US Army Corps of Engineers
Alaska District

Navigation Improvements
Final Interim Feasibility Report
and Environmental Assessment

Nome, Alaska

JULY 1998

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, ALASKA
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NAVIGATION IMPROVEMENTS
FINAL INTERIM FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT

NOME, ALASKA

July 1998

Cover illustration by Bart Lane; photo by Sofia Troutman.
The Corps' Alaska District website is at http://www.usace.army.mil/alaska/

SUMMARY

This study recommends a plan for improvements to the marine navigation system at Nome, Alaska, which would reduce vessel delays, reduce damage to vessels due to grounding and hazardous entrance conditions, and ultimately increase vessel traffic and harbor use.

Nome harbor is the only facility for boat moorage and service in the region. Dutch Harbor, in the Aleutian Islands, is the closest harbor with similar facilities. (St. Paul, in the Pribilof group, nearer than Dutch Harbor but still more than 885 km from Nome, is likely to improve its facilities in the near future.) Given the high cost of airfreight and the lack of a system of highways or railroads, the regional economy is tied to water transportation. Nome is a regional center of trade, health care and education for 23 outlying communities within the Bering Strait-Norton Sound area, and is also home port to a commercial fishing fleet.

The original Federal navigation project at Nome, completed in 1917, consisted of two jetty structures stabilizing a -2.4-meter-MLLW channel passing through the Nome spit where the Snake River enters Norton Sound. Vessel delays and damage are being caused by shoaling and hazardous wave conditions within the channel and entrance area. Efforts to maintain the existing project have met with limited success, and complete loss of function is likely in the near future.

Historically Nome has not been a commercial fishing port, but with the creation of a community development quota system that allocates harvest quotas to coastal communities, the fishing fleet at Nome has grown to approximately 170 vessels. A new fish processing plant is being constructed along with other inner harbor improvements, including new docks, dredging, and shoreline property improvements. Also, a vital commercial transportation fleet of more than 40 vessels regularly use the harbor and the causeway structure. Clearly, the existing navigation system is grossly inadequate for the present and future needs of Nome and the communities that depend on Nome for goods and services.

The recommended plan for a new navigation system that can meet the immediate and future needs of the users includes the following components: a new rubblemound breakwater west of the existing project entrance, extending seaward approximately 910 meters (m); a new navigation channel passing through the spit between the causeway and the new breakwater, varying in depth from -3.1 m to -6.7 m MLLW; a 71.6-m rubblemound extension to the existing causeway; a sand bypassing plan; and deepening of the operational area for the causeway cells.

The average annual cost of the project over a 50-year period is estimated at \$2,339,000. Annual benefits would be \$3,608,000, for net benefits of \$1,269,000 and a benefit/cost ratio of 1.5.

The fully funded project cost is estimated at $23,372,000, of which $23,083,000 is cost-shared. Of the cost-shared amount, the Federal fraction is estimated at $20,727,000, while the local fraction, including LERRD[1], is estimated at $3,893,000. Harbor improvements costing $289,000 are 100-percent locally funded.

[1] LERRD = Lands, easements, rights-of-way, relocations, and disposal areas.

PERTINENT DATA

Navigation Improvements, Nome, Alaska
Recommended Plan

Excavations	Length (m)	Bottom elev. (m MLLW)	Dredging volume (m^3)
Entrance channel	1,150	-3.0 to -6.7	207,000
Sediment bypass system		-6.7	108,000
Contaminated material		-3.0	16,000
Dock approach channel (Federal & non-Federal)		-6.7	64,000
TOTAL			395,000

Breakwater	Length (m)	Crest elev. (m MLLW)	Crest width (m)	Rock volume (m^3)	
	910	+4.3	3.7	Armor rock	**60,800**
				Secondary rock	**17,600**
				Core & filter	**50,000**

Causeway spur	Length (m)	Crest elev. (m MLLW)	Crest width (m)	Rock volume (m^3)	
	70	+4.3	8.8	Armor rock	**12,200**
				Secondary rock	**3,100**
				Core & filter	**6,400**

PROJECT CONSTRUCTION COSTS ($000)[a]

Item	Federal	Non-federal	Total
General Navigation Features[b]	20,173	2,294	22,467
Local NED-associated costs[c]	0	1,507	1,507
Total NED costs			**23,974**
Navigation aids (U.S. Coast Guard)			10
Interest during PED			10
Interest during construction			1,550
NED investment cost			**25,544**
Interest and amortization of NED investment cost			1,880
Average annual maintenance cost			440
Total average annual cost			2,320
Average annual NED benefits			3,608
Net annual NED benefits			1,208
Benefit/cost ratio (7-1/8% interest)			**1.5**

[a] Basic assumptions:
(1) October 1997 price levels.
(2) 50-year project life.

[b] Cost sharing reflects provisions of the Water Resources Development Act of 1986.
[c] Costs for National Economic Development (NED) project components that are paid for 100% by the non-federal sponsor.

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GLOSSARY
Abbreviations, Acronyms, and Technical Terms

ABC = allowable biological catch
ADF&G = Alaska Department of Fish and Game
ADOT&PF = Alaska Department of Transportation and Public Facilities
BCR = benefit/cost ratio
CDQ = community development quota
CERC = Coastal Engineering Research Center; part of WES
cm = centimeter(s)
ER = Engineering Regulation
GI = General Investigations. This is the type of Corps study specifically authorized by Congress.
ft = foot, feet
gal = gallon(s)
General Navigation Features = Features of a project which can be paid for in part by the Federal Government through the Corps of Engineers. A breakwater is a general navigation feature.
H = horizontal
h = hour(s)
IPHC = International Pacific Halibut Commission
lb = pound(s)
LERRD = lands, easements, rights-of-way, relocation, and disposal areas
LOA = Length Overall (said of a vessel)
m = meter(s)
mt = metric ton (tonne)
mg/kg = milligrams per kilogram
mi/h = miles per hour
MLLW = mean lower low water
mo = month(s)
NED = National Economic Development. NED features of a project are those that increase the net value of goods and services provided to the economy of the United States as a whole.
NEPA = National Environmental Policy Act
NMFS = National Marine Fisheries Service
NPFMC = North Pacific Fishery Management Council
NSEDC = Norton Sound Economic Development Corporation
O&M = operation and maintenance
OMRRR = operation, maintenance, repair, replacement, and rehabilitation
PED = preconstruction engineering and design
PL = Public Law
P&I = Property and Indemnity (insurance)
SPM = *Shore Protection Manual*
USACE = U.S. Army Corps of Engineers
USCG = U.S. Coast Guard
USFWS = U.S. Fish and Wildlife Service
V = vertical
WES = Waterways Experiment Station (of the U.S. Army Corps of Engineers)
WRDA = Water Resources Development Act
yd^3 = cubic yard, yards
yr = year(s)

CONVERSION TABLE FOR SI (METRIC) UNITS

This table is provided to help in the conversion of SI (metric) units of measurement to inch-pound units.

Multiply	By	To obtain
Celsius degrees	*	Fahrenheit degrees
centimeters	0.3937	inches
kilograms	2.2046	pounds
kilometers	0.5396	miles (nautical)
kilometers	0.6214	miles (U.S. statute)
meters	3.281	feet
meters	1.0936	yards
metric tons (tonnes)	1.1	tons

* To obtain Fahrenheit (F) temperature readings from Celsius (C) readings, use the following formula: F = (9/5 x C) + 32.

About English and metric units:

Measurements and quantities in this report are primarily reported in metric units. However, since surveys for the study were in English (inch-pound) units, the design work was carried out using English units. Therefore, Appendix A, Hydraulic Design, and some figures in the main report providing detailed survey information are in English units. It is critical to remember that the exact design values were calculated in English units and converted to metric in this report. Some error is obtained due to the rounding.

ACKNOWLEDGMENTS

This report was prepared by the staff of the Alaska District, U.S. Army Corps of Engineers, in Anchorage, Alaska. The study manager was Mr. William Appleton of the Project Formulation Section in the Civil Works Branch, Engineering Division of the Alaska District. Mr. Randy Romanesko managed the study for the city of Nome, the non-federal sponsor.

Economic analyses were performed by Mr. Kenneth Boire, working for Raytheon Engineers and Constructors, of Bellvue, WA. Mr. John Burns of the Environmental Resources Section, Civil Works Branch, was principal preparer of the Environmental Assessment.

The hydraulic design analysis was done by Mr. Ken Eisses and Mr. Ed Sorenson of the Hydraulics Hydrology Section of Civil Works Branch, in conjunction with Mr. John Oliver of John Oliver Consulting, Sherwood, OR. Mr. Ray Bottin of the Waterways Experiment Station, Coastal Engineering Research Center, conducted the two- and three-dimensional model studies.

Geotechnical investigations were carried out by Woodward-Clyde under contract with the city of Nome, and reviewed by Mr. Jeff Harman and Mr. Bret Walters of Geotechnical Branch.

The project cost was estimated by Mrs. Valarie Smith of Cost Engineering Branch, Engineering Division. Mr. Doug Trosper of Real Estate Division analyzed the real estate requirements. The report was edited by Ms. Carolyn Rinehart of Project Formulation Section, and Ms. Diane Walters of Environmental Resources Section edited the environmental documents. Mr. Bart Lane and Mr. Jim Fuhrer of Civil Works Branch prepared the figures.

These investigations were conducted under the direction of Mr. Kenneth E. Hitch, Acting Chief, Engineering Division; Mr. Carl D. Stormer, Acting Chief, Civil Works Branch; Mr. Ken Eisses, Chief, Hydraulics and Hydrology Section; Mr. Andrew W. Miller, Chief, Economics Section; and Mr. Guy R. McConnell, Chief, Environmental Resources Section.

Commander and District Engineer of the Alaska District during this study was Colonel Sheldon Jahn, Corps of Engineers.

