested up to tree line.

Cook Inlet provides navigable access to the Port of Anchorage at the northern end. The Cook Inlet region includes the most densely populated part of Alaska with almost 400,000 people living within the Cook Inlet watershed. Many of the communities located on the eastern side of the inlet are connected by road.

Figure 6.14.1 depicts the communities included in this study which are in the Cook Inlet region.

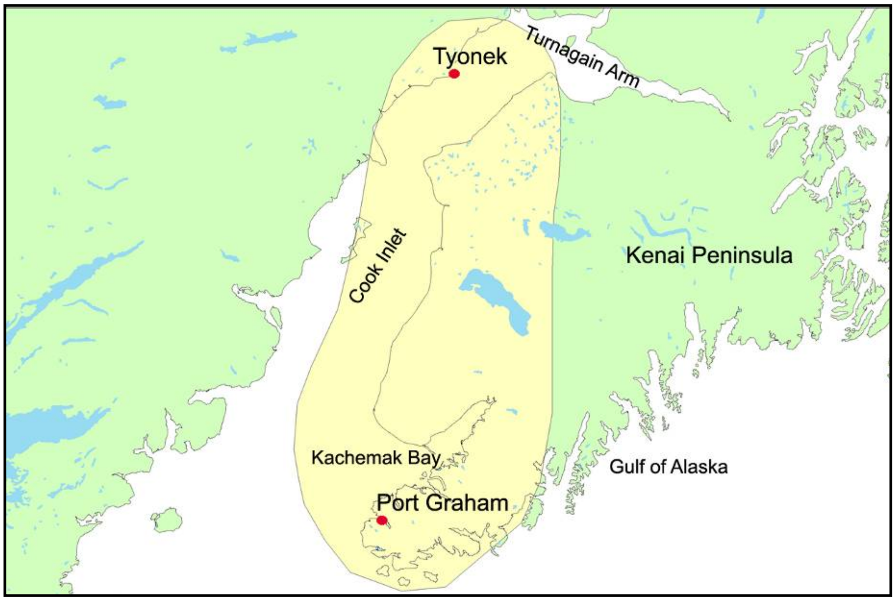

Figure 6.14.1: Cook Inlet Region Map.

6.14.1 Tyonek

Tyonek lies on a bluff on the northwest shore of Cook Inlet, 43 miles southwest of Anchorage. Winter temperatures range from 4 to 22°F; summer temperatures average 46 to 65°F. Recorded temperature extremes are -27 to 91°F. Average annual precipitation is 23 inches, including 82 inches of snow (DCCED 2008).

The current population of Tyonek is 199, up from 193 in 2000 and 154 in 1990. Tyonek residents practice a subsistence lifestyle. Twenty residents hold commercial fishing permits. Tyonek offers recreational fishing and hunting guide services. Some residents trap during winter. The North Foreland Port Facility at Tyonek is a site for export of Beluga coal (DCCED 2008).

The community is not accessible by road. There is a local gravel airstrip, owned by the Village of Tyonek. A State-owned gravel airstrip is available at Nikolai Creek. A local road connects to nearby Beluga. Barges deliver heavy goods to the community (DCCED 2008). The North Foreland Dock, located near the community, is available for public use (Figure 6.14.2).

Barge access to the community is weather and tide dependant. The freight barge operators who were interviewed stated they did not regularly service Tyonek, although they have landed there in the past to support projects (i.e., timber loads).

Power is provided by Chugach Electric Association, via a natural gas powered plant in nearby Beluga. The only bulk fuel in the community is a 4,000 gallon capacity tank owned by the village council. Therefore, fuel barge deliveries are less frequent and less essential than in other rural communities. For this reason, and because the existing dock facility is available, landing improvements at Tyonek are not recommended for the purposes of this study.

Figure 6.14.2: The North Foreland Dock near Tyonek.

6.14.2 Port Graham

The community is at the southern end of the Kenai Peninsula on the shore of Port Graham. It is adjacent to Nanwalek, which is accessible by a 4 mile trail. It is 7.5 miles southwest of Seldovia and 28 air miles from Homer. Winter temperatures range from 14 to 27°F; summer temperatures vary from 45 to 65°F. Average annual precipitation is 24 inches (DCCED 2008).

The current population of Port Graham is about 136, a decrease from 171 in 2000 and 166 in 1990. Port Graham residents primarily practice a fishing and subsistence lifestyle. A fish cannery and hatchery opened in 1999. The cannery provides seasonal employment for 70 Port Graham and Nanwalek residents. Red salmon fry are raised for area lakes, and pink salmon are raised for the cannery. Twelve residents hold commercial fishing permits (DCCED 2008).

Homer Electric Association provides power to Port Graham. Port Graham is not accessible by road; however, a State-owned gravel airstrip is available. The community also has existing docking facilities (DCCED 2008).

An aerial view of the existing docking facilities at Port Graham is shown in Figure 6.14.3, below. Barge operators reported the existing docking facilities are sufficient for their purposes and no recommendations for improvement were made.

Figure 6.14.3: Aerial view of the docking facilities at Port Graham (©Google).

A summary of the recommended barge landing improvements for each of the communities included in this study is shown in Table 6.1, below.

Table 6.1: Alaska Barge Landing Design Study, Recommended Improvements

Region	Community	Dead -men	Staging Area	Dock	Ramp	Dredging or Rock Removal	Co-locate Fuel Header or Tanks[1]	Other[2]
Chukchi Sea/ Beaufort Sea	Barrow	--	--	X	--	--	--	--
	Kaktovik	X	--	--	--	--	--	--
	Point Hope	--	--	--	--	--	--	--
	Point Lay	--	--	--	--	X	--	--
	Wainwright	--	--	--	--	--	X	--
Norton Sound / Bering Sea	Brevig Mission	X	--	--	--	--	--	--
	Diomede	--	--	--	--	--	--	--
	Elim	X	--	X	X	--	--	X
	Gambell	--	--	--	X	--	--	X
	Golovin	X	--	X	--	--	--	--
	Koyuk	X	X	--	X	--	--	X
	Nome	--	--	--	--	--	--	X
	Savoonga	X	--	X	X	--	--	--
	Shaktoolik	--	--	--	--	--	--	--
	Shishmaref	--	--	--	--	--	--	--
	St. Michael	--	--	--	--	--	X	--
	Stebbins	--	--	X	--	X	X	--
	Teller	X	--	--	--	--	X	--
	Unalakleet	X	--	X	--	--	--	--
	Wales	--	--	--	--	--	X	--
	White Mountain	X	--	--	--	--	--	X
Lower Yukon River Delta	Alakanuk	X	--	--	X	--	X	--
	Anvik	X	--	--	X	--	--	X
	Emmonak	X	X	X	X	--	--	--
	Grayling	X	--	--	--	--	--	--
	Holy Cross	X	X	--	--	--	--	--

Region	Community	Dead -men	Staging Area	Dock	Ramp	Dredging or Rock Removal	Co-locate Fuel Header or Tanks[1]	Other[2]
	Kotlik	X	X	X	X	--	--	--
	Marshall	X	X	--	X	--	X	--
	Mountain Village	X	X	--	X	--	--	--
	Nunam Iqua (Sheldon Pt)	X	--	--	--	--	--	X
	Pilot Station	X	--	--	X	--	--	X
	Pitkas Point	X	--	--	--	--	--	X
	Russian Mission	X	X	--	X	--	X	X
	Saint Mary's	X	--	--	--	X	--	X
	Shageluk	X	X	--	X	--	X	X
Middle Yukon River	Galena	X	--	--	--	--	--	X
	Kaltag	X	--	--	X	--	--	--
	Koyukuk	--	--	--	--	--	--	--
	Nulato	X	--	--	--	--	X	--
	Ruby	X	--	--	X	--	--	--
	Tanana	X	--	--	--	--	X	--
Upper Yukon River	Beaver	X	--	--	X	--	--	--
	Circle	--	--	--	--	--	--	--
	Eagle	--	--	--	--	--	--	--
	Eagle Village	--	--	--	--	--	--	--
	Fort Yukon	X	--	--	--	--	X	--
	Stevens Village	X	--	--	--	--	--	--
Kuskokwim River Delta	Chefornak	--	--	--	X	X	--	X
	Chevak	X	--	--	--	--	X	X
	Goodnews Bay	X	X	--	--	X	X	--
	Hooper Bay	--	--	--	--	--	X	X
	Kipnuk	X	X	X	X	--	--	--
	Kongiganak	X	X	X	X	X	X	X
	Kwigillingok	X	X	--	--	--	X	X
	Mekoryuk	--	X	--	--	X	X	--
	Newtok	--	--	--	--	--	--	--
	Nightmute	--	X	--	--	X	X	--
	Platinum	--	--	X	--	X	X	--
	Quinhagak (Kwinhagak)	--	--	X	--	X	X	--
	Scammon Bay	X	X	--	--	--	X	--
	Toksook Bay	--	--	--	X	X	X	--
	Tununak	X	X	--	X	X	--	X
Lower Kuskokwim River	Akiachak	X	--	--	--	--	X	--
	Akiak	X	X	--	--	--	X	--
	Bethel	--	--	--	--	--	--	--
	Eek	X	X	--	X	--	X	--
	Kasigluk	X	X	--	X	--	--	--
	Kwethluk	--	X	X	X	--	X	--
	Napakiak	--	X	X	X	--	--	X
	Napaskiak	X	X	--	X	X	--	--
	Nunapitchuk	--	X	--	X	--	--	X

Region	Community	Dead -men	Staging Area	Dock	Ramp	Dredging or Rock Removal	Co-locate Fuel Header or Tanks[1]	Other[2]
	Oscarville	--	--	--	X	--	--	--
	Tuluksak	--	X	--	--	--	--	--
	Tuntutuliak	X	--	X	--	--	X	--
Middle Kuskokwim River	Aniak	X	X	X	--	--	--	--
	Chuathbaluk	X	X	--	X	--	--	--
	Crooked Creek	X	X	--	--	--	X	--
	Lower Kalskag	X	--	--	--	--	--	--
	Napaimute	--	--	--	--	--	--	--
	Red Devil	--	X	--	--	--	--	--
	Sleetmute	--	X	--	--	--	--	--
	Stony River	--	--	--	--	--	--	--
	Upper Kalskag	X	--	--	--	--	--	--
Upper Kusko-kwim River	McGrath	X	--	--	X	--	--	--
	Nikolai	--	--	--	--	--	--	--
Bristol Bay	Clark's Point	--	--	--	--	--	--	--
	Dillingham	--	--	--	--	--	--	--
	Egegik	X	--	--	--	--	--	X
	Ekwok	--	--	--	X	--	--	X
	Naknek	--	--	X	--	X	--	X
	New Stuyahok	--	X	--	X	--	--	--
	S. Naknek	--	--	--	--	--	--	X
	Togiak	X	--	--	--	--	--	--
	Twin Hills	X	X	--	--	--	X	--
Kotzebue Sound	Buckland	X	X	--	X	--	--	--
	Deering	--	X	--	X	--	--	X
	Kivalina	--	--	--	--	--	--	--
	Kotzebue	--	--	--	--	X	--	--
	Selawik	--	X	--	--	--	--	X
Kobuk River	Ambler	X	X	--	--	--	--	--
	Kiana	X	X	--	--	--	--	X
	Kobuk	X	X	--	--	--	--	X
	Noorvik	X	X	--	X	--	X	--
	Shungnak	X	X	--	--	--	--	--
Aleutians	Akutan	--	--	--	--	--	--	--
	Atka	--	--	--	--	--	--	--
	Chignik Lagoon	--	--	--	--	--	--	X
	Chignik Lake	--	--	--	--	--	--	X
	Pilot Point	X	--	--	--	--	X	--
Cook Inlet	Port Graham	--	--	--	--	--	--	--
	Tyonek	--	--	--	--	--	--	--

[1] Providing fuel headers, relocating fuel headers or fuel tanks is not included in the Denali Commission Funding program associated with this study. This is included for general information only. It is not included in the scoring for this report.
[2] Other: This generally consists of building new roads, breakwater structures, providing gravel for maintenance or improving the existing landing area, or other maintenance of existing facilities.