NAVIGATION IMPROVEMENTS
FINAL INTERIM FEASIBILITY REPORT
NOME, ALASKA

1. INTRODUCTION

1.1 Study Authority

This feasibility study was recommended in a December 1996 report by the Alaska District, U.S. Army Corps of Engineers, entitled "Navigation Improvements Reconnaissance Report, Nome, Alaska." This study is authorized by a resolution adopted on December 2, 1970, by the Committee on Public Works of the U.S. House of Representatives. The resolution states:

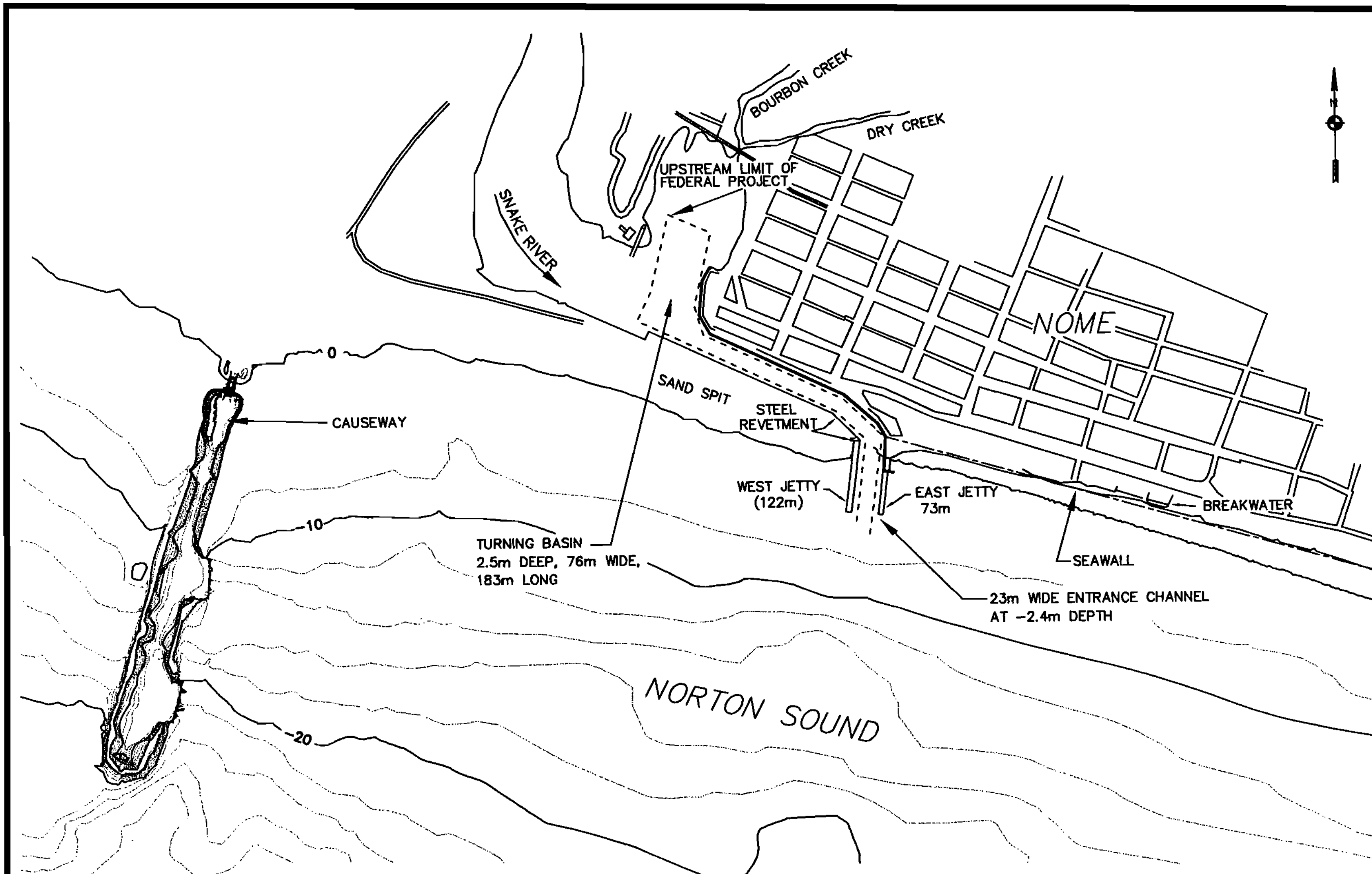
> *Resolved by the Committee on Public Works of the House of Representatives, United States, that the Board of Engineers for Rivers and Harbors is hereby requested to review the reports of the Chief of Engineers on Rivers and Harbors in Alaska, published as House Document Numbered 414, 83rd Congress, 22nd Session; and other pertinent reports, with a view to determine whether any modifications of the recommendations contained therein are advisable at the present time.*

1.2 Scope of Study

This feasibility study evaluates various project alternatives designed to improve the navigational characteristics and conditions at Nome harbor and causeway. The existing navigation project and the location of Nome are shown in figure 1. Evaluation of the alternatives is based upon their implementability, economic viability, and environmental soundness. Detailed engineering, economic, and environmental analyses were conducted to the extent necessary to satisfactorily identify the NED plan from those alternatives evaluated.

1.3 Study Participants

The city of Nome requested a preliminary reconnaissance study in a letter dated August 9, 1993. The study was initiated under Section 107 of the River and Harbor Act of 1960, as amended, but it was found that the level of benefits and the size of the project warranted that the study be changed to a general investigation. Support from the city for continuing the study as a general investigation was supplied by letter dated April 30, 1996.



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PROJECT AREA MAP

NAVIGATION IMPROVEMENTS, NOME, ALASKA

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The General Investigation Reconnaissance Report and Feasibility Cost Sharing Agreement were certified to be in accordance with current policies and priorities on April 24, 1997, at which point the city of Nome and the Corps' Alaska District initiated a feasibility level study. The study was conducted as a partnership under the terms of the agreement. The costs of this study have been shared equally, and the study management team includes representatives from both the city of Nome and the Alaska District. City officials, members of the Community Development Quota organization and the port commission, commercial shippers, commercial fishing organizations, and other members of the community were key participants in the yearlong planning effort.

Other agencies and organizations contacted or contributing to this study include:

- Alaska Department of Fish and Game
- U.S. Fish and Wildlife Service
- U.S. Environmental Protection Agency (EPA)
- National Marine Fisheries Service
- Alaska Department of Transportation and Public Facilities
- State Historic Preservation Officer
- Alaska Division of Governmental Coordination
- Alaska Department of Natural Resources

1.4 Previous Studies

Numerous studies have been conducted on the Nome harbor and causeway. The most important studies reviewed for this report are listed here.

1.4.1 Investigations by the Corps of Engineers.

USACE Alaska District. 1996. "Disposal Management/Monitoring Plan for the Nome Ocean Dredge Material Disposal Sites, Nome, Alaska."

USACE Alaska District. 1996 (Dec). "Navigation Improvements Reconnaissance Report, Nome, Alaska," Anchorage.

1.4.2 Investigations by Others.

City of Nome. "1989 Annual Report, Nome Littoral Drift Monitoring and Shore Protection Program."

Environmental Services Limited. 1981 (Jul). "City of Nome Coastal Management Program Background Report."

Ettema, R., and Kennedy, J.F. 1982. "Ice Study for the Port of Nome, Alaska," IIHR Limited Distribution Report No. 101, Iowa Institute of Hydraulic Research.

Gute & Nottingham. 1974 (Oct 15). "Engineering Feasibility Study, Marine Barge Terminal at Nome, Alaska." Prepared for State of Alaska, Department of Public Works, Division of Water & Harbors.

HartCrowser. 1996 (Jul 24). "Results of Sampling and Analysis, Sediment Quality Assessment, City of Nome Harbor Development Project, Nome, Alaska," J-4579, prepared for DHI Consulting Engineers.

Tetra Tech, Inc. 1981. "Port Master Plan, Nome, Alaska."

Tippetts-Abbett-McCarthy-Stratton Engineers. 1982. "Port of Nome, Alaska Design Memorandum."

U.S. Geological Survey. 1995. "Overview of Environmental and Hydrogeologic Conditions at Nome, Alaska," Open-File Report 95-178.

Wang, Hsiang *et al.* 1983 (Jul). "Two-Dimensional Breakwater Stability Test For Port Facility, Nome Alaska," UFL/COEL/TR-048, Coastal & Oceanographic Engineering Department, University of Florida.

Woodward-Clyde Consultants. 1998 (Jan). "Nome Harbor Site Investigation Report," prepared for city of Nome, 3501 Denali Street, Suite 101, Anchorage, Alaska 99503.

2. REGIONAL SETTING

2.1 Socioeconomic Setting

2.1.1 Study Overview.

Nome harbor provides the only facility for boat moorage and service in the region. Dutch Harbor, located in the Aleutian Islands, is the closest harbor with similar facilities; however, St. Paul, located on St. Paul Island in the Pribilof group, is likely to improve its facilities in the near future. Lacking a system of highways or railroads, the regional economy is tied to water transportation, the only other choice being high-cost airfreight. Due to the importance of Nome as a regional center of trade, health care, government, and education for 23 outlying communities within the Bering Strait-Norton Sound area, it is necessary that this vast area be considered in the study. Nome and its dependent communities are pictured in figure 2.

2.1.2 Study Area.

The study area, generally referred to as the Bering Strait-Norton Sound area, has a land and water area of approximately 258,000 square kilometers (km^2). It encompasses all watersheds draining into Norton Sound and the Bering Strait, from Shishmaref in the north to Hooper Bay in the south.

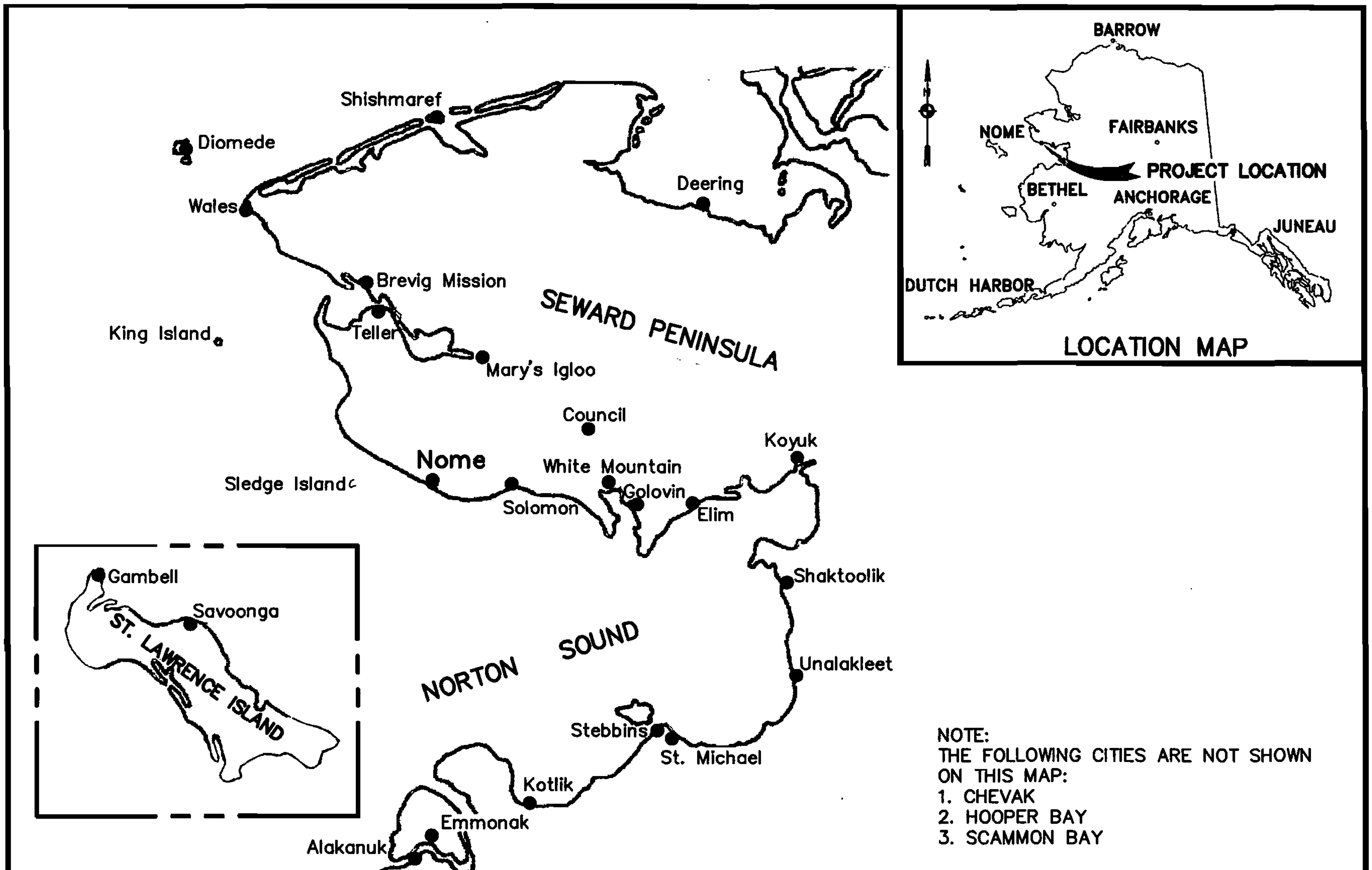
2.1.3 Local Opportunities.

State and Federal regulations in Alaska have intentionally granted a marine harvest advantage to shore communities by allocating harvest quotas specifically to community groups. Known as the Community Development Quota (CDQ), this initiative is creating local industry and an expanding fishing fleet at Nome. The new fleet is owned by citizens of several villages but operated out of Nome because the harbor location allows a lower-cost operation compared to alternative arrangements.

2.1.4 Population.

By Alaska standards, Nome is a community of moderate population size. The city population of 3,656 includes 40 percent of the population in the census area. The census area, with 8,800, is the 10th largest in the State.

Only 23 communities in the State have populations between 1,000 and 10,000. Of the State's population, 21 percent reside in communities smaller than 1,000, while about



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COMMUNITIES DEPENDENT UPON NOME
AS A TRANSPORTATION HUB
NAVIGATION IMPROVEMENTS, NOME, ALASKA

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63 percent reside in the State's three largest cities -- Anchorage, Fairbanks, and Juneau.

2.1.5 Economy.

The study area suffers from profound economic problems, with a 22 percent unemployment rate and more than 31 percent of the population in poverty, according to census information. Subsistence harvest is essential to the Native population that accounts for 90 percent of the people within the census area and 78 percent of the residents of the CDQ communities.

Use of the term "mixed economy" has special implications in rural areas of Alaska. In the Alaska-style mixed economy, households typically follow a pattern of activity that combines employment for cash with traditional fishing and hunting. Subsistence gathering contributes to the household food supply, but it also provides building material, fuel, and raw material for tools, clothing, and arts and crafts. Some villages are more traditional than others, but in a number of them the residents still use the Native language daily and hunt with traditional methods, such as the use of open boats covered with walrus hide.

2.1.6 Employment.

Government services provide the major source of Nome's employment. The workforce of 1,570 includes 526 who work for the Federal, State or local government. Of the 1,018 persons employed in the private sector, the single largest class of employment is retail trade, which accounts for 308 jobs. Health care is second with 198 jobs, and education is third with 144. The employment profile shows that Nome is serving as a regional center for government, trade, health, and education support.

Fishing, while it does not provide year-round employment locally, is important to the local food supply and the mainstay of a regional economy that depends on summertime activity for cash income. There are 281 commercial fishing permits registered for use within the greater area of Norton Sound, and an additional 57 halibut permits are registered to residents of the Nome census area. Of this total of 338 permits, 72 belong to Nome residents.

2.1.7 Income.

Using census data from 1990, updated to 1994 by the State, per capita personal income (PCPI) for the Nome census area is $16,573. This PCPI ranked 23rd in the

State, and was 71 percent of the State average of $23,437 and 76 percent of the national average of $21,696. Conclusions about economic well-being based on PCPI need to be tempered by the fact that the cost of living in the Nome area is about twice the cost of living outside the State.

2.1.8 Transportation Problems.

Ideally, village residents would elect to use water transportation at every opportunity. It promises to be the cheapest delivery mode, and since most of the villages are located directly on the beach, water transportation has the advantage of being the least complex. The major disadvantage is that goods shipped by water must be delivered first to Nome, where they are reshipped to the final destination. Reshipping involves delivering the cargo to land-based staging areas at Nome, where it is sorted for delivery to a final destination. Sorting the cargo at Nome involves several pieces of machinery, several storage areas, and a number of personnel. Final deliveries are made by small, shallow-draft vessels called lighters, which go from a larger barge or directly from Nome to deliver cargo to communities where water depths are too shallow for delivery by larger vessels. The sorting is a necessary operation to minimize time, confusion, risk, and breakage for the lighter making the final delivery, which may need to beach itself to unload. The lighters minimize time spent in conditions that put the hull and machinery at risk of damage.

2.2 Physical Setting

2.2.1 Estuary.

The lower reach of the Snake River meets Norton Sound to form an estuary, an area of interaction between salt and fresh water. Because of the minimal freshwater flow, the system is stratified, with most of the fresh water passing near the surface and salt water intruding landward along the bottom. Flow strengths are minor, and little mixing occurs due to stratification within the water column. Modest tides limit water exchange, and flushing within the estuary is minimal.

Saltwater intrusion does not appear to play an important part in estuary sedimentation. The region that experiences heavy shoaling is downstream of the point of zero net flow. The apparent location of marine sediment entrapment at Nome is in the first few hundred feet inside the jetties. Upland suspended sediments appear to deposit in the vicinity of the mooring basin at the downstream extent of the Snake River.

2.2.2 Climate.

Temperatures in Nome and across much of Norton Sound are moderated by open ocean waters typically from early June to about the middle of November. The average temperature during the summer months (June-September) is 8.3 °C. Storms within this area during these months result in extended periods of cloudiness and rain. During the summer months, the daily temperature range is very slight. The average temperature during the winter months (December-March) is -14.5 °C. The freezing of Norton Sound, which usually takes place in November, causes a rather abrupt change from a maritime to a continental climate. Temperatures generally remain well below freezing from the middle of November to the latter part of April, with January being the coldest month of the year.

Nome receives an average annual rainfall of approximately 40.5 centimeters (cm). Precipitation reaches its maximum during the late summer months and drops to a minimum in April and May.

2.2.3 Ice Conditions.

The proposed project is within an area of sea ice formation. According to the *Alaska Marine Ice Atlas,* ice pack can begin to show up off Nome as early as November, and by mid-December, the leading edge of Arctic ice is shown to extend as far south as 60° north latitude. Fast ice extends out from the shore as much as 7 miles. Farther out from about 307 m, the ice surface typically has more buckled ice and ice ridges than the smoother ice close to shore. Beyond the fast ice is the pack ice zone, consisting of drifting ice. Maximum ice thickness is about 1.4 m. By April, the ice pack begins to recede. Nome usually experiences breakup in late May or early June.

The Snake River at the existing harbor turning basin typically freezes up around the end of November but has frozen as early as September, according to some residents. The upstream portion of the river, with a smaller cross-sectional area, is more susceptible to freezing than the area near the existing turning basin. Spring breakup of the Snake River occurs prior to the Norton Sound ice breakout, with the river discharge helping to clear the area of Norton Sound ice at the exit into Norton Sound. At the existing sheet-pile-faced dock just east of the existing turning basin, vessels are placed in the water by an average date of May 15.

2.3 Existing Navigation Project

In 1917, the Corps was authorized to construct a navigation project at Nome consisting of a navigable channel in the lower reaches of the Snake River and stabilizing the mouth of the river with two concrete and timber jetties. The easternmost structure was 102 m long, and the western structure was 140 m long. Construction was completed in 1923. Wave and ice activity led to major deterioration of the jetties, and both were reconstructed in 1940 using reinforced concrete to lengths of 73 m and 122 m. Since then, major repairs to the jetties and entrance area have been made in 1954, 1965, 1985, and 1986.

The authorized width of the channel is 23 m at a depth of -2.4 m mean lower low water (MLLW) from Norton Sound through the Snake River, ending in a basin of the same depth. The basin is 76 m wide and 183 m long. The entrance channel was constructed with an abrupt 90-degree turn without widening and has not been maintainable with dredging efforts applied since construction. The channel is approximately 587 m long. The channel and riverbanks were originally stabilized with timber piling. The timber piling was severely damaged during a storm in 1945. The timber piles were completely refaced with steel sheet pile in 1952. The total length of sheet-pile bulkhead is 1,169.9 m.

Due to continued deterioration of the harbor's navigation features, the city of Nome requested a preliminary reconnaissance study investigating navigation improvements to the existing federal channel and jetty structures in a letter dated August 9, 1993. A Section 107 study was initiated under the authority of the River and Harbor Act of 1960. However, the Section 107 study was replaced by a General Investigation study due to the possibility for large growth in the fishing fleet, barge traffic, and operation and maintenance (O&M) savings.