7.0 BARGE LANDING IMPROVEMENTS – DESIGN CONSIDERATIONS

The purpose of this study is to develop “standard” conceptual designs for barge facilities to serve remote communities along major river systems and coastal communities in western Alaska. Because these designs must serve communities with diverse conditions, they are conservative in terms of the structural approach and address poor soil conditions (weak soils), erosion, ice loads, over topping by floods, permafrost conditions, ease of construction and maintenance. The designs presented are intended to be as simple as practical and require the use of basic construction tools and equipment. Most public works should be designed for a useful life of 30 to 50 years. These standards were considered when developing the design concepts for this report.

The landing site improvement design that is applicable to a site will vary from the concept designs provided in this report, depending on the specific conditions present at the site. These may include a number of environmental conditions that must be understood and designed around accordingly. These include:

- Soils
- Permafrost
- Variable water levels, existing elevations, and flooding
- Ice
- Availability of gravel and other construction materials
- Seismic
- Scour and stream bank stability
- Corrosion

Each of these will be further discussed in the following subsections.

7.1 Soils

The soils in many areas included in this study are often fine-grained and weak, and in some cases include permafrost. The soils in some of the broad delta regions are primarily alluvial silts. These conditions complicate foundation design and erosion problems. Due to their relatively low internal friction angles, fine grained soils can increase the loads on earth retaining structures like sheetpile bulkheads. These soils are typically not suitable for structural backfill and are prone to erosion and slope stability problems. Many structures in these areas will require imported structural fill and armor protection for the slopes.

Soils in the upper river areas and coastal areas may include more stable sand and gravels. In addition, coastal areas outside of the river delta regions are generally rocky. The more northern coastal areas also include more beach gravels, ice-laden soils, organics, and exposed/melting permafrost at the beach. Construction cost-savings may be realized and construction claims mitigated if more information is gathered about site-specific soil conditions prior to final design of a new barge landing facility.

7.2 Permafrost

Permafrost may be an issue at some sites. In recent years, there has been a measurable increase in permafrost temperatures throughout Alaska. Coastal areas in the northern regions tend to have ice-rich, fine-grained soils that are exposed at the shoreline, and wave action can increase thawing and subsequent erosion. Most rivers in permafrost areas have a thaw bulb associated with them. This is typically a semi circular area around the river corridor where the soils are thawed by the comparatively warmer water temperatures. In some cases, an equilibrium condition is reached between the frozen soils, the thaw bulb, and the river channel. Construction activities at the edge of the channel (such as constructing an earth filled bulkhead, placing a gravel pad, or building an access road) can upset this equilibrium and result in increased thawing. This is particularly true if the insulating vegetation is striped away. Because many of the permafrost areas have frozen fine grained soils, thawing them can result in a bog like area of wet, very weak soils. This can quickly lead to erosion and stream bank stability issues. Also, in frost-susceptible soils, foundation and structures placed in permafrost areas may need to address frost jacking concerns. An assessment of permafrost conditions was completed as part of this study, for the Priority Sites. The results are presented in a report, Permafrost Assessment and Preliminary Geotechnical Review, provided in Appendix C.

Accordingly, designs involving permafrost foundations, or designs that could thermally alter the permafrost regime, must account for potential problems. Site specific geotechnical investigations should be conducted for all new structural improvements. Borings must extend deep enough to verify the presence, or absence, of permafrost and the thermal impact of new structures must be carefully evaluated. The use of insulation under new fills and the installation of thermal siphon piles may be appropriate in some circumstances.

Also, it is important to consider the effects of freezing on any backfill. Some fine grained soils are frost susceptible and prone to heave when frozen. These could place very large loads on sheetpile walls or other structures. Consequently non-frost susceptible (NFS) granular fill is preferred to prevent this problem. Additional engineering considerations recommended for permafrost areas are provided in the Permafrost Assessment and Preliminary Geotechnical Review provided in Appendix C.

7.3 Variable Water Levels, Existing Elevations, and Flooding

Many of the landing sites are subject to large seasonable variations in water levels. In some areas there could be spring flooding, followed by a comparatively short summer navigation season, followed by falling water levels in the fall and then freeze up. Sometimes there is a short spike in high water levels during typical fall rains.

This leads to a number of design considerations. First, it is important to set the deck height of the structure so that it is optimized for the normal navigational flow of the river. Next, consideration should be made for the height of any dock structure to be established from flood records so that its top is at least at the level of the anticipated high water during its design life. If this is not possible or practical, then the design must include protective features for potential extreme water levels and flooding. This includes erosion protection for the toe of the structures and for any fill behind it that may be impacted. The structural design must also include consideration of the hydraulic forces of saturated fill and foundation materials.

Finally, the location and elevation of ancillary equipment and structures (buildings and fuel headers for example) must take into consideration the local extreme water levels.

7.4 Ice

For communities on the rivers of Alaska, the upstream end of barge landing facilities may be subjected to heavy ice loads during spring break-up and possible erosion behind the upstream end of the structure, particularly where highly erosive soils exist. Accordingly, the lateral forces from ice must be considered and the designs should address erosion. Where possible the structures should be as close to the existing bank or shoreline as possible while meeting the draft requirements of the design vessels. For coastal sites, ice shove events need to be considered and designed for accordingly, or regular maintenance considered.

7.5 Availability of Gravel and Other Construction Materials

The local availability of gravel, armor rock and other materials will have some effect on the cost of construction. A site specific geotechnical evaluation prior to design should include researching the location and availability of local construction materials. In some areas it may be possible to mine suitable materials from the local pit sources or river/beach sources. In other areas it will have to be imported. In locations where gravel pits appear to be present on aerial photography, the ownership, quality or suitability of these sources for structural fill is not known.

7.6 Seismic

Many of the sites are in active seismic zones. Because the barge landings are important lifelines to the communities, it is important to include attention to the seismic performance of the structures in the design. The US Geological Survey (USGS) National Seismic Hazard Maps can be used to provide appropriate probability based peak ground accelerations for various return periods. Pile supported platform docks can be designed using seismic design procedures outlined in American Society of Civil Engineers standard 7-05 (ASCE, 2006). For earth filled structures the Mononobe Okabe method can be used to provide equivalent static lateral loads. More sophisticated design procedures are available. The level of seismic design included in a particular structure’s design depends on the level of risk that is acceptable in relation to the importance of a structure in a community. For the most part, barge landing facilities consisting of wharfs or docks at large hub communities may warrant some level of seismic design as opposed to simple barge landings and offloading areas at small destination/end communities.

7.7 Scour and Stream Bank Stability

The stream bank in the vicinity of the proposed facility should be evaluated for stability prior to final design. Historical records including surveys and aerial photographs can aid in this. Site surveys across the channel at the proposed site and upstream and downstream are required. This is important for design and to provide baseline for monitoring the stream bank during the life of the structure. A site visit to observe any possible active cut banks can also help to determine stability. It is important to note that the addition of a large structure into an otherwise stable river area may alter the flows and create an erosion problem where none previously existed. This is particularly true if the size of the structure is such that it constricts the normal flow, thereby increasing velocity along the face of the structure, or redirects the flow.

Bulkhead designs should consider erosion protection alternatives, including placement of armor rock. Barge operators have indicated that rocks bigger than about 8 inches are considered a hazard. (Any landing that requires large angular rock may not be useful and may become more of an obstacle for landing.)

Also, erosion at the toe of sheetpile bulkheads can increase the loads on walls and tie-back anchors (if used) and reduce global stability. A scour allowance should be included in the design of any structure along the riverbank.

7.8 Corrosion

Corrosion protection is particularly important for structures in or near saltwater or in tidally effected river areas. In theses areas it can be one of the most important considerations for design life and maintenance. Corrosion protection should be included in the design for any structure located in these areas. Consideration should be given to coatings, galvanizing, and active and passive anode systems.

7.9 Other Considerations: Siting of Docks and Ramps

The siting of docks and ramps must balance several factors including the local topography and bottom contours, tidal range (for coastal facilities), variations in river stage, and barge drafts and freeboard. The operational river stage must be established based on available hydrographs or local anecdotal information. The operational river stage will likely vary over the shipping season.

The percentage of time that a berth can be occupied by a given vessel may vary; 100 percent access is the goal but in some cases may not be practical. In coastal regions at extreme low tides near shore water depths may result in grounding unless dredging is possible. In these situations barges may have to hold off until the flood tide to access the dock. Extreme low tides that prevent a vessel from reaching a specific dock or ramp may occur over a relatively small percentage of the time. In cases where full tide access is required, modifying the ocean or river bottom through dredging may need to be considered.

The finish grade on docks will depend on several factors including the draft and freeboard of the barges they serve, the variations of water levels at the site and the local topography, including the bottom contours. The deck or wharf finish grade in coastal areas should be about 2 to 4 feet above the highest recorded tides. Some over topping during storm events may occur. Where possible, docks or wharfs in coastal areas should be located such that at the lowest tides, the deepest draft vessel can occupy the berth with 1 to 2 feet below the bottom of the hull. For example, at a -2 foot tide (-2 MLLW) and a 6-foot draft vessel, a bottom elevation of -10 feet is desired.

Rivers present other siting challenges because of the seasonal and historical nature of the flows. The important elevations for landing improvement design considerations are the water levels during the shipping season, which is referred to as the operational levels. In general, wharfs and docks should be set 2 to 4 feet above the highest operational water level. However, if the extreme water level is substantially above the highest operational level then over topping will occur, which may result in negative impacts to a wharf or dock. With rivers, extreme events may occur very infrequently; some damage or loss of service may be acceptable as a result of extreme events.

The shape of the river channel is also important. Where there are large variations in operational water level it may not be possible to provide access to a dock or wharf at the lowest elevations. This would occur in a situation where a wharf or dock has to be constructed at a considerable distance out into the river in order to provide sufficient depth of water at the lower water levels. Large variations in river stage may preclude the construction of wharfs.

At some sites overtopping of the sheets may periodically occur as a result of flooding. During spring break up this may be accompanied by ice. Some loss of fill from within the cells may occur as a result. Placing a layer of cobbles a foot or so below the top of the fill to mitigate the loss of material during flooding under these circumstances may be prudent.

Some form of fenders should be provided along the outer face of the bulkhead to protect the wharf and the vessels. This can be as simple as used heavy equipment tires chained to the face, or commercial pneumatic or foam-filled cushions. Fenders should be removed at the end of each season to avoid loss or damage from winter ice or from ice during spring breakup.

Bollards or other type of fixtures are needed to moor vessels. Where soil properties permit, this may be as simple as driving a pipe pile to depth, cutting it off above finish grade, capping it and installing a cross-arm to form a bollard. In other situations deadmen-type anchors may be required. Deadmen can be created using navy anchors, pre-cast concrete blocks or anchor piles.