Findings of the Reconnaissance Report indicated that the existing navigation project at Nome is not functionally adequate and requires major modifications or replacement to meet the needs of the growing fleet and barge traffic. Even under moderate seas, treacherous conditions can exist within the channel and entrance area due to the highly reflective sheet-pile-lined channel, poor jetty configuration, and inadequate channel depths. Barges and other vessels using the entrance area incur extensive damage when wave action causes them to impact the sheet-pile walls. Table 1 lists hazardous conditions in the entrance channel with their frequency of occurrence.

TABLE 1.--*Threshold entrance conditions*

PROBLEM	OCCURRENCE
Shoaling	Often happens at the beginning of the season and gets worse as the season progresses.
Set-down*	About 3 times per year with 2-3-day duration.
Swell	About 36 times per year during about 20 percent of the navigation season.
Waves in excess of 1 meter	About 48 percent of the time during the navigation season.
Perpendicular winds above 20 knots	About 2 percent of the time during the season.

* A wind-induced recession of water along the shoreline.

2.3.1 Present Condition of Federal Channel.

High shoaling rates, coupled with frequent weather-related work stoppages, have hindered efforts to maintain authorized channel depths at Nome. The sheet-pile bulkhead lining the channel is corroded and in danger of failing. Numerous piles have holed through at the water line, allowing sand to enter the channel, while other piling sections are severely corroded and in danger of total failure. Large segments could fail during any major storm and curtail harbor activity as a result.

The channel configuration includes a constant-width 90-degree turn, and a wall that reflects wave energy propagating down the channel. Unattenuated wave action in the channel frequently creates a surfing condition for vessels, during which helm control can be compromised. The outer channel is within the zone of sediment transport and therefore subject to sediment deposition. Maximum dredging efforts by the Corps of Engineers have not been able to maintain a continuously open system at the -2.4 m-MLLW federally authorized depth. That dredging effort has included continuous active dredging presence through the open navigation season and the removal of up to 10,000 cubic yards of material per year.

2.3.2 Present Inner Harbor Condition.

The city of Nome has begun to upgrade and expand the Nome small boat harbor and its facilities. The area of upgrade is adjacent to the northern portion of the existing federally authorized turning basin area. (See figure 1.) The new construction includes a sheet-pile bulkhead, dredging to depths of –2.4 m to –3.1 m MLLW, filling an area of approximately 6 acres, constructing floating docks and ramps, and placing rip-rap along the shoreline. The city started construction in April 1997 by dredging the west half of the harbor and plans to complete the work in December 2000.

2.3.3 Locally Constructed Causeway.

The causeway was constructed with 22-ton, 16-ton, and 8-ton armor rock on the west side of the trunk, 22-ton rock at the head, and 8-ton rock on the east side of the trunk. The side slope of the west side and head is 2H:1V; the side slope on the east is 1.5H:1V. The top elevation of the west face varies from +20 to +28 ft MLLW. The east face top elevation is +15 ft MLLW. The core of the causeway is pit run tailings, a clean gravel with a maximum unit weight of 100 lb and not more than 5 percent by weight passing a 200 sieve. Adequate mass was placed to resist up to 110 kips per linear foot of lateral ice thrust.

A breach was left in the causeway to allow passage of juvenile fish and other marine life. The breach was placed at the preconstruction -2.4-m (MLLW) depth contour and bridged to allow cargo transfer on the causeway.

After completion of the causeway, two earth-filled open-cell sheet-pile docks were constructed on the west side. The inner cell was completed in the fall of 1989, and the outer cell was completed in August 1991. A pipeline extends to the outer dock. Both loading/off-loading cells were constructed using 21.5-m-long sheet pile.

2.3.4 Present Causeway Condition.

The causeway structure is in excellent condition, but the fish passageway has shoaled to an elevation of –0.76 m MLLW. The structure appears to be very stable. There is no known movement of stone, and ice has not presented a problem. A load limit on the bridge across the fish passage breach controls loads on the causeway road.

The causeway acts as a littoral barrier, preventing the vast majority of littoral drift from passing around the structure. As a result, a large area of accretion has developed on the western and to a lesser degree on the eastern side of the causeway. Modeling has shown that decreased depth along the causeway is causing wave focusing due to refraction as well as wave shoaling, which causes wave heights to increase up to 30 percent at the dock facilities.

2.4 Hydraulics

2.4.1 Tides and Water Levels.

Storm surges, discussed in the next subsection, cause greater sea level fluctuations at Nome than do the tides. Extreme high tide levels, however, can result from the combination of astronomic tides and rises in local water levels due to atmospheric and wave conditions. Table 2 presents Nome tidal data referenced to MLLW.

TABLE 2.--*Nome tide levels (meters)*

Mean Higher High Water (MHHW)	+0.49
Mean High Water (MHW)	+0.43
Mean Low Water (MLW)	+0.12
Mean Lower Low Water (MLLW)	0.0
Lowest Tide (estimated)	.-0.76

Source: NOAA Chart 16206, 6th ed., July 21, 1990.

From the above data, the mean tide, the arithmetic average of the mean high water (MHW) and the mean low water (MLW), is 0.27 m. The mean range is the difference between MHW and MLW of 0.31 m.

2.4.2 Storm Surge.

Storm surge is a short-term variation in water level brought about by wind-induced shear stress on the ocean's surface and by barometric pressure differentials. It can cause significant changes in water level along the Nome coastline. The shallow depth of Norton Sound amplifies the surges. Both setup, a "piling up" of water along the shoreline, and set-down, a "pushing away" of water along the shoreline, can occur. This century, there have been 14 recorded events during which Nome experienced flooding due to an increase in water levels caused by storm surge.

2.4.3 Currents.

Coastal currents at Nome vary depending upon wind and wave direction, wave height, and wave period. According to Hood *et al.*, 1974, observations in August and September showed current speeds of 0.3 to 0.5 knots with occasional peaks up to 0.8 knots. According to the *Coast Pilot* (NOAA 1983), offshore 2 miles, the currents average in the 1-knot range with a diurnal pattern. The flood sets east and the ebb sets northwest. Physical modeling results showed significant rip currents along the causeway depending upon the still water level, wave direction, and wave height. The results are explained in detail in subsection 5.10 of this report and in appendix A (section 6).

2.4.4 Wave Hindcast.

Due to a lack of physical data, it was necessary to generate wave data synthetically for the project site. To accomplish this, existing wind velocity data was used to drive a numerical wind wave model, the products of which are wave heights, periods, and direction. This technique is called hindcasting, and it is used extensively in coastal engineering to create realistic, synthetic wave data for locations where no physical data is available. The wave hindcast information was then used with appropriate adjustments in the physical model to test alternative designs.

2.4.5 Alongshore Transport.

The movement of littoral drift is primarily dependent upon the wave field and the incident wave angle to the beach. Since the majority of the waves incident to the study site are out of the west-southwest, net sediment transport at the site is from west to east. This is supported by the large accumulation of sediments on the west side of the causeway structure; the structure acts as a partial littoral barrier. The gross sediment transport rate is estimated to be 138,000 cubic meters (m^3) per year, while the net is estimated to be 46,000 m^3/year to the east. These transport rates, though not immense, go a long way in defining the futility of attempting to maintain an unprotected channel that passes through the active transport zone. Cross sections surveyed through the shoaled area indicate that active onshore/offshore sediment movement ceases at about –6.7 m MLLW. That depth is defined as the "depth of closure," the point at which there is no longer any significant sediment movement due to wave action.

2.4.6 Fluvial Transport.

Under normal low flow conditions, the Snake River does not contribute a significant amount of sediment.

2.5 Soils

2.5.1 Site Investigations.

The city of Nome contracted with Woodward-Clyde Consultants to complete a geotechnical/chemical site investigation for this study. Soil sampling was done during the winter of 1997, and the final report was completed in January 1998.

2.5.2 Physical Results.

All soil samples were classified as loose sands with or without silts and gravel. Subsurface samples were generally described as medium sand, while offshore sediment samples were described as fine sand. Based on these results, channel side slopes of 1V:3H (18°) are recommended.

Boring logs, in addition to the observed stability of the causeway, which is within the immediate project area, indicate that the bearing capacity of the *in situ* soils is adequate for the proposed structures. Soil borings also indicated that standard dredging practices, *i.e.* clamshell or dragline, could be employed successfully at the project site.

2.5.3 Chemical Results.

All soil samples were tested for volatile (VOC) and semi-volatile (SVOC) organic compounds, as well as metals. No VOC's are believed to be present at the site, given laboratory results on the soil samples collected. Several SVOC's were detected in the subsurface samples and in one of the sediment samples. Two SVOC's, benzo(a)pyrene and dibenzo(a,h)anthracene were detected in one of the samples above EPA residential Risk Based Concentrations (RBC's). Of the four soil borings, two grab samples, and five sediment samples taken, all were found to contain arsenic. Arsenic was detected at concentrations of 5.1 to 260 milligrams per kilogram (mg/kg). The concentration of arsenic in all samples, except for 4 offshore samples, exceeded the EPA residential soil RBC (23.0 mg/kg). The only other metal of concern was mercury, which was found to be above the Marine Sediment Quality Standards (0.41 mg/kg) in two of the boring samples, AP-1001 (1.7 mg/kg) and AP-1003 (0.61 mg/kg).

3. PLAN FORMULATION

3.1 Problem Statement

The existing navigation project at Nome is not functionally adequate and requires major modifications or replacement to meet the needs of the growing fleet and barge traffic. Even under moderate seas, treacherous conditions can exist within the channel and entrance area due to the highly reflective sheet-pile-lined channel, poor jetty configuration, and inadequate channel depths. Barges and other vessels using the entrance area incur extensive damage when wave action causes them to impact the sheet-pile walls. During the navigation season, delays caused by poor entrance conditions can cause vessels to miss ice-free windows and delay shipments to outlying villages for months. Delays, vessel damage, and vessel safety are of major concern to harbor users and will continue to be as growth in the fleet continues to stress the resources of the present harbor. The isolated nature of the communities, the profound economic underdevelopment, and the harsh arctic climate underscore the importance of modern navigation. A navigation project would result in positive economic effects throughout the web of villages that depend on the Nome harbor for survival.

These two primary problems were described by the project sponsor and verified by research and technical analysis:

- Delays and damages in accessing the inner harbor facilities, caused by inconvenient channel alignment and inadequate channel depth and width. The problems are compounded by deteriorated structures and a difficult maintenance environment.

- Delays and damages related to use of the causeway docks. Local interests state that they are unable to make dock landings when waves are about 1 meter in height. Review of shipping records indicates that wave conditions make the causeway unusable about 40 percent of the time at the outer dock and 30 percent at the inner dock.

3.2 Study Overview

This study analyzes the role of the harbor and evaluates three navigation system development scenarios. The study identifies impacts of proposed improvements on the national and local economies. These three scenarios were evaluated in this study:

- Major rehabilitation of the existing project based on replacement in kind.
- Reconstruction of the entrance including improved alignment, a new breakwater, and increased channel depth.
- In addition to reconstruction of the existing navigation features, modification of the causeway end resulting in a calmer vessel off-loading area adjacent to the causeway.

Through the plan formulation process, design alternatives were developed and evaluated to determine which plan best meets the needs of the intended users while being constructable, economically viable, and environmentally acceptable. These five primary design concepts were considered during the development of alternatives:

- Dredging a new channel through Nome Spit.
- Extending and deepening the Federal channel.
- Relocating the existing harbor.
- Constructing new navigation structures.
- Modifying the existing causeway.

The design alternatives incorporated solutions to historical problems with the existing project, which include sediment deposition within the navigable channel, wave-impacted channel conditions, and poor entrance conditions. Also, several of the alternatives include solutions to problems with use of the existing causeway. Local input was used to identify specific improvements that could be made to the existing project, identify the future needs of the fleet, and outline difficulties with use of the causeway. Therefore, alternative design concepts responded to the need to accommodate the fishing fleet and to reduce delays and damages experienced by commercial shippers and users of the causeway.

3.3 Without-Project Condition

The existing Nome harbor project has deteriorated and is in danger of immediate failure. This study assumes that the most likely future condition will be major rehabilitation of the project rather than its abandonment. Reasons for this assumption are discussed in the following paragraphs.

- The project was authorized in 1917 and constructed in 1923. It has been maintained by the Federal Government with jetty reconstruction in 1940 and major repairs to the jetties and entrance area in 1954, 1965, 1985, and 1986.

- The city of Nome has begun upgrading and expanding the Nome small boat harbor and facilities adjacent to the northern portion of the existing federally authorized turning basin.

- The existing harbor is essential to the area.

- It is a federally authorized project, with no deauthorization foreseen.

- The reconnaissance report did not support abandonment of the project.

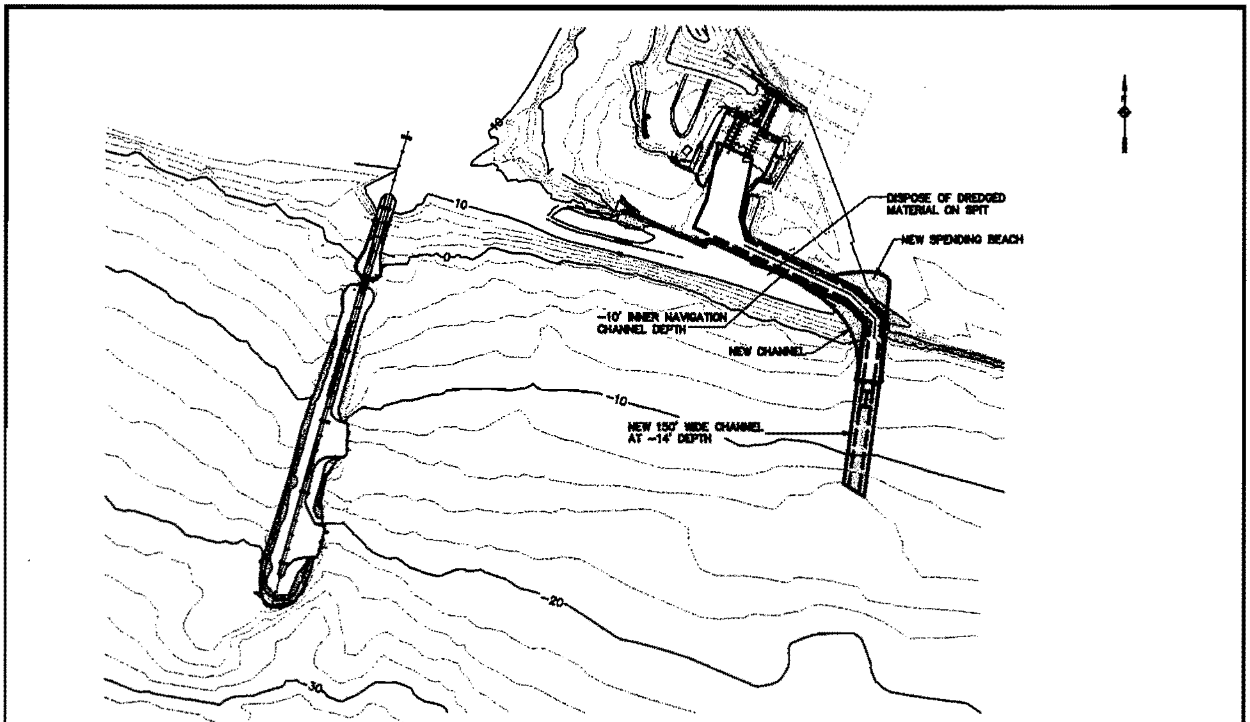
- The analyses in this report demonstrate that major rehabilitation is economically justified. Strong economic arguments favor extending the service that has been provided by the project since the 1920's. The economic rationale is that even with all of the current problems associated with the project's high O&M cost and outdated design, the potential annual benefits from major rehabilitation exceed costs by a ratio of 2.4 to 1. This is further discussed in Appendix B, Economic Analysis.

3.4 Alternative Plans

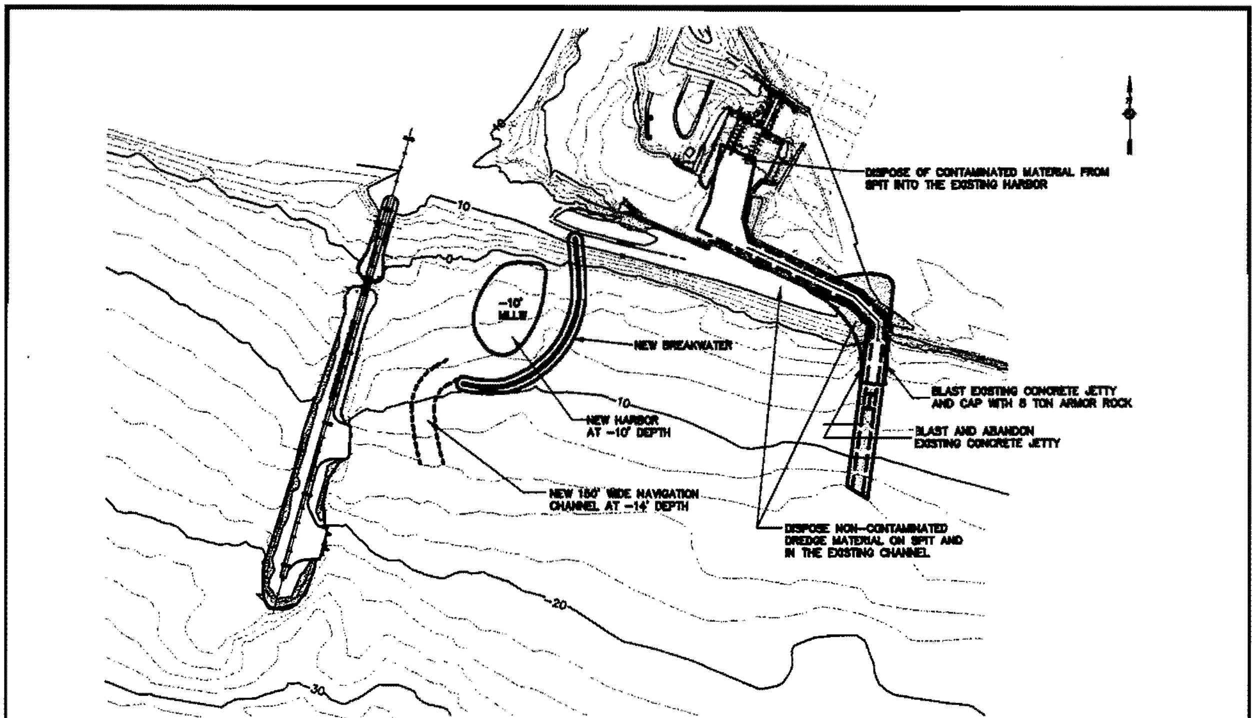
Detailed drawings of 12 of the 14 alternatives are shown in this section of the report and in Appendix A, Hydraulic Design. The two not illustrated are plan G, addition of a causeway cell, and plan N, no action. All of the alternatives are described briefly in the remainder of this section. Additional details can be found in appendix A.

- **Plan A** – This plan, shown in figure 3, would extend the existing jettied entrance, deepen and modify the geometry of the navigable channel, and add a spending beach at the elbow in the channel to allow for dissipation of wave energy within the channel. Though this plan was initially viewed as a low-cost alternative capable of solving both maintenance and navigation problems, it was found to have high costs and low effectiveness. The jettied entrance would still be within the seaward limit of sediment motion and would therefore be subject to the same frequent shoaling as the present project. This shoaling would be likely to aggravate entrance conditions by causing wave focusing and wave breaking, which in turn would lead to continued delays and vessel damage. Also, the design does not solve any of the problems associated with the causeway and would not benefit the oceangoing fleet.

- **Plan B – This** alternative, in figure 4, involves the construction of a curved breakwater structure extending from the shoreline 365 m seaward. The structure would provide a quiescent area between the causeway and the lee side of the new breakwater that would be developed into a small boat harbor. A 244-m-long, 46-m-wide channel, dredged to –4.3 m, would facilitate access into the harbor area. Aside from shoaling and level-of-protection issues, the potential accomplishments of this alternative are negated since the plan complicates coordination with existing harbor facilities. In addition, this plan does little to solve problems associated with the causeway.