8.0 BARGE LANDING IMPROVEMENTS – CONCEPT DESIGN OPTIONS

To accommodate the type of barge operations typical of these Alaska regions, barge operators suggested a number of various improvements that could be made including:

- Mooring points
- Staging areas
- Ramps
- Docks

The following concept designs were considered as practical options for barge landing improvements at the communities included in this study. A selection of these has been identified as the best options for the landing sites included in this study. Concept designs have been developed for the recommended improvements and are illustrated in the drawings included as Appendix D.

8.1 Mooring Points

The barge landing improvement that was most widely requested by barge operators is buried mooring points to facilitate tying off of barges or landing craft and holding position during offloading. At least one mooring point is needed upstream of each landing site, although another downstream mooring point may also be helpful. At sites with strong currents at the landing site, two upstream mooring points are desired. Mooring points are primarily needed at communities with dedicated landing sites and consistent currents. The strength and location of the mooring points at the landing site will be a function of the size and draft of the vessels, the local currents and the orientation of the vessel when moored. There are several common methods for accomplishing this including:

- Concrete Deadmen
- Gravity Anchors
- Stake Piles
- Battered Piling
- Navy Anchors
- Bollards

Mooring points should be set back from the edge of riverbanks in areas that are easily accessible, yet away from areas of frequent inundation and high erosion. In general, barge operators would like buried mooring points, rather than piles or posts that stick up above the ground surface or river thus creating hazards for four-wheelers and snow machines. All of the mooring options described herein may be buried.

Mooring points currently used by barge operators in this region consist of a buried deadman anchor (anything from cars/scrap metal to creosote poles) and wire rope (cable) or chain. The deadmen are frequently located onshore, about 125 to 150 feet upstream of the midpoint of the landing. Two upstream mooring points are desired in locations where the current is strong. The second upstream mooring point may be placed somewhat closer—about 100 to 125-feet upstream of the landing. Additionally, one downstream mooring point located 75 to 125-feet downstream of the landing would be helpful; although at most locations downstream mooring points are not considered a priority by the barge operators. The configuration for coastal landings may be different, where site specific tidal fluctuations need to be considered prior to determining whether upland mooring points will be useful. Chains are more durable than wire rope, which tends to fray and corrode.

The following mooring point options are proposed for use at Alaska barge landings:

8.1.1 Concrete Deadmen

Precast concrete elements can be used as deadmen. Depending on the mooring loads and the local soil conditions imported fill may have to be placed and compacted in front of the deadmen in order to develop the required resistance. This is illustrated as Details 2 and 3 on Drawing 1 in Appendix D.

8.1.2 Gravity Anchors

Gravity anchors should also be constructed of precast concrete. These use the deadweight of the concrete block as well as the frictional resistance of the soil backfill to resist pullout. They are more massive than the deadmen; and because they rely on the sliding resistance of the block against the soil, the bottom of the block should be roughened. Additionally, a course high-friction angle, well-compacted granular (non-frost susceptible [NSF]) soil is recommended. Gravity anchors are shown as Detail 1 on Drawing 1 in Appendix D.

8.1.3 Navy Anchors

Navy anchors are identical to anchors used by boats when being moored to the ocean floor. They come in many sizes depending on the required resistance. The resistance that a given anchor can develop depends on the soil conditions and the angle of the load. This type of anchor may be very cost-effective in most areas, however, it is not recommend for use in thaw-unstable permafrost areas, because the ice-rich frozen soils would not provide high resistance to pullout of the navy anchor if thawed. An example of a navy anchor is shown as Detail 4 on Drawing 1 in Appendix D.

8.1.4 Stake Piles

Stake piles are constructed by driving an H-pile into the soil and attaching the mooring line to the top of the pile. Resistance comes from bending in the pile and lateral soil pressure against the face of the pile. Frost jacking of stake piles may be a concern where thawed, fine-grained soils are present near a water source and the stake pile embedment depth must be designed to consider and resist these potential forces. A stake pile type mooring point is shown as Detail 5 on Drawing 1 in Appendix D.

8.1.5 Bollards

Bollards consisting of a pipe pile with a smaller diameter pipe cross-arm may be installed at key points along the face of the wharf. Pipe piles 20 to 24 inches by 0.50 inch wall with 6-inch diameter extra strong cross arms should be considered. Mooring bollards are typically used in conjunction with a dock or wharf. A typical detail for a bollard is shown on Drawing 5 in Appendix D.

The type of mooring used at a specific site is a designer preference influenced by the magnitude of the loads and local soil conditions. For example, where local soils consist of relatively dense, well-graded, sand-gravel mixes burying a navy anchor may be the least costly solution. In other cases, stake piles or concrete deadmen may be required. If there are no other piling on a project it will normally be less costly to use anchors or concrete deadmen, which do not require the use of a pile driver.

If shallow bedrock precludes the use of piles, concrete deadmen or gravity anchors, then rock anchors should be considered.

All of the mooring devices should include the necessary hardware and chains to place the connection point as close to the edge of the shoreline as practical. Anchors should be placed sufficiently back from the top of the bank to avoid erosion and to develop adequate passive soil pressure where required.

8.2 Staging Areas

Upland staging areas are needed to place full containers and bulk materials coming in and to stage empties prior to pickup. Sometimes, due to weather the operators cannot get back to a community before winter and the containers need to be staged until the following spring. Depending on the configuration and size of the site, frequency and volume of cargo delivered, the size of the pad needed at a landing site may vary from 10,000 to 40,000 square feet.

A storage pad consisting of about 2-feet thick gravel overlain by a 6-inch leveling course with drainage ditches is recommended. Up to 2-ft of settlement may be expected at some sites. This may be mitigated by placing filter fabric as a separator between the gravel fill and the subgrade. However, in areas where high rates of settlement are expected, it may be necessary to account for an additional thickness of gravel to ensure long-term stability.

In permafrost areas, it is recommended to install a layer of rigid board insulation that is suitable for direct burial to help reduce the rate of thawing expected. Note that insulation is not likely to prevent subgrade thaw in areas of warm permafrost, but it will help significantly to reduce the rate of thaw. Where significant thaw settlement is expected, periodic re-grading of the gravel fill will likely be needed. Alternatively, thermo-siphons could be used to passively refrigerate the gravel pad and control thaw settlement.

Drawing 2 in Appendix D illustrates a typical staging area concept design. The size, layout, length of access road, thickness of gravel needed, etc. will vary depending on site-specific conditions.

8.3 Landing Ramps

For a number of sites a ramp is a preferred method for barges to land. This is a simple reliable method that typically involves the barge grounding along the bank and (for freight) a loader or other similar heavy equipment unit driving down a gravel or concrete ramp on shore and up a steel ramp on the barge. In order for this to work efficiently the slopes of the various ramps and the bottom must be within certain parameters. The river bottom in the landing area must have sufficient slope to allow the barge to ground in a position near the beach. If it is too shallow the barge may be too far from shore for practical loading operations. A level gravel fill slip, or causeway, may be incorporated at the landing end of a gravel ramp to extend the landing out to deeper water at very shallow locations. The shore side ramp is typically set at between 10 and 15 percent slope. There is typically a vertical curve at the top of this slope as opposed to a sharp angle grade break. This reduces the possibility of high centering the vehicle. The steel ramp on the barge should be set as close to level with the deck as possible.

In general, placement of a ramp is preferred on the inside bend (or aggradational bank) of a river where the natural bank is usually not as steep and the structure will be less susceptible to erosion and ice-forces.

8.3.1 Shore-Based Hinged Ramps

Except in southeastern Alaska, RO-RO ramps are not common in Alaska, because of higher initial costs, and the increased costs to maintain them. These structures generally consist of a steel bridge or ramp hinged at the shoreline. The ramp often consists of parallel steel box beams with integral floor beam and a steel grate deck. There are a variety of ways that the ramps are raised and lowered, including winches, pontoons or counter-weighted lifting beams, among others.

If this style is chosen for any of the Alaska communities, it is proposed that there will be a tower or support columns at the shoreline on which hinged, cantilevered lifting-beams are mounted. The lifting-beams will support the ramp at about two-thirds of the span; the lifting-beams will extend shoreward from the columns and be outfitted with counter-weights to reduce the force required to raise the ramp. In addition, it is proposed to bury deadmen under the counterweights for safety, to restrict the downward motion of the ramp and to stow it. The counterweights would be sized to lift 80 to 90 percent of the deadweight of the ramp. The lifting system needed for the balance of the load could consist of a simple chain-fall or powered winch or similar device. Assuming the maximum container length is 20 feet, the clear space between the support columns should be a minimum of 30 feet. Barge operators recommend 50 feet, where possible. The approach ramp, which is clear of tower structures, could be narrower. The clear height between the deck and any structure should be about 15 feet.

These types of ramps are not preferred for construction at barge landing sites in these more rural communities primarily due to the higher level of periodic maintenance required to upkeep the structure. For this reason, a concept design drawing has not been developed for this type of ramp.

8.3.2 Gravel Ramp

The gravel ramp essentially provides a firm surface on a cut, graded and sloped surface from the upland area to the landing site, which is provided with an armored gravel pad. The pad juts out into the water and would be at a sufficient height for the barge's landing ramp to be lowered onto it easily. A gravel ramp may often be used in conjunction with a gravel fill causeway, which is essentially a level fill structure that extends further out into the water in order to reach deeper water to allow barges to land. The gravel fill must be protected with armor rock at the water edge and extensive armor rock may be provided along the upstream and downstream beach to provide for erosion/ice protection of the ramp as well as adjacent affected areas. To alleviate the concern expressed by barge operators when landing at such structures where large armor rock (greater than 8-inches) is used, the design may incorporate a "soft" landing area, where smaller armor rock is used at the end of the causeway/ramp and larger armor rock is limited to the sides of the structure. Because some erosion is likely under this scenario, it is likely that annual maintenance/filling at the end of the ramp may be required. If this alternative is pursued, it is recommended that the community enter into a maintenance agreement prior to construction.

A detailed study of the currents, erosion and sediment transport must be conducted at each site prior to final design to determine ramp placement, and the size and extent of armor needed.

At sites where locating the barge landing site away from an active cut-bank of a river is not possible, a gravel ramp may be the most viable option. This type of structure is more easily repaired and maintained year to year if erosion and ice cause damage to the structure.

Also, at sites with suitable soil conditions and nearby gravel sources, a gravel ramp may be the most cost-effective solution. The local soils must be strong enough to support the heavy wheel loads form the loader, lifting a full 20-ft long container. This type of ramp may require annual grading and maintenance.

Drawing 3 in Appendix D illustrates the gravel landing ramp design option, which would likely be chosen for sites with suitable current and soil conditions, and where gravel and rock material is available nearby.

8.3.3 Concrete Plank Ramp

For sites where the native soils are generally poor, gravel or armor rock is not available locally, or where environmental conditions (i.e., current, erosion) call for a more robust structure, concrete plank ramps may be constructed. Also, at sites where existing soils are soft and a hard surface is needed for offloading freight across a beach to the upland area, concrete plank ramps will help alleviate this problem.

For this alternative, a ramp will be cut to a suitable slope based on the topography and soil conditions. A filter cloth (geotextile) will be placed on the prepared slope and topped with gravel. Filter fabric will be folded over the top of the gravel and pre-cast concrete planks placed on top of the fabric. To protect the fill from scour and undermining where conditions warrant it, armor rock will be placed and/or short sheet piles driven along the sides of the ramp. Both rock and sheetpile need to be carefully designed to minimize barge strikes or grounding. Drawing 4 in Appendix D illustrates this concrete plank landing ramp design option.