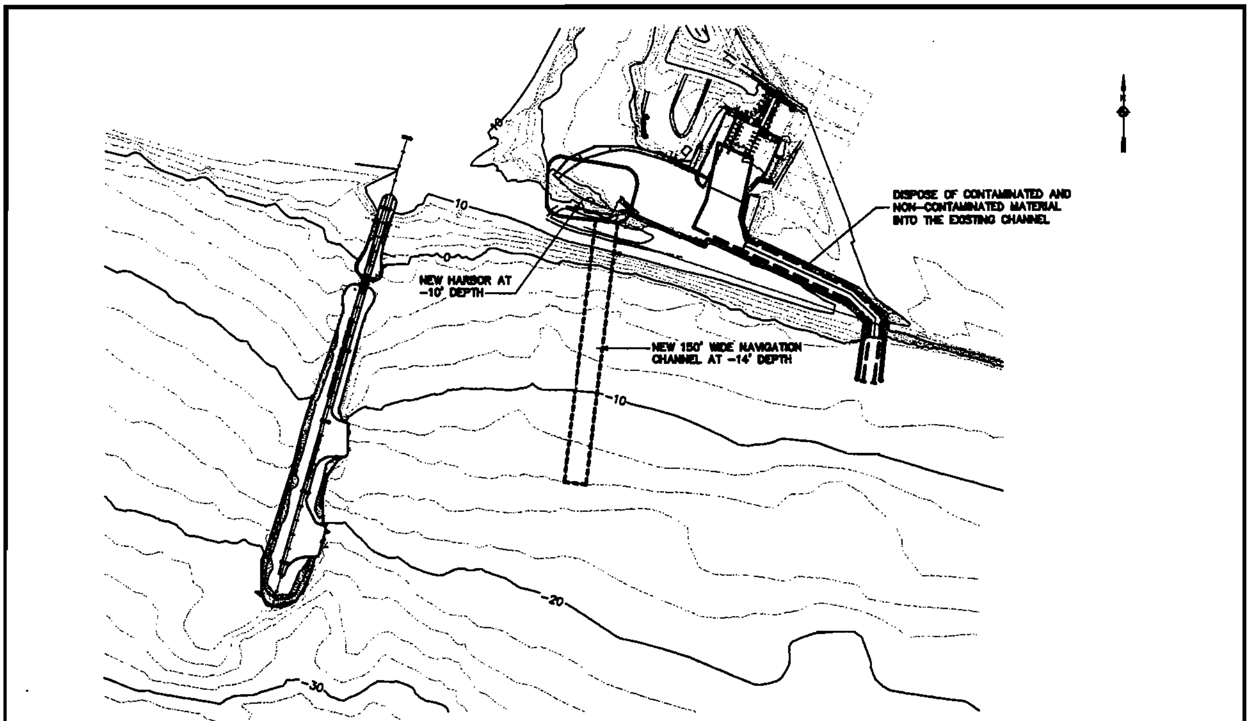
ALASKA DISTRICT CORPS OF ENGINEERS CIVIL WORKS BRANCH	**ALTERNATIVE A** **NEW CHANNEL NEXT TO EXISTING W/SPENDING BEACH** **NAVIGATION IMPROVEMENTS, NOME, ALASKA**	3



ALASKA DISTRICT CORPS OF ENGINEERS CIVIL WORKS BRANCH	**ALTERNATIVE B** **NEW CHANNEL OFF CAUSEWAY W/BREAKWATER** **NAVIGATION IMPROVEMENTS, NOME, ALASKA**	4

- **Plan C** - A new harbor located within an area that is now part of the spit would be created with this plan, shown in figure 5. The plan involves dredging a new channel through the spit to a newly excavated harbor. The new harbor would create logistical problems due to the distance from the existing harbor and the support facilities. This would be a major operational disadvantage, given the harsh weather at Nome. The extremely high cost of new development rules out relocation of existing harbor facilities as part of this plan. The spatial layout of this plan provided negative aspects but did not create advantages able to outweigh them. From an engineering standpoint, the lack of channel stabilization structures in this design would lead to enormous O&M costs to keep the channel open and maintained at the authorized depth. Although the new harbor entrance would be sheltered to a greater extent by the causeway structure, the plan still allows wave energy to enter directly into the new harbor area with little dissipation.

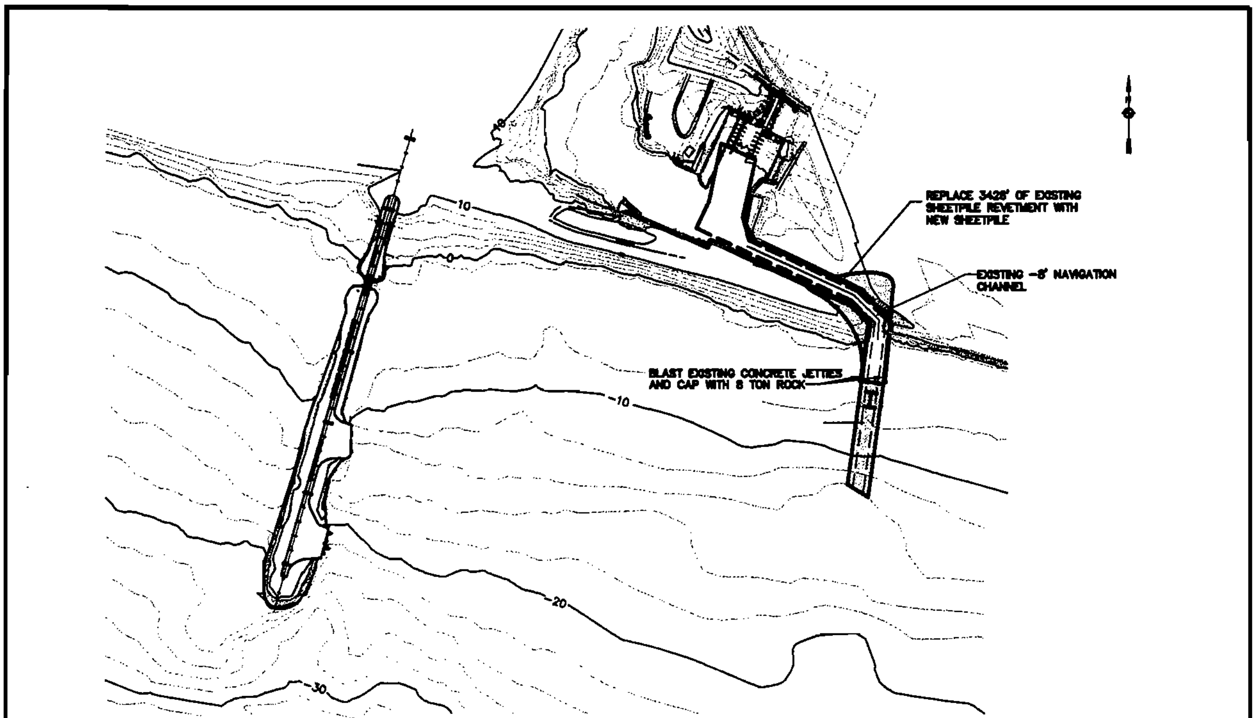
- **Plan D** - This plan, in figure 6, is limited to major rehabilitation of the existing project. The condition of the project requires that rehabilitation take place immediately if the community is to continue benefiting from the harbor. However, the present project configuration has proven to be a poor design, subject to both sediment deposition and high wave energy within the entrance and channel areas. Therefore, present levels of vessel damage and delays would likely remain following the rehabilitation of the existing project. Although plan D is economically justified, net benefits are increased substantially if the plan is developed beyond replacement in kind. Plan D is the without-project condition for evaluation of all other plans.



ALASKA DISTRICT
CORPS OF ENGINEERS
CIVIL WORKS BRANCH

ALTERNATIVE C
HARBOR OUTSIDE RIVER BED IN SPIT
NAVIGATION IMPROVEMENTS, NOME, ALASKA

5



ALASKA DISTRICT
CORPS OF ENGINEERS
CIVIL WORKS BRANCH

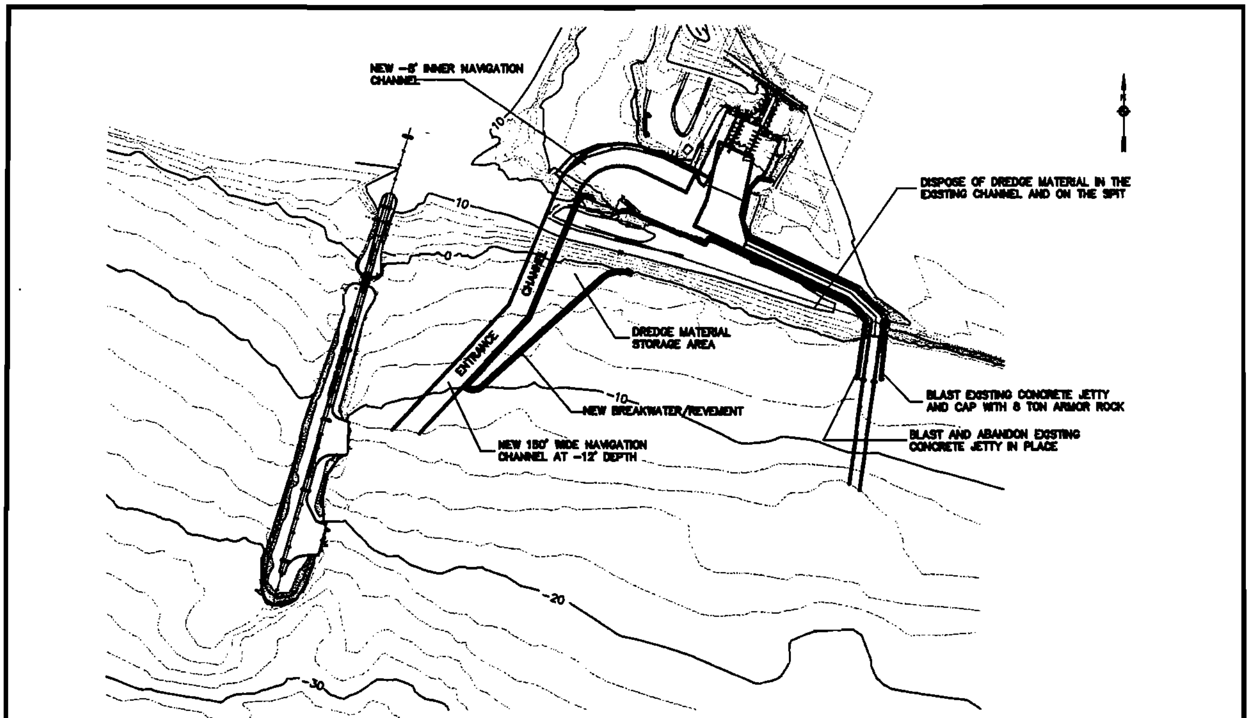
ALTERNATIVE D
MAJOR REHABILITATION
NAVIGATION IMPROVEMENTS, NOME, ALASKA

6

- **Plan E** - A new 46-m-wide channel with a breakwater located closer to the east side of the causeway is the focus of this plan, shown in figure 7. Since the accretional patterns seen along the east side of the causeway would be reproduced along any structure built to the east of the causeway, the breakwater length is critical if sediment deposition at the tip and within the entrance channel is to be minimized. In this plan, the breakwater does not extend out far enough to minimize shoaling or reduce problems at the causeway. Consequently, high O&M costs, delays, and problems at the causeway would persist with this plan in place. Therefore, despite the large savings offered by this plan over others, it does not adequately address and solve existing problems and therefore is not practical.