The geotextile fabric wrapped around the gravel and overlain by the concrete planks serves to hold the gravel material in place. The concrete planks also provide a firm surface for offloading freight with heavy equipment. The sheetpile holds the gravel and concrete planks in place at the end of the ramp without using large armor rock. This section of sheetpile should be provided with “hull protection” to provide a smooth surface on which barges can land. Drawing 4 shows a concrete cap on the sheetpile in this area, with a steel plate embedded in the concrete to provide a steel to steel contact surface for landing.

Alternate hull protection material such as timber or synthetic polyethylene materials could be considered if regular maintenance and replacement of this material is planned. Similarly, if annual maintenance is planned and there is a rock or gravel source nearby, the sheetpile/cap at the end of the ramp could be replaced with sacrificial gravel and small armor rock because it would be subject to erosion and ice-plucking.

A detailed study of the currents, erosion, and sediment transport must be conducted at each site prior to final design to determine ramp placement, and the size and extent of armor needed. Other design considerations for the concrete plank ramp option include ensuring pile penetration depths are designed for the site-specific conditions associated with geotechnical conditions, lateral forces of current and ice on the structure as well as scour, frost jacking, and settlement.

Settlement may be expected when structures are built on fine-grained thaw unstable soils as the underlying frozen soils thaw. Therefore, thaw-unstable soils, where they exist, could be excavated prior to gravel placement or excess thickness of gravel should be placed to allow for settlement.

8.3.4 Mats

Flexible load-distributing mats may be considered as an alternative to a ramp in locations were a stable surface is needed for offloading freight and site conditions prohibit the construction of one of the other options. These conditions may include the landing site varies from year to year, highly erosive sites, no gravel/armor rock readily available, low use/frequency of delivery, etc. Some barge operators have steel plates or crane mats on board which are installed by hand and/or loader upon arrival at sites with unstable offloading conditions.

There are several commercially available flexible load-distributing mat systems (e.g., Armortec™, Dura-Base®), which could be installed without heavy equipment. These could be purchased and stored at a dry covered storage area near the landing area, and re-installed by the community each season, or portable mat systems (i.e., synthetic mats or steel plates) could be stored and made accessible to barge operators upon arrival. In addition to purchasing the mats, this option would require construction of a storage shed and community commitment to install the mats each season and/or ensure security and provide access to the mats in storage.

8.4 Permanent Dock Structures

There are numerous options for construction of sheetpile wharfs, primarily including:

- Cantilevered retaining walls
- Tied-back sheet-pile walls
- Combination-walls (combi-wall)
- Cellular cofferdam sheet-pile structures, including:
    - circular cellular cofferdams
    - diaphragm cellular cofferdams
    - modified diaphragm cellular cofferdams
- Pile-supported dock

Each of these options along with variations is discussed in detail in the following sections.

8.4.1 Cantilever Retaining Walls

- **Gravity and Concrete Cantilever Retaining Walls**—A gravity retaining wall typically consists of a massive concrete wall. Typically the base will be similar in length to the height of the wall. They may be triangular in shape with the wide part of the triangle near the bottom. A cantilever wall is an L shaped structure often constructed of concrete.

  Both of these structures are typically designed so that the self weight and weight of the earth backfill acting down on the bottom of the L or base, combined with the friction force against sliding, provides a reaction sufficient to overcome and resist the horizontal force of the retained earth mass.

Both of these structures are suitable for low wall heights in areas of sound foundation soils and predictable environmental factors. This type of construction is not ideal for most of the sites in the study region because of the anticipated poor soil conditions and potential for scour and meandering stream beds. Also, the cost of construction involving pouring concrete in remote areas may be excessively high. For this reason, a concept design drawing has not been developed for this option.

- **Sheet-pile Bulkhead Cantilever Wall**—A cantilever sheetpile wall typically consists of Z sheets driven into the foundation soils with some engineered granular fill on the upland side. Cantilevered walls are a fairly simple type of structure. The sheets are more or less driven one after another in a straight line typically with a template. Simplicity of construction is one of the benefits of this system.

  Because they derive their strength solely from the sectional or beam properties of the sheets in the existing ground they are typically limited to heights of about 10 to 15 feet. These structures are sensitive to wall height and the loads increase with fine grained soils with low internal friction angles. These poor soils place comparatively large active earth pressures against the back face of the wall and, also, have comparatively low passive resisting pressures on the front face. Also, fine grain soils are often frost susceptible. This means they may expand when frozen. This is undesirable particularly in the backfill behind the wall where frozen expanding soils could cause excessive stress and deflections of the wall.

  Because it is anticipated that many of the sites in this study will have fine grain sands and silts and because of the potential for scour, it is recommended that these structures be limited to areas where the following conditions can be met:

  - The face of the wall (from the scour line to the top of the sheet) should be no higher than about 10 feet.
  - Some type of scour protection (for example 6 to 8-inch diameter rock) should be placed at the toe of the wall along its face.
  - Existing granular materials should have soil friction values of at least 30 degrees.
  - Granular engineered fill should be placed and compacted behind the wall.
  - Wing walls should be considered to protect against erosion around the backside of the wall.

Based on the prevalent conditions at the sites within this study area, a cantilevered wall would be limited to shallow draft sites with suitable soils. These conditions may be typical at some of the upper river regions (i.e., Upper Kuskokwim, Upper Yukon, and Kobuk River above Ambler), shallow water and existing granular soils may be suitable for this simple and cost-effective approach. A detailed study of site-specific conditions is necessary prior to final design to confirm whether the above conditions can be met at a particular site.

8.4.2 Sheetpile Bulkhead – Combination Wall

Combination-walls (combi-wall) are a special case of cantilevered walls that employ pipe or H-shapes in combination with Z-shaped sheets to achieve the required stiffness to control deflections and/or stress. Combi-walls are generally used where Z-sheets alone are incapable of resisting the loads due to the height of the wall in combination with surcharge loads. Conditions similar to those described for cantilevered walls must be present to use this concept, except a combi-wall concept could be considered when a wall height higher than 10-feet is needed.

8.4.3 Sheetpile Bulkhead – Tied Back Wall

Sheetpile bulkheads that employ tie-backs may use substantially less steel than cellular structures. These bulkheads rely on passive soil pressure against anchors or anchor walls and passive soil pressure against the toe of the sheets to resist the lateral soil pressure. Individual anchors often consist of cast-in-place or precast concrete blocks buried 30 to 40 feet (or more), behind the front wall. Discrete groups of sheetpiles may also be used as anchors. Alternatively, battered or cantilevered pipe or H-piles may be used to resist the tie-rod loads. The tie rods are typically spaced 8 to 12 feet on center and extend from the face of the bulkhead to the anchoring system. These walls are normally constructed of Z-sheets in order to resist bending stresses and reduce deflection. The soil in front of the anchors must be sufficiently strong to develop the needed passive soil pressure to resist the forces; this normally equates to a well-graded granular material with an internal friction angle of 30 degrees or greater.

Sheetpile structures are sensitive to soil conditions and erosion. Accordingly, these structures may require a more conservative design approach, particularly, tied-back bulkheads. The loads on the wall increase with finer grained soils with low internal friction values. Erosion at the toe of the sheets can be controlled through the use of rip-rap or other manmade products. Depth of placement is critical because rip-rap creates a hard-angular bottom condition, which may create grounding conditions if adequate space cannot be maintained or assured between the top of the rip-rap and the bottom of barges. Another consideration is many of the potential sites are in river deltas characterized by shallow, very fine-grained sands and silts with no practical sources of better fill material or rip-rap.

This dock design would include tie-backs to anchor the upper portion of the sheets. Threaded rod tie-backs would be anchored to either precast concrete anchor blocks, battered anchor piles or a sheet-pile anchor wall. A waler consisting of steel channels would be installed on the inboard face of the bulkhead for attaching the tie-back anchors in a way that minimizes projections on the outboard face that could damage barges. At some sites, external walers will be required with a timber facing to protect barges and other vessels. Some type of utilitarian fenders will be provided on the face all wharfs. The return walls at the ends of the wharf will be armored at the toe of the wall to prevent erosion. Armoring of the front face where depths are sufficient to protect barges may also be required.

Although the tied-back wall is a viable option for use at some of the sites, the design is more sensitive to erosion, poor soils and melting permafrost to ensure proper function of tie-back anchors, and use of this design would require detailed site-specific study to determine whether it would be appropriate for any particular site. The cellular cofferdam sheetpile structures offer more stability in these types of conditions, which are expected at many locations within the study area. For this reason, a concept design drawing has not been developed for the tied-back sheetpile dock.

8.4.4 Cellular Cofferdam Sheetpile Bulkhead Dock

Generally, the design of a cellular cofferdam proceeds much the same as that of an anchored wall. However, the overall stability in poor conditions and the practically of construction of this type of structure may be more appropriate for the remote sites included in this study. The cellular cofferdam is a gravity retaining structure formed from the series of interconnected straight web steel sheetpile cells filled with sand and gravel soils. The interconnection provides water-tightness and self-stability against the lateral pressures of water and soil much the same way as the tie-back anchors, except construction from a barge based operation may be simpler.

There are several types of cellular cofferdam designs. Those considered for barge landings for this study include:

- **Circular Type Cellular Cofferdam** - This type consists of individual large diameter circles connected together by arcs of smaller diameter. These arcs generally intercept the circles at a point making an angle of 30 or 45 degrees with the longitudinal axis of the cofferdam. The prime feature of the circular type cofferdam is that each cell is self-supporting and independent of the next (U.S. Steel, 1984).

  Although, the circular type requires fewer piles per linear foot of cofferdam as compared with a diaphragm type of equal design (described below), the complexity of construction, especially in these remote locations, likely results in an overall higher cost of construction for this type of structure.

  Circular cell structures are somewhat more difficult to construct than modified diaphragms because they require more accurate placement of the sheets for closure at the wyes. Driving templates are needed to accomplish the required accuracy, although templates are also required for modified diaphragm designs and other types of sheet pile bulkheads. All of the sheets should be pitched and aligned prior to the start of driving to assure proper fit up. Driving templates should have two levels and be sufficiently rigid to avoid distortion or movement during driving.

- **Diaphragm Type Cellular Cofferdam** - This is a steel sheet pile wharf constructed from flat sheets. The cell consists of two series of circular arcs which form a scalloped face, connected together by diaphragms perpendicular to the axis of the cofferdam. Wyes are installed where the arcs intersect and web or diaphragm walls are driven perpendicular to the front face. The diaphragm walls resist thrust from the arcs through friction between the sheets and the soil. Fenders will be provided on the outboard face of the arcs. Armoring of the ends and along the front of the wharf may also be required for protection against toe scour and erosion. It is common practice to make the radii of the arcs equal to the distances between the diaphragms. At the intersection point the two arcs and the diaphragm make angles of 120 degrees with each other. The diaphragm type cofferdam can easily be widened by increasing the length of the diaphragms. This increase will not raise the interlock stress, which is a function of the radius of the arc portion of the cell (U.S. Steel, 1984).

Drawing 5 in Appendix D illustrates the Diaphragm Cellular Cofferdam, which was chosen as the sheetpile bulkhead dock design concept for the barge landing sites included in this study for the following reasons:

  - Ease of construction
  - High performance in less stable conditions (i.e., weak soils, erosion)
  - Flexibility of this type of design to the potentially varying conditions expected at the various landing sites

- **Modified Diaphragm Type Cellular Cofferdam** – This type of cofferdam design has been used successfully in some areas of Alaska. This design eliminates or changes certain arcs in the circular or diaphragm arrangements, such that the back side of the cell is open, as a way to reduce costs. In a few cases where stability is not a problem, it may be possible to do this. However, the remaining portions of the cells must be adequately anchored before this is practical (U.S. Steel, 1984).

  Circular and diaphragm-type sheetpile structures are generally the most stable. These structures rely on the mass of the soil within them to resist over turning and soil shear at the base of the structure to resist sliding, unlike modified diaphragm designs which rely on friction between the anchor walls and the soil. The internal soil pressures in closed cell cofferdam structures are resisted by tension in the sheets.

  The modified diaphragm configuration may be practical at some barge landing sites included in this study, such as some of the non-delta coastal sites. However, many communities with weak soils and high potential for erosion would not be appropriate candidates for this type of design. A site-specific evaluation must be conducted to ensure the stability of a modified cellular cofferdam design.

Adding a ramp on the downstream end of the Diaphragm Cellular Cofferdam sheetpile dock would allow both side-landing and end-landing barge offloading operations. This is a preferred arrangement recommended by the barge operators to allow flexibility with the type of vessel and offloading arrangement employed. This is presented on Drawing 6 in Appendix D.

8.4.5 Pile-Supported Platform Dock

There may be sites that for various reasons are not suited to the construction of a sheetpile wharf and a pile-supported, platform dock may be a better choice. For example, permafrost conditions may preclude the use of a sheetpile wharf due to the detrimental effects on the thermal regime resulting from that type of structure.

There may also be cases where for reasons of global stability a sheetpile structure may not work. In these cases, it is recommended that the dock consist of pre-cast concrete deck panels over a grid of steel beams, which in turn are supported by pipe piling. The piling and the beams should be hot-dip galvanized. The beams should be connected to one another by bolting and attached to the piles by field welding. The deck should be designed for composite action with the beams through the use of welded headed studs. In this arrangement, the deck panels have block-outs to accept the studs, which are in turn filled with concrete to develop the composite action. The use of pre-cast concrete reduces field labor costs and insures the overall quality of the deck. The pre-cast panels may be either pre-stressed or normally reinforced.

Pipe piles must resist gravity and lateral loads. The lateral loads include ice, seismic, mooring and berthing. As a means to protect the dock from ice damage, piles on the upstream pile bent will consist of large diameter pipe with a smaller diameter pin-pile inside. The large diameter pile is driven 10 to 20 feet below the mud line, an H-pile or pipe pile is driven through the center to the depth required to carry the gravity loads and is left about 5 feet above the mud-line. It is suggested that all piling be concrete filled to at least the mud-line. At minimum, the large diameter pipe is then filled with concrete to provide mass and prevent localized buckling from ice.

In most cases, concrete and equipment to batch and place it will have to be transported to the site. Large nylon sacks of premixed aggregate and cement is generally the most economical way of providing concrete at remote locations. Piles may be driven with a vibratory hammer but should be proofed with a diesel hammer.

Erosion protection should be provided where required. Removable fenders could be installed on the outboard face of the dock.

Unlike a diaphragm or modified diaphragm sheetpile structure, the platform dock is more load-sensitive. In other words, its design and cost are driven primarily by the superimposed loads, whereas the diaphragm-type wharf is a function of soil loads.

Depending on permafrost temperatures and the general permafrost regime at a specific site, thermal siphons or thermal piles may have to be employed for a pile supported structure. Both siphons and thermal piles must be protected from physical damage from equipment and from ice, including ice combined with flood conditions. Where it is determined that piling must be driven into permafrost, H-piles generally drive better. Pre-drilling and then driving may also be required.

The cost to construct a pile supported concrete platform is relatively high, and is recommended primarily at sites where constructing a sheetpile dock is impractical. Because it is likely that these sites are in remote locations, the cost to build a pile supported dock may be impractical. In these cases, a ramp or alternate structure would likely be recommended for barge landing improvements. For this reason, a concept design drawing for this option has not been included.

Recommended Dock/Wharf Designs and Construction Methods

The recommended dock design for most of the sites within the study area is a diaphragm-type, closed cell sheet-pile design, back-filled with granular material such as sand, gravel or gravel-sand mixtures. Some of the native material within the cells may have to be removed prior to filling them. Settlement of the fill, and possibly the sheets themselves, should be anticipated and accounted for in the final design. Surcharging of the cells or vibration may be considered to accelerate settlement. Surcharge material could be removed after a specified period of time and then used to construct upland pads.

In a few locations, such as the upper river sites where shallow draft and appropriate soils exist, a cantilever sheetpile design may provide significant cost savings.

One approach to construction of the diaphragm-type cellular sheetpile wharf is to place the granular fill and then drive the sheets from the resulting pad. This provides a level platform upon which to set templates and operate equipment. Depending on currents some material may be lost in this process due to erosion. Excess material will have to be removed in front of the wall once the cells are completed. The excess material can be used for surcharging and/or construction of upland pads. Alternatively, the template is supported on spuds (temporary piling); the sheets are pitched and then driven. After driving, the template is moved to the next cell and the process is repeated until all the cells are completed. Backfilling within the cells should be brought up at a fairly uniform rate to balance the interlock loads at the wye connections. A typical construction method is shown in Figure 8.1.1, below.

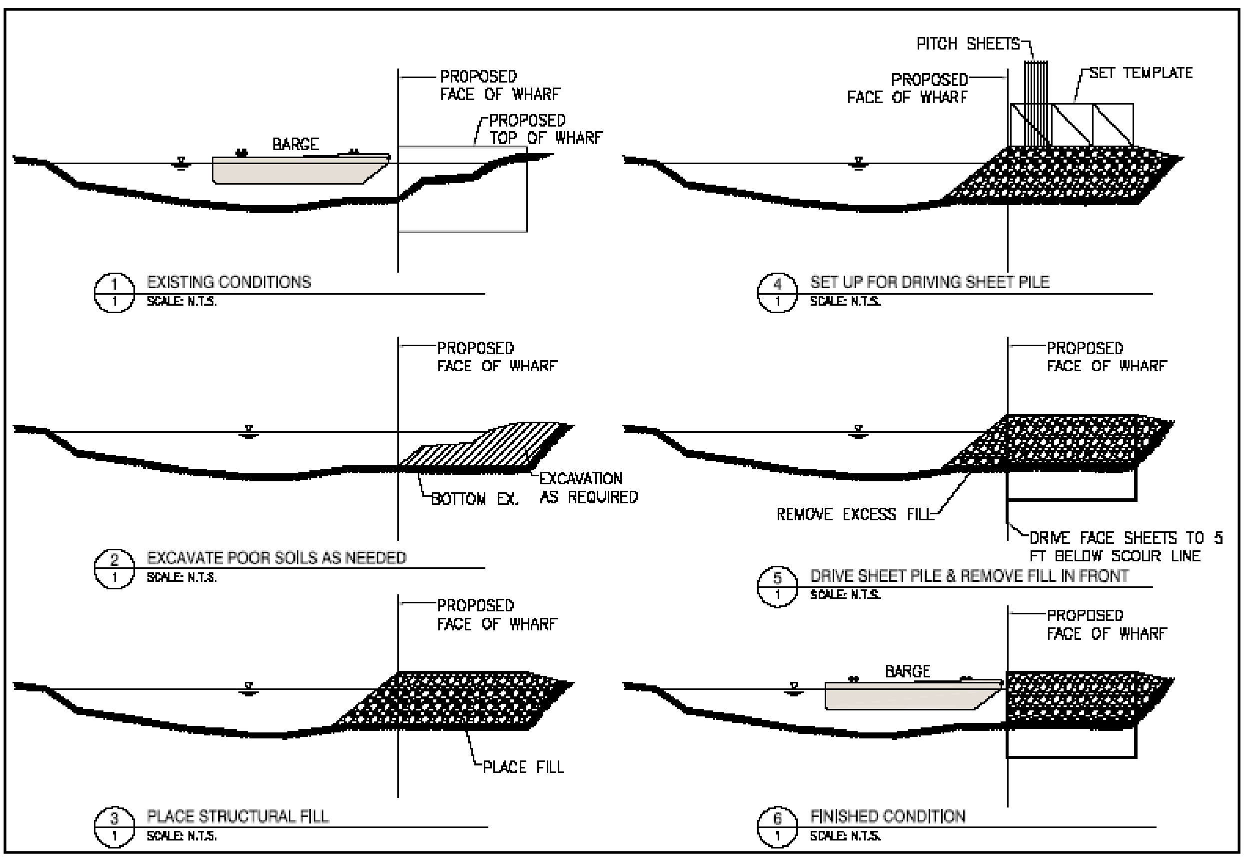

Figure 8.1.1: Example of Possible Sheet Pile Wharf Construction Sequence.

We recommend for stability that the width of the cells (distance between the front and rear walls) be 1 to 1.5 times the height, including scour. That actual distance should be determined based on site specific soil information. In computing sliding resistance, we recommend ignoring any passive soil pressure against the front face of the wall.

The diaphragm walls are equally spaced and, therefore, the overall length of the wharf can be adjusted by adding or subtracting cells. Where local site conditions permit, this concept can be modified and constructed as a modified diaphragm cellular cofferdam wharf. In this arrangement the diaphragm walls resist the thrust from the face through soil friction. This will require local and imported soils to consist of relatively dense granular material with internal soil friction angles of 30 degrees or more and adequate protection provided to insure against the loss of material due to overtopping or erosion. Unlike closed cell structures, which are stable even if the river were to cut behind them, the soil surrounding a modified diaphragm cellular cofferdam wall structure must remain in place behind the wall.

A detailed study of the currents, erosion, and sediment transport must be conducted at each site prior to final design of any dock structure to be located on a river or coastline to determine the pile embedment depth, erosion and scour potential, and downstream effects of structure placement, as well as other factors.

It should be noted that any structure placed in rivers or coastal areas are subject to regular periodic maintenance needs that may include minor dredging or placement of rock and/or gravel material in areas where sediment deposition, erosion, scour and ice-plucking have occurred at the landing facility. Barge operators have suggested that a general permit be obtained from the regulatory agencies to allow them to conduct this type of maintenance each year when they arrive at a landing site. Note that the USACE has nationwide permits in place that cover limited amounts of dredging and fill associated with maintenance of existing facilities and boat ramps. Some pre-notification and restrictions (i.e. for fish-spawning areas) are required and outlined in the general conditions associated with these permits. Refer to USACE Nationwide Permit numbers 3, 18, 19, and 36, which may be applicable to maintenance of barge landing facilities in Alaska.

9.0 PRIORITY SITES AND PROPOSED IMPROVEMENTS

The 111 communities included in this study have been evaluated and scored to determine the Priority Sites that should be considered for initial funding. Any site that received a score of 20 or higher was included as a Priority Site.

Each of the communities where scored based on:

1. Urgency/Timeframe: Based upon the apparent urgency for landing facility improvements at a particular site, this score represents the practical timeframe for which the recommended improvements should be performed.
    - 10 points: Immediate need
    - 5 points: Recommend improvements within 5 years
    - 1 point: Recommend improvements within 10 years
    - 0 point: Improvements not recommended, or recommended beyond 10 years.