- **Plan F** - This plan, in figure 8, involves placing a channel through the spit without the use of any channel stabilization structures, such as jetties. The location of the channel was shown to be unimportant, as there was no location that was not subject to serious maintenance and wave problems. Regardless of cost, the plan was not practical from a design standpoint since it did little to solve problems at the entrance and did nothing to alleviate problems at the causeway.

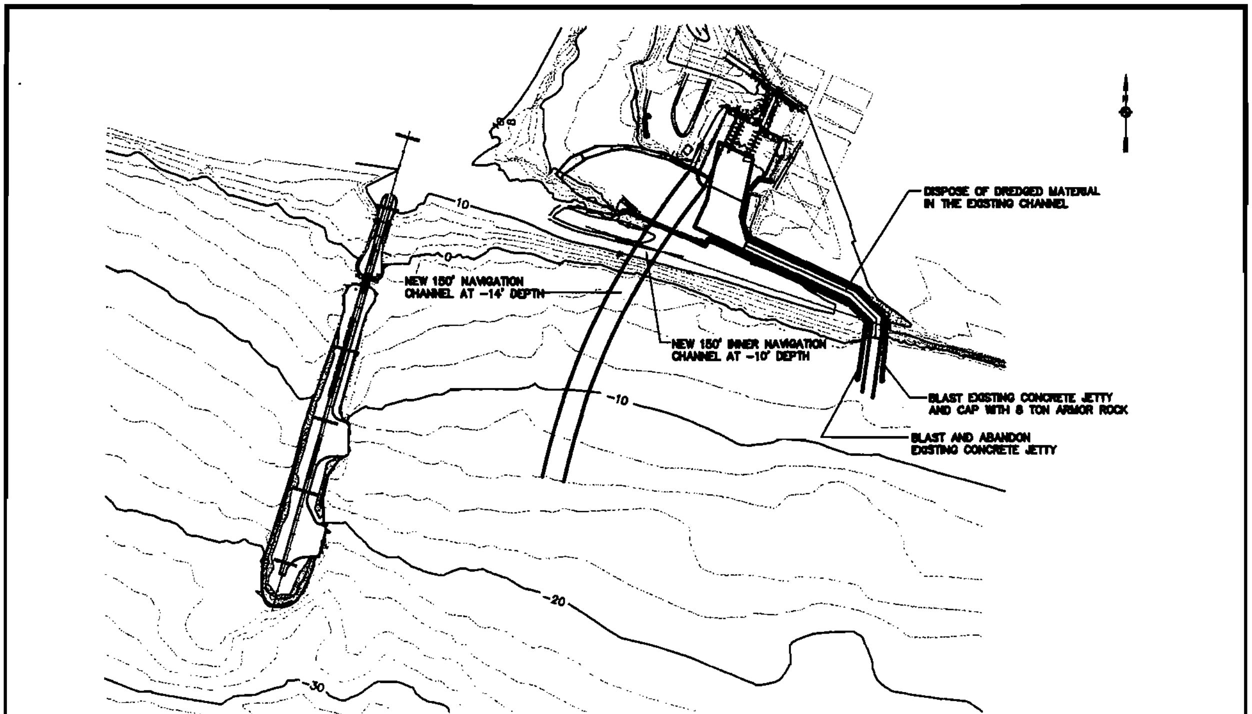
- **Plan G** - This plan, not illustrated, involves only adding a cell to the causeway. It was considered as a way to expand capacity of the existing navigation facilities without costly breakwater and channel work. The cell would help with congestion problems but could do so only during fair weather conditions because the location is not protected. Planning also indicated the idea to be impractical, as the location is shallow and subject to constant shoaling problems. Even without the cost of O&M, the concept could not demonstrate adequate benefits to cover its cost.



ALASKA DISTRICT
CORPS OF ENGINEERS
CIVIL WORKS BRANCH

ALTERNATIVE E
CHANNEL THROUGH SPIT WITH BREAKWATER/REVETMENT
NAVIGATION IMPROVEMENTS, NOME, ALASKA

7



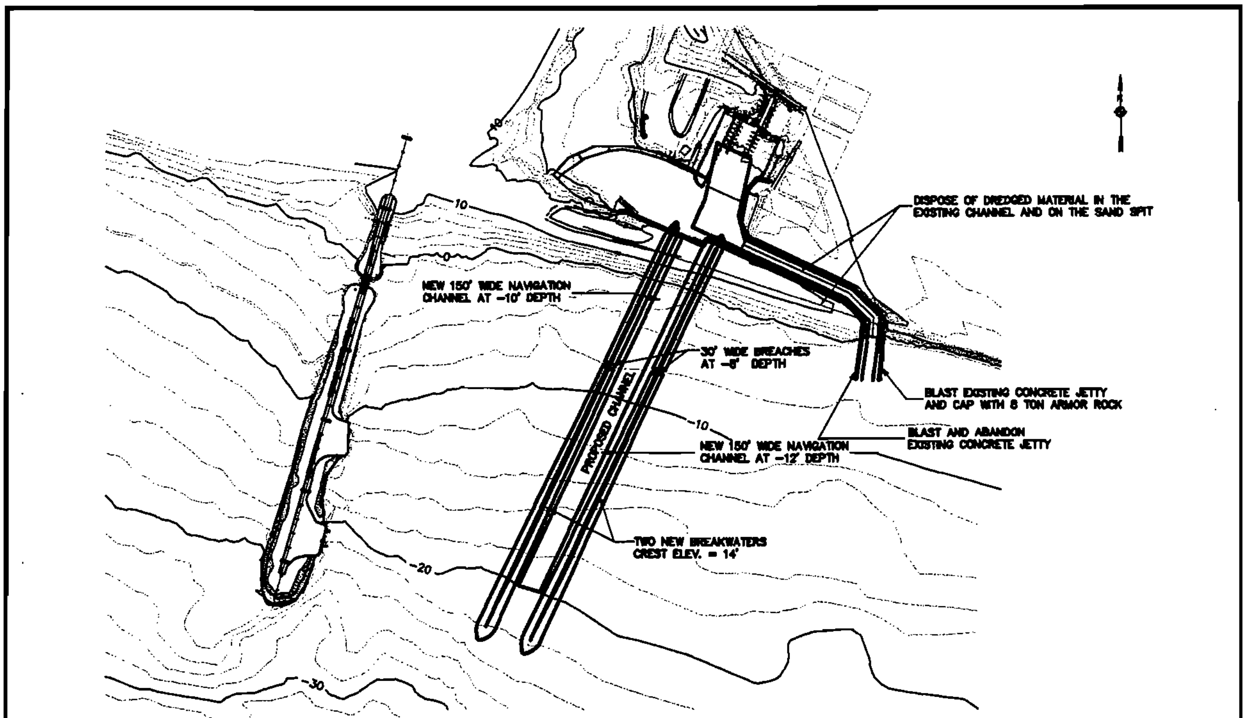
ALASKA DISTRICT
CORPS OF ENGINEERS
CIVIL WORKS BRANCH

ALTERNATIVE F
CHANNEL THROUGH SPIT
NAVIGATION IMPROVEMENTS, NOME, ALASKA

8

- **Plan H -** Two jetty/breakwater stabilization structures and a channel are the primary features of this plan, shown in figure 9. The jetties are each approximately 910 m in length and have a crest elevation of +4.3 m MLLW. The new channel would be constructed to a width of 46 m and a depth of -3.7 m MLLW. This design provides a safe, navigable channel and minimizes potential O&M costs. The plan also protects the causeway to a greater degree than any of the preceding plans. Both jetty structures extend out to a depth at which there is very little movement of sediments; therefore, shoaling at the heads of the structures and within the channel would be minimized. While the performance of this plan would be superior to many, it is the most expensive of all the alternatives and does not capture all of the benefits gained from other plans. It would be effective in solving problems at the entrance and within the channel but would leave residual delay and damage problems at the causeway. Since it does not address some of the navigation needs but costs more than other plans, it cannot be given serious consideration in advanced stages of planning.