2. Frequency/Impact: This score is based on the relative frequency that barges deliver fuel and supplies to a particular site, and the perceived impact that improvements would have on increasing frequency of use or improving the operational efficiency, worker safety, environmental impacts, and/or quality of goods delivered to a community or region.
   - 10 points: Barges currently utilize the site frequently and improvements would clearly improve efficiency, safety, environment, and/or quality of goods to a region (i.e., a hub serving 5 or more communities).
   - 8 points: Barge deliveries are made several times per year and the community is dependant on continued barge service, and improvements would clearly improve access, efficiency, safety, environmental impact, and/or quality of goods at the site.
   - 7 points: Barge deliveries are made once or less per year and improvements would likely result in increased deliveries, or would significantly improve efficiency, safety, environmental impact, and/or quality of goods at the site.
   - 5 points: Barges currently utilize the site several or many times per year and improvements are considered somewhat effective in improving efficiency, safety, environmental impact, and/or quality of goods at the site.
   - 3 points: Barge deliveries made once or less per year and/or improvements would not result in increased deliveries or significant improvement in efficiency, safety, environmental impact, or quality of goods at the site.
   - 1 point: Barge access is one or more times per year and/or community has alternate means of obtaining goods (i.e., road, another dock) or improvements are unlikely to have a significant impact on efficiency, environmental impacts, safety, or quality of goods.
   - 0 points: Barge deliveries made once or less per year and usage not expected to increase if improvements made. Or, existing landing site facilities or delivery methods are sufficient. Or, another project is in progress to handle the need.

3. Ease of Construction: The primary types of needed landing facility improvements identified during the study were used to score the community for ease of construction. The highest score is given to sites where simple improvements, involving little planning and design, and minimal specialized equipment are given the highest scoring. Sites where a significant amount of study, planning, and design or complicated construction may be necessary to complete the work are given lower scores. Essentially, this

category facilitates the potential for funding of the Priority Sites projects which will take less time to be ready for construction.

- 10 points: Recommendations for improvements primarily consist of mooring points.
- 7 points: Recommendations for improvements consist of mooring points and/or gravel ramp and/or staging area improvements.
- 5 points: Recommendations for improvements include a sheet pile or pile-supported dock structure.
- 2 points: Recommendations for improvements include dredging and/or more involved work (i.e., breakwater, long road).
- 0 points: Recommendations for improvements were not made, or include fuel tank/header work (not considered a "landing" under this study), or improvements are currently being studied under a separate project.

This method of scoring was derived to allow priority funding of projects at sites with the highest need and where simple improvements will provide the most value. The categories may offset each other somewhat to allow some projects that have a high urgency, high usage, but which need complicated projects to be included on the high priority list for initiating feasibility studies for these projects as soon as possible (i.e., Quinhagak, Goodnews Bay).

The scores given in each of the three categories was summed to give the total score for each site. The results of the scoring are included in the matrix table provided as Appendix B. The Appendix includes two versions of this table: one provides the information with the communities sorted by region, and a second table provides the same information sorted alphabetically by community name.

The sites with a total combined score of 20 or more points were selected as the Priority Sites projects. This resulted in 34 Priority Sites projects, which are summarized in Table 9.1, below.

Conceptual site plans showing the proposed work at each site have been developed using ortho-rectified (i.e., to scale) aerial photography, where available and standard aerial photographs or satellite imagery where ortho-rectified photos where not available. A sketch of the recommended facility improvements for each Priority Site has been overlaid onto the aerial photograph to illustrate the extent of work proposed at each site. These depictions were used to estimated quantities and develop budgetary construction cost estimates, discussed later in this report. In addition, the site plans are intended to serve as a basis for discussion with community representatives, user groups, and others to aid in planning and completing the design work for the landing facility improvements. The conceptual site plans have been included in Appendix E.

Table 9.1: Proposed Barge Landing Facility Improvements, Priority Sites

Region	Community	Dwg No.*	Brief Description of Recommended Barge Landing Facility Improvements
Norton Sound/ Bering Sea	Elim	E1	Provide a ramp and staging area, preferably at a co-located fuel and freight landing site to reach deeper water and avoid rocks and sewer outfall. Site conditions and land availability may preclude a co-located site; and two separate ramps may be considered. Design should include mooring points.
	White Mountain	E2	Provide a total of 6 mooring points the landing sites.
	Savoonga	E3	Fuel barge anchors and floats hose in to shore and freight barges land 2 miles west, in the bay. Provide a dock or gravel causeway to at the freight landing to allow them to drop their bow ramp while staying offshore to avoid rocks, and a ramp to the upland area. Design should include erosion protection and mooring points. Improvements at the fuel landing site may include mooring dolphins and/or coastal protection; however, such improvements require a site investigation to determine feasibility, siting, and other site specific requirements.
Lower Yukon River and Delta	Alakanuk	E4	Provide a gravel causeway/ramp and 2 mooring points at a new barge landing site, plus mooring points at 3 other landing sites. Two optional locations for the gravel causeway are shown. Option A utilizes the existing landing near already developed upland staging areas; however it is at a highly erodible location. Option B shows an alternate location, with a new staging area.
	Emmonak	E5	Provide a sheet pile dock with a downstream ramp. Provide improvements to expand the existing staging area in the adjacent uplands. Also provide 2 mooring points both at this site as well as at the downstream fuel landing for the Store.
	Kotlik	E6	Provide a sheet pile dock with a downriver loading ramp. Extend dock out 20-ft min. from shoreline and provide 50-ft min. width ramp. Provide gravel pad at the existing upland staging area and consider expansion of the staging area to the south.
	Mountain Village	E7	Improve the existing gravel causeway/ramp at the City landing site and provide an upland staging area. Install 3 mooring points each at the Native Corporation landing and the City landing and provide 2 mooring points at the fuel barge landing for the School/AVEC tanks.
	Anvik	E8	Provide a gravel or concrete ramp and 3 mooring points at the existing barge landing located adjacent to the fuel header.
	Grayling	E9	Install 2 new mooring points at the downriver landing site, located just south of the access road. In addition, replace the cable with chain at the three existing cable/deadmen mooring points located in the trees at the upriver fuel barge landing.
Middle Yukon River	Nulato	E10	Install 3 mooring points at the existing co-located fuel/freight barge landing site and one additional mooring point above the waterline at the upland AVEC fuel barge landing site.
	Galena	E11	Provide 3 mooring points at one fuel landing and 2 mooring points at an upriver fuel landing.
	Tanana	E12	Install 2 mooring points at 2 upriver fuel barge landings and 4 mooring points along the beach landing in front of the runway.
Upper Yukon River	Stevens Village	E13	Provide total of 4 mooring points at 2 barge landing sites.
	Fort Yukon	E14	Provide total of 8 mooring points at 3 barge landing areas.

Region	Community	Dwg No.*	Brief Description of Recommended Barge Landing Facility Improvements
Kuskokwim River Delta	Goodnews Bay	E15	Provide dedicated upland staging areas and 5 mooring points at the existing beach landing areas. Additionally, conduct a study to determine the feasibility of deepening the existing channel from Platinum to allow passage of vessels drawing 6-ft or more.
	Quinhagak (Kwinhagak)	E16	A feasibility study is a priority to analyze alternatives for long-term access to this site. Some alternatives suggested include: Option A: Dredge an access channel to the existing City dock. This is the user groups' preference, at least for short term. Periodic maintenance dredging would likely be required. Option B: For a long term solution, consider providing a new dock at a landing site that is not experiencing problems with sediment accretion. o One alternate for a new dock landing site is depicted on the Site Plan. A residential house is nearby, and property ownership issues would need to be resolved. Another option, not shown on the Site Plan (shown on figure in report), is to study whether Arolik Creek is accessible by barge and constructing a new landing facility at the end of Arolik Rd.
	Kongiganak	E17	Provide a sheetpile dock and staging area. A 500 to 1000-ft long access road to the staging area may be required to reach uplands area (Another project is possibly underway to accomplish some of this work as part of airport work). Also, provide mooring points at two upriver fuel barge landing sites.
	Kwigillingok	E18	Provide a co-located fuel/freight landing at the downriver fuel landing area by installing an upland staging area using a thick layer of crushed rock and gravel to create dry ground. Install mooring points at this landing area as well as at the downriver fuel landing, located near the Native Corp. building.
	Kipnuk	E19	Provide 3 mooring points at the fuel header/landing site. Provide a sheetpile dock and ramp, and a gravel pad at the existing upland staging area at the freight landing site.
	Chefornak	E20	Improve and widen existing gravel causeway with new armor rock and smaller 6" minus rock at landing end. Dredge boulders from shallow area (<6ft) around causeway.
	Toksook Bay	E21	Provide gravel ramp to extend 100-ft or more to reach deeper water and improve existing road with gravel. At a minimum, consider dredging out large rocks in shallows near the landing.
	Chevak	E22	Provide three mooring points at the existing beach landing site.
Lower Kuskokwim River	Eek	E23	Provide a causeway/ramp to reach deeper water and provide stable surface for offloading. Also provide 2 mooring points at the landing and expand the upland staging area.
	Nunapitchuk	E24	Option A in Drawing D28-A presents one possible co-located fuel/freight ramp landing located on the same side of the river as the main part of the community. Requires a site investigation to determine whether sufficient depth available for freight barge access in this area. Alternately, Option B in Drawing D28-B presents an option for development of the existing landing site at the fuel barge landing area located north of the airport landing area, across the river from the community. For this option, provide a co-located fuel/freight barge ramp landing and staging area. This is low elevation and likely susceptible to flooding and would require more fill for a dry staging area.

Region	Community	Dwg No.*	Brief Description of Recommended Barge Landing Facility Improvements
	Napaskiak	E25	A feasibility study is a priority to determine the best solution for long-term access to this site. Some options suggested include: Option A: Improvements to existing landing area. Provide a gravel ramp with erosion protection and expand and elevate the existing upland staging area. Dredge the washout area on the opposite bank and shallow area in front of the landing. A study may be required to determine the feasibility of maintaining dredging prior to proceeding with this option. Option B: A new landing site could be developed in an area of less sediment accretion. Provide a new concrete ramp and a new upland staging area. Three mooring points would be needed at this landing due to the swifter currents along the main branch of the Kuskokwim River.
	Akiachak	E26	Install 2 mooring points at the fuel/freight barge landing site.
Middle Kuskokwim River	Upper Kalskag	E27	Install 2 mooring points at both the fuel and the freight barge landing sites.
	Aniak	E28	Provide a dock and upland staging area for freight, near the existing freight barge landing area. Although somewhat steep, a ramp could be provided on the downstream end of the dock. 25,000 to 30,000 sq. ft. of staging area is recommended for this small hub community. Also, provide 2 mooring points at the fuel barge landing area.
Upper Kuskokwim	McGrath	E29	Provide a gravel ramp and 3 mooring points to facilitate offloading cargo from the fuel barge/lighter vessel.
Bristol Bay	New Stuyahok	E30	Create a new dedicated barge landing site, near the downriver end of the community. Provide a gravel or concrete plank ramp, a staging area, and access to the road system.
Kotzebue Sound	Buckland	E31	Provide a new landing site and upland staging area located closer to the existing marine fuel header. Grading and/or a small gravel ramp may be needed to create room for landing at the new site. A site assessment is required to confirm that access to this area is feasible and/or whether rock hazards can be removed. At a minimum, install mooring points at the existing landing area.
Kobuk River	Noorvik	E32	Install 2 mooring points at each of 4 landing sites. Provide a gravel ramp and upland staging area near the existing freight barge landing area.
	Kiana	E33	Provide improvements and a dedicated barge landing at a site upriver of the existing freight barge landing area, to alleviate the issues associated with mooring at the confluence of the rivers. Improvements include a new upland staging area, access road, and mooring points. In addition, mooring points are needed at the downriver fuel barge landing.
Aleutians	Pilot Point	E34	Provide two mooring points at the fuel/freight barge landing site.

*Drawing number associated with the drawings included in Appendix E.

10.0 CONSTRUCTION COSTS

All of the Priority Sites, which are being considered for the first generation of improvement projects, are located in rural Alaska and are not accessible via the Alaska road network. However, some communities are interconnected by local roads, for example on the Seward Peninsula. Most of the sites can be accessed by boat or barge only during the summer months. Some sites can be reached by shallow draft tugs and barges, while others may be accessible by deeper ocean-going barges. In some situations, cargo is transferred from ocean-going barges to lighters and then to shore. Most of the communities either have runways, or are near other communities with runways.

Construction costs in western Alaska are notoriously high. There is a limited number of qualified construction firms that do the type of work involved in constructing these types of facilities. Mobilization costs are high and for that reason it will be more cost effective to combine several projects under a single contract. This will allow the contractor to better utilize personnel and equipment. Because of the short construction season at remote sites, work is normally performed on a schedule of 10 hours per day, 7 days per week. Labor costs are about $1000 per day per worker, including room, board, transportation and overtime. Crew sizes will likely be 4 to 5 people, plus local hire. Recently, barging costs in this region have run $12,000 to $15,000 per day.

One of the primary design considerations for these facilities is constructability; structures that require as few elements as practical, that can be erected with relatively small crews and basic equipment spreads. Typical unit prices for this work are as follows:

• Sheetpiling (projected area)	$60 to $70 per square foot
• Coatings on Steel	$5 per square foot
• Miscellaneous Structural Steel	$4 per pound
• Classified Fill (sand/gravel)-local source	$100 per cubic yard
• Classified Fill (sand/gravel)-imported	$150 per cubic yard
• Reuse Existing Fill	$50 per cubic yard
• Rip-rap armor rock	$150 per ton
• Cast-In-Place Concrete	$2500 to $3000 per cubic yard
• Pre-cast Concrete	$2000 per cubic yard
• Unclassified Excavation	$25 per cubic yard
• Dredging	$50 per cubic yard
• Geotextile filter fabric	$2 per square foot
• Insulation	$5 per square foot

The cost to transport materials and equipment to and from the sites – mobilization and demobilization – represents a significant construction cost at these remote sites; $200,000 to $350,000 is not unusual to move equipment and materials to a site and then back again when the job is complete. Some locations that are exceptionally difficult to access and offload material may be much higher than that. One way to reduce individual project costs is to use a single mobilization to execute multiple projects. This also allows more efficient use of manpower and equipment. Grouping of projects should consider the total project costs, the proximity of communities to one another, similarity of construction materials and the ability of local contractors to bond the work.

Another factor affecting prices is bid timing. Projects should be advertised and awarded on a schedule that allows adequate time to purchase and ship materials so that the work can be completed in one season, including demobilization. Of particular note is the availability of steel, particularly sheet piling. Delivery times of 8 to 16 weeks or more is common to the Pacific Northwest.

This work can be done under either lump sum or unit price contracts. We recommend unit price contracts where the funding source allows. Where funding is tight or prices are not well known, deductive alternates should be considered to avoid the need to revise and rebid work, including the associated delays.

Opinion of Probable Construction Cost (OPCC) estimates for this work represents fair market value; it is not the lowest price. For example, if there were five bids for a project the engineer's estimate should be about the third lowest cost. There should also be a contingency set aside for unforeseen or changed conditions.

Traditionally, 10 percent is used; however, in some cases it may be prudent to set a larger amount aside. At this stage, these are planning level estimates and a 20 to 25 percent contingency should be carried.

Funding level budgets must include amounts for field investigations (e.g., survey, geotechnical study), permits, design, and construction administration. A typical allowance for these services is 15 to 20 percent. Where standard or repetitive designs are used the design fee may be less than the traditional 5 to 6 percent. Field investigation costs may be higher then normal due to mobilizing field crews and equipment to remote areas. Like construction, the field costs can be reduced by doing multiple sites under one contract or mobilization. The following is a sample funding level estimate:

• Engineer's Construction Cost Estimate	$1,000,000
• Construction Cost Contingency	$ 250,000
• Field Investigations	$ 100,000
• Permits/Design/Construction Administration	$ 150,000
Budget	**$1,500,000**

The above amount does not include any costs for land acquisition, Owner's internal project management, administration, legal fees or extensive public involvement.

OPCC estimates for the recommended improvements at each of the Priority Sites are included in Appendix F. However, because of the remote nature of most of this work and the limited number of contractors working in these areas, it would not be unusual to receive fewer than three bids. For that reason, we recommend maintaining a construction contingency greater than 10 percent throughout the life of the projects.

Table 10.1 provides a summary of the total estimated costs for these individual projects. These total costs assume that each site represents a stand-alone project for design and construction. The following section discusses the potential cost savings that might be realized if projects are bundled to include multiple communities in a single project.

Table 10.1: Proposed Barge Landing Facility Improvements, Estimated Costs

Dwg #	Community	Brief Project Description	Total Estimated Cost*
E1	Elim	Concrete ramp, staging, and mooring points at 2 landings	$3.12M
E2	White Mountain	Mooring points at 2 landings	$0.16 M
E3	Savoonga	Sheetpile dock and staging area	$5.01M
E4	Alakanuk	Option A: Gravel ramp and 9 mooring points (high erosion) Option B: Gravel ramp, staging area, and 9 mooring points	A:$1.03M B:$2.01M
E5	Emmonak	Sheetpile dock/ramp, staging, & mooring points at 2 sites	$7.12M
E6	Kotlik	Sheet pile dock/ramp, staging areas and mooring points	$2.63M
E7	Mountain Village	Improve City Dock by elevating with 2-ft of backfill, provide upland staging area, and mooring points at 3 landing sites	$1.62M
E8	Anvik	Concrete ramp and mooring points	$1.19M
E9	Grayling	Mooring points at 2 landings	$0.15M
E10	Nulato	Mooring points at 2 landings	$0.13M
E11	Galena	Mooring points at 2 landings	$0.15M
E12	Tanana	Mooring points at 4 landings	$0.19M
E13	Stevens Village	Mooring points at 2 landings	$0.13M
E14	Fort Yukon	Mooring points at 3 landings	$0.19M
E15	Goodnews Bay	Conduct feasibility study associated with dredging an access channel, Also construct staging areas, and 5 mooring points	$0.70M
E16	Quinhagak (Kwinhagak)	Conduct a feasibility study of various alternatives to provide long-term access.	$0.16M
E17	Kongiganak	Sheetpile dock, staging areas, access road, and mooring points	$3.51M
E18	Kwigillingok	Staging area and mooring points at 2 landings	$3.30M
E19	Kipnuk	Sheetpile dock/ramp, staging area, and mooring points	$2.93M
E20	Chefornak	Improve existing gravel causeway and dredge boulders	$0.78M
E21	Toksook Bay	Gravel causeway/ramp and improve existing road with gravel	$0.85M
E22	Chevak	Mooring points at one landing	$0.12M
E23	Eek	Gravel ramp, staging area, and mooring points	$2.49M
E24	Nunapitchuk	Option A: Gravel ramp and staging area Option B: Gravel ramp and staging area	A:$1.36M B:$0.49M
E25	Napaskiak	Recommend feasibility study to analyze alternative locations for a ramp landing.	$0.13M
E26	Akiachak	Mooring points at 1 landing site	$0.10M
E27	Upper Kalskag	Mooring points at 2 landing sites.	$0.13M
E28	Aniak	Sheetpile dock, staging area and mooring points	$3.09M
E29	McGrath	Gravel ramp and mooring points	$0.35M
E30	New Stuyahok	Concrete ramp, staging area, and access road	$2.71M
E31	Buckland	Gravel ramp, staging area, and mooring points	$1.73M
E32	Noorvik	Gravel ramp, staging area, and mooring points at 4 landings	$2.07M
E33	Kiana	Staging area, access road, and mooring points	$2.25M
E34	Pilot Point	Mooring points at 1 landing site	$0.10M

*Total Estimated Costs are based on quantities and assumptions included in Appendix F.

10.1 Project Bundling

Individual budget-level cost estimates, included in Appendix F, have been prepared for each community based on a stand-alone project for design and construction. Given the large number of sites involved, some in relatively close proximity to one another, significant overall cost savings may be realized by grouping, or “bundling” individual projects together into a single contract for design and construction. Such a larger contract may be more attractive to prospective bidders and hence more competition should be expected.

Bundling the projects in this way would primarily save on mobilization costs to the area, which is notably high. It should also be expected to result in cost savings related to field investigations, design, permitting, and construction administration. It is also possible to a have a single contract for the design of several sites, but individual contracts for construction (or vise versa).

Bundling can be performed in several ways; the two most obvious are:

- Geographically—Grouping project by geographic area is the most obvious approach, and would primarily save mobilization costs to a region. Secondarily, the design and administrative costs would also be less.
- Type of Project—Grouping projects by type, where similar equipment and/or materials are needed complete the work. For example, those projects that require pile driving or those that only require excavation/fill work. A cursory look at this approach for the Priority Sites, finds that the sheetpile projects are too far apart for this approach to be very economical.

  However, if it is determined that installing mooring points throughout Alaska is found to be of upmost priority, a project of this kind may be appropriate. The pre-cast concrete anchor blocks could be made in a larger batch and savings would be realized from this approach. Additional investigation would be needed to determine whether this work could be accomplished in one or two mobilizations.

We have bundled the Priority Sites projects roughly into $5 to $10 million projects, as depicted in Table 10.2. These projects have been grouped together primarily by geographic proximity, with some consideration for similar projects and equipment needed to construct them.

In preparing the estimated costs for bundled packages involving two or more sites the estimates have been prepared as follows:

- For sites where more than one option was estimated, the larger of the two was used
- The mobilization costs were backed out of the stand-alone estimates
- Mobilization amounts were reduced by 50 percent
- The reduced mobilization costs were added to the bottom-line of each site cost
- The aggregate cost of the packages was totaled.

Table 10.2: Barge Landing Facility Improvements, Proposed Project Bundles

Project Number	Community	Estimated Stand-Alone Project Cost	Estimated Bundled Project Cost
1	Elim	$3.12M	$6.96M
	White Mountain	$0.16 M	
	Savoonga	$5.01M	
2	Alakanuk (B)	$2.01M	$3.92 M
	Anvik	$1.19M	
	Grayling	$0.15M	
	Mountain Village	$1.62 M	
3	Emmonak	$7.12M	$9.09 M
	Kotlik	$2.63M	
4	Galena	$0.15 M	$2.41 M
	Nulato	$0.13 M	
	Tanana	$0.19 M	
	Fort Yukon	$0.19 M	
	Stevens Village	$0.13 M	
	Chefornak	$0.78 M	
	Chevak	$0.12 M	
	Quinhagak (Study)	$0.16M	
	Toksook Bay	$0.85 M	
	Goodnews Bay (Staging & Study)	$0.70 M	
5	Kipnuk	$2.93 M	$8.74 M
	Kongiganak	$3.51 M	
	Kwigillingok	$3.30M	
6	Akiachak	$0.10 M	$3.58 M
	Eek	$2.49 M	
	Napaskiak (Study)	$0.13 M	
	Nunapitchuk (A)	$1.36 M	
7	Aniak	$3.09 M	$3.07 M
	Upper Kalskag	$0.13 M	
	McGrath	$0.35 M	
8	New Stuyahok	$2.71 M	$2.71 M
9	Buckland	$1.73 M	$5.06 M
	Kiana	$2.25 M	
	Noorvik	$2.07 M	
10	Pilot Point	$0.10 M	$0.10 M
TOTALS:		**$45.6 M**	**$52.6 M**

Project bundling has the effect of reducing the construction costs as well as the construction contingency, the field investigation and design fees and construction administration as those costs were computed as percentages of the total project with mobilization included in the stand-alone estimates. For example, if the mobilization cost was $100,000 in the stand-alone estimate, $25,000 was added as a contingency, $5,000 as field investigation and $15,000 construction administration. Therefore, the reduction in overall costs by packaging is $50,000 plus $45,000, or a total of $95,000.

The 50 percent reduction in mobilization by bundling projects together seems reasonable. Without detailed information as to when contracts will be awarded and the time the contractors will be given to complete the work it is impossible to accurately estimate mobilization costs. Those costs will depend on the required contract schedule, the contractor's work plan, the number of barges required, availability of barges and tugs at the time, and other factors. A 50 percent reduction seems reasonable for these planning-level estimates.

Some of the Priority Sites were not bundled due to the location and nature of the project being too different (i.e., New Stuyahok and Pilot Point). For these sites it would be feasible to bundle these projects together with second generation projects in the vicinity.

Another method for saving costs is to tag on to larger projects within a community, such as a fuel tank or school construction project. For instance, if such a project is planned for a community where only mooring points are needed for landing facility improvements, it makes the most sense from an economic standpoint to include the mooring points into the larger project. This is especially true for sites where small projects are planned and no other landing facility improvement projects are located within the vicinity (i.e., Pilot Point).

11.0 SUMMARY

This assessment of barge landing system needs, focusing on Western Alaska and the Yukon and Kuskokwim river areas, has identified the infrastructure improvements needed at each community included in the study, with the goal of improving barge operations, increasing worker and environmental safety and cumulatively, improving fuel and freight delivery costs through system improvement. This represents the first phase of the assessment and a second phase of work is being undertaken to address the remaining areas of the State.

Fuel is the primary product delivered to these rural communities, followed by deck freight (delivered along with fuel orders or separately on regular scheduled barges), and primarily containers, or break-bulk cargo (loose, non-containerized material such as long lengths of pipe or timber, vehicles, palletized cargo, etc.). Other chartered barges are generally associated with community construction projects like schools, fuel tank farms, health clinics and airports. In addition, commercial fishing vessels and tenders constitute the other primary users of the barge landing sites.

In general, operators reported the larger communities such as Nome, Bethel, and St. Mary's have sufficient barge landing facilities in place and are in relatively good shape, with the exception of some maintenance upgrades that may be needed.

The operators report that in general, the communities on the Yukon and Kuskokwim river deltas and lower river areas have the most difficult landings, and are most in need of improvements. Especially problematic are those that have marginal permafrost, soft soils and high erosion rates, as well as low-lying communities with boardwalks and utilities close to the shoreline that get in the way of offloading operations. Recommended improvements for these sites primarily include a ramp or dock and stabilized staging pads as well as mooring points.

Fuel deliveries are made by nosing-in to the beach and pushing the beach while product is pumped through hoses to shore-based fuel header or tanks. The key issues that impede operational efficiency in fuel deliveries include:

(1) Many communities have multiple tanks and/or headers, each of which requires a separate barge landing within the same community. This extends delivery times, and at some tidally-influenced sites can halt operations for up to 24 hours.

(2) Several sites have tank farms with no marine header and the fuel delivery operations require dragging hose over 800 to 1,500 feet along the road to the tank farm locations. This increases environmental risks associated with longer hose runs as well as the time to offload the fuel.

(3) At several communities barges cannot access the beach in front of a fuel header or tank due shallow water or because of large boulders or other hazards near the shore. In these cases, fuel barges anchor offshore and float the hoses to shore. Although fuel transfers are done as safely as possible, floating hose to shore in itself increases the environmental risk associated with potential spills.

The primary recommendation for improving fuel delivery operational efficiency is to consolidate marine fuel headers to a single landing site location at communities where multiple landings are required to deliver fuel (i.e., power company, school, Village Corporation and/or stores all have separate tanks and headers).

Secondarily, to improve environmental concerns associated with floating fuel hose to shore, barge access to the shore should be provided where possible. Third, providing a centralized fuel header for all fuel tanks within a community, at a single landing site is the ideal fuel delivery situation for safe and efficient operations.

Although fuel system improvements such as header and pipeline work are not included in the scope of design effort for this study, these concerns expressed by the barge operators are included in the report for the purposes of future planning associated with fuel system upgrades in the communities.

Where fuel hoses are currently being floated in to shore, access should be provided by dredging out any large rocks or boulders or minor dredging of shallow areas where continued access can be maintained by doing so. In some cases, building a gravel causeway into the water is feasible to reach sufficient water depth. However, several communities are in very shallow areas, such as the upper river locations or along the aggragational bank of a river where sediment is continually being deposited and in these cases providing safe access may not be feasible by providing a new landing facility or by dredging. In this case, relocating the tanks and/or fuel header should be considered as an option.

Freight deliveries are by RO-RO where the barge/landing craft noses into shore and pushes the beach, lowers their ramp, and uses loaders or forklifts to offload goods. Another method of offloading freight is by using a crane that is positioned either on a dock or on the barge, where the barge lands parallel to the shore and side-loads from the barge. The main issues with freight deliveries are:

(1) Soft soils on the beach make driving the loaders difficult

(2) Environmental concerns with disturbing the river bottom when pushing into the beach as well as the additional fuel expenditure needed to do this

(3) Keeping position in areas with swift currents without dedicated mooring can be challenging

(4) There are limited dry dedicated storage areas nearby and the roads may not be wide enough for bulk materials to pass easily

The primary items identified by operators to improve landings at these communities are to install mooring points to hold position and to provide upland storage pads, or staging areas. Secondarily, dedicated landings such as a bulkhead dock or ramp are needed. At some sites, dredging or rock removal is needed to provide access to the landing site.

In summary, barge operators and other users indicated that the needed landing facility improvements (not including fuel system upgrades) in order of priority are:

(1) Installing mooring points with chains for tie-offs

(2) Upland staging areas/gravel pads are needed for freight operations,

(3) Dredging for access to shallow areas or for navigation safety (i.e., removing specific boulder hazards)

(4) A dedicated landing site including permanent ramps and/or bulkhead docks with erosion protection

(5) Minor repairs to existing facilities such as dock repairs, widening, grading or repairing landings, erosion protection, road widening, and staging area improvements

More than 50 percent of the communities studied need mooring points to help barge operators control their position, thereby increasing safety during freight and fuel offloading and to decrease potential environmental damaged cause by prop wash while they are “pushing” onto the beaches.

At a minimum, communities with multiple fuel tank farms or fuel delivery points, need mooring points at each delivery site. The ideal capital project in these cases would be to develop a single fuel header location at one landing site for all fuel customers in a community. Until such a project can be realized, mooring points at the separate landings would be relatively inexpensive and are considered the primary and immediate need.

The freight delivery companies, generally expressed a desire for construction of stable, dedicated gravel storage pads located near the landing sites. About 40 communities would experience increased operational efficiency if these pads were constructed. Staging areas would minimize difficulties associated with equipment and cargo sinking into the soft soils, or the need to haul cargo over long distances, sometimes along roads that are too narrow to allow a normal load to pass. It would also provide a dedicated location to store their shipping containers for fall pickup and minimize the chance of the containers sinking and freezing in to the tundra or beaches.

The barge operators reported it would be beneficial for abut 50 of the communities studied to have more permanent, dedicated landing facilities such as ramps and/or wharfs or docks in order to increase operational efficiency and/or worker or environmental safety. Of these communities, there are up to 20 communities that are experiencing activity levels and may have suitable site conditions, such that a sheetpile dock structure may be appropriate.

Approximately five communities require minor dredging such as boulder/hazard removal to improve access to landing sites. An additional seven communities were identified as possibly benefiting from more involved dredging in order to maintain safe, all-tide access to the sites or to eliminate the need for lightering to shore. One of these sites, Quinhagak, was cited by one operator as needing immediate emergency dredging in order to allow continued fuel deliveries to the existing City dock. While one-time boulder/hazard removal may well be practical, dredging improvements need to be carefully studied for their long-term stability. For these sites, a feasibility study of dredging and/or alternated landing sites was recommended as a first step to making a practical long-term improvement.

Finally, there are more than 30 communities where long hose runs and/or multiple stops are required to deliver fuel to the various fuel tank farms in the community. About ten of these sites do not currently have marine fuel headers, resulting in the need for extensive fuel hose runs from the beach up to the tank farms. Fuel barge operators indicate all parties would benefit from providing marine fuel headers and consolidating the location of the headers at a single landing site. Future planning for locating headers should consider barge operators' recommendations for placement. They indicate that the header location is ideal if installed no more than 300 feet from the landing site, while about 100-feet from the landing is preferred.

It is understood that there are often some difficulties associated with consolidating tank farms due to the varying ownership. However, even if separate pipelines are required, providing marine fuel headers and consolidating the location of the existing headers should be considered as a way to minimize the time/cost associated with multiple barge landings and long hose runs. Providing and properly co-locating marine fuel headers should be a primary consideration for all future fuel tank and distribution project upgrades in these communities.

In addition, due to the difficulty of accessing the communities located further up river, it would be ideal to deliver to these communities only once per year. Providing a sufficiently sized, centralized tank farm may facilitate this goal.

Conceptual designs were developed based on the barge landing facility improvement types that were most recommended by the user groups during the interview process. A drawing was created to illustrate each of the design concepts including:

- Several options for mooring points including gravity anchor deadmen, concrete block deadmen, buried navy anchor, and stake piles as well as mooring bollards associated with a dock or wharf.

- Gravel pads for use as staging areas to offload and store cargo and materials, ranging in size from about 10,000 to 40,000 square feet depending on the size of community and volume of goods delivered.
- Gravel causeway or access ramp consisting of a gravel spit that juts out into the water, protected from erosion and ice on each side by armor rock, with smaller, sacrificial rock at the end to provide for a softer barge landing surface. These facilities are appropriate in areas where access to deeper water is required or where ice-damming is not a significant issue or regular maintenance of the structure can be accomplished.
- Concrete plank ramp including driven sheetpile to retain the gravel and planks on each side and to retain the upper slope. This structure also includes a geotextile filter fabric wrap around the gravel to further retain the material from scouring. Additional armor rock may be added in areas where high erosion or ice damming is a concern. This is a more robust structure intended for use in areas where a permanent hard surface across the beach is needed and where existing topography is such that appropriate slopes can be accomplished up the bank.
- Diaphragm Cellular Sheetpile Bulkhead Dock (Wharf) is the recommended dock design that is suitable for the entire study area. It is chosen because of this design's flexibility to the varying and remote conditions expected at the range of locations in Alaska, and its high performance in less stable conditions such as weak soils and erosion, which are known to exist at many sites, as well as the relative ease of construction. During the design phase of each project it may be determined that existing site conditions allow for an alternate, more cost-effective dock design.
- A combination sheetpile bulkhead dock and earthen ramp structure was also conceived based on recommendations by the barge operators to allow flexibility for side, end and ramp offloading.

A group of Priority Sites was identified for the initial round of funding. These Priority Sites were chosen based on a scoring matrix which evaluated (1) the urgency of need/time frame in which a project can be completed, (2) frequency of use and impact for a community, and (3) the relative ease for which the project can be planned and constructed. Essentially, the goal of the scoring is to determine which sites are thought to have the most positive impact for the funds expended and can reasonably be expected to be ready for near-term funding and construction. The result was 34 Priority Sites that are recommended for the first round of barge landing facility improvements.

OPCC estimates were prepared for each of the Priority Sites to assist the Commission with the planning and budgeting of the work. These estimates were completed based on a stand-alone project and include separate mobilization, field investigation, design, and construction administration costs for each site. Then, an effort to recommend reasonable grouping, or bundling of projects was made. The result is a total of approximately $50 M to complete barge landing facility improvements at the 34 Priority Sites.

12.0 REFERENCES

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