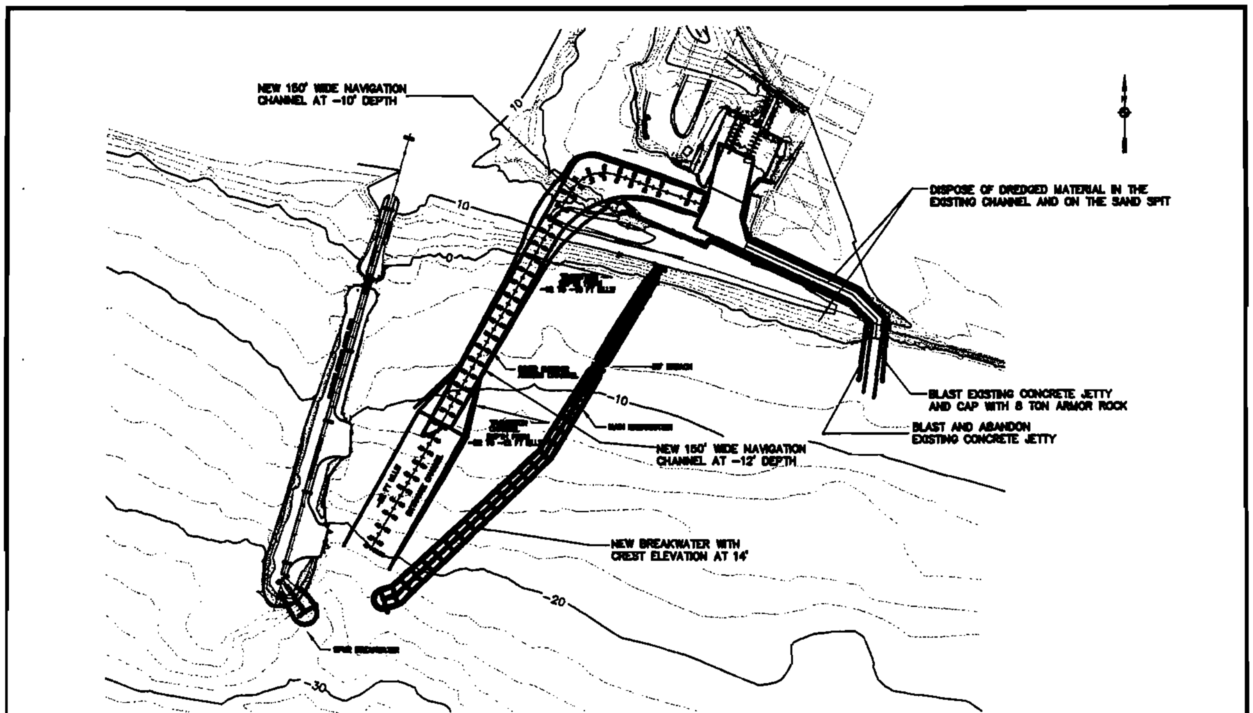
- **Plan I -** This plan, in figure 10, involves the construction of an attached breakwater structure positioned just east of the causeway. The crest height of the structure would be +4.3 m MLLW, and it would extend offshore approximately 910 m, with the last half angling more toward the causeway structure. A new 3.7-m-deep channel would be cut through the spit between the causeway and the breakwater, extending out approximately 450 m. This design uses the causeway in combination with the new breakwater structure to create a quiescent, navigable entrance area. The length and proximity of the new breakwater restrict the amount of incident wave energy reaching the causeway cells, which reduces problems with loading and offloading operations. Entrance and tip shoaling along the new breakwater should be minimal since the new structure extends beyond the depth of significant sediment motion. Due to depth constraints, this plan is limited in its capacity to accommodate larger vessels and also limited in its ability to protect causeway operations. In addition, this plan has no scheme to deal with sediments that accumulate at the tip of the causeway. The tip shoal causes waves to focus on the end of the structure, which results in more frequent disruption in causeway cell use due to wave refraction.



ALASKA DISTRICT
CORPS OF ENGINEERS
CIVIL WORKS BRANCH

ALTERNATIVE H
CHANNEL THROUGH SPIT WITH NEW BREAKWATERS EXTENDING PAST DEPTH OF CLOSURE
NAVIGATION IMPROVEMENTS, NOME, ALASKA

9



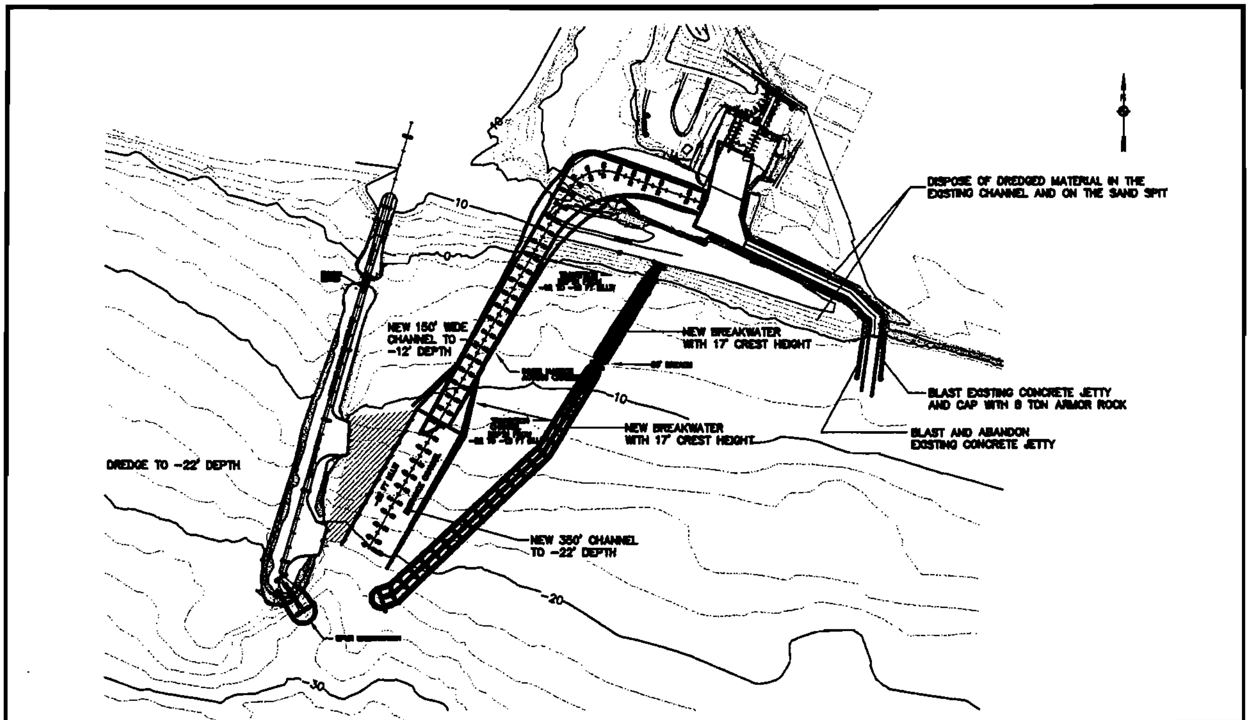
ALASKA DISTRICT
CORPS OF ENGINEERS
CIVIL WORKS BRANCH

ALTERNATIVE I
CHANNEL THROUGH SPIT WITH BREAKWATER EXTENDING PAST DEPTH OF CLOSURE
NAVIGATION IMPROVEMENTS, NOME, ALASKA

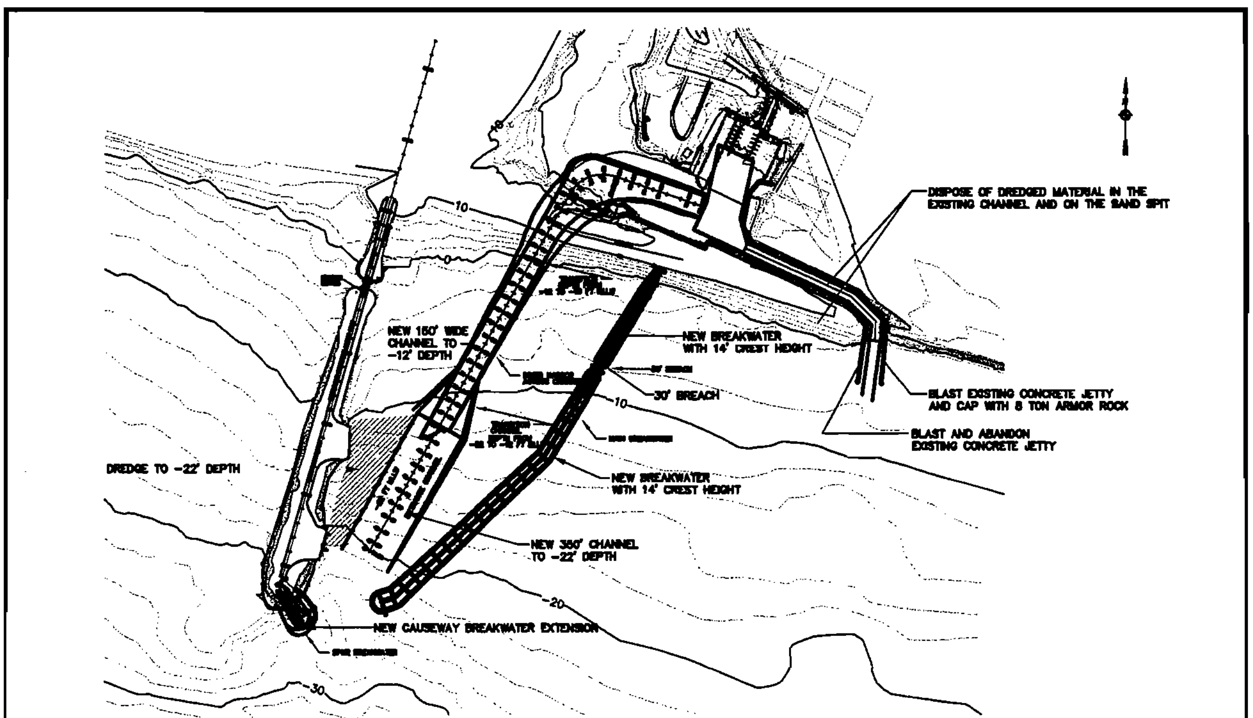
10

- **Plan J** – This plan, in figure 11, is a modification of both the channel and the breakwater design outlined in plan I. The breakwater crest height is +5.2 m MLLW, and the channel extends out to the entrance area between the causeway and the breakwater. The additional section of channel is deepened to -6.7 m MLLW, and the operational area off the causeway cells is also deepened to -6.7 m MLLW. All other aspects of the plan are the same as plan I. By increasing the depth of the entrance area and the area along the causeway cells, deeper-draft vessels are able to use the causeway and the quiescent area created between the causeway and the breakwater structures. Although the new breakwater would significantly reduce problems at the causeway, physical model testing showed substantial delays would still exist at causeway cells due to wave energy passing through the wide entrance area.

- **Plan K** - This plan (figure 12), another iteration of plan I, is the same as plan J except for two design modifications. The breakwater crest height was reduced to +4.0 m MLLW, and a rubblemound spur was added to the end of the causeway to further protect the loading/offloading cells by minimizing the amount of wave energy entering the navigable channel area. This plan was shown to capture all of the significant benefits identified with the project. However, it could be improved through the addition of a sand bypass system to reduce continued accretion at the head of the causeway.



ALASKA DISTRICT CORPS OF ENGINEERS CIVIL WORKS BRANCH	ALTERNATIVE J PLAN "I" BUT WITH -22' DEPTH AT THE CAUSEWAY NAVIGATION IMPROVEMENTS, NOME, ALASKA	11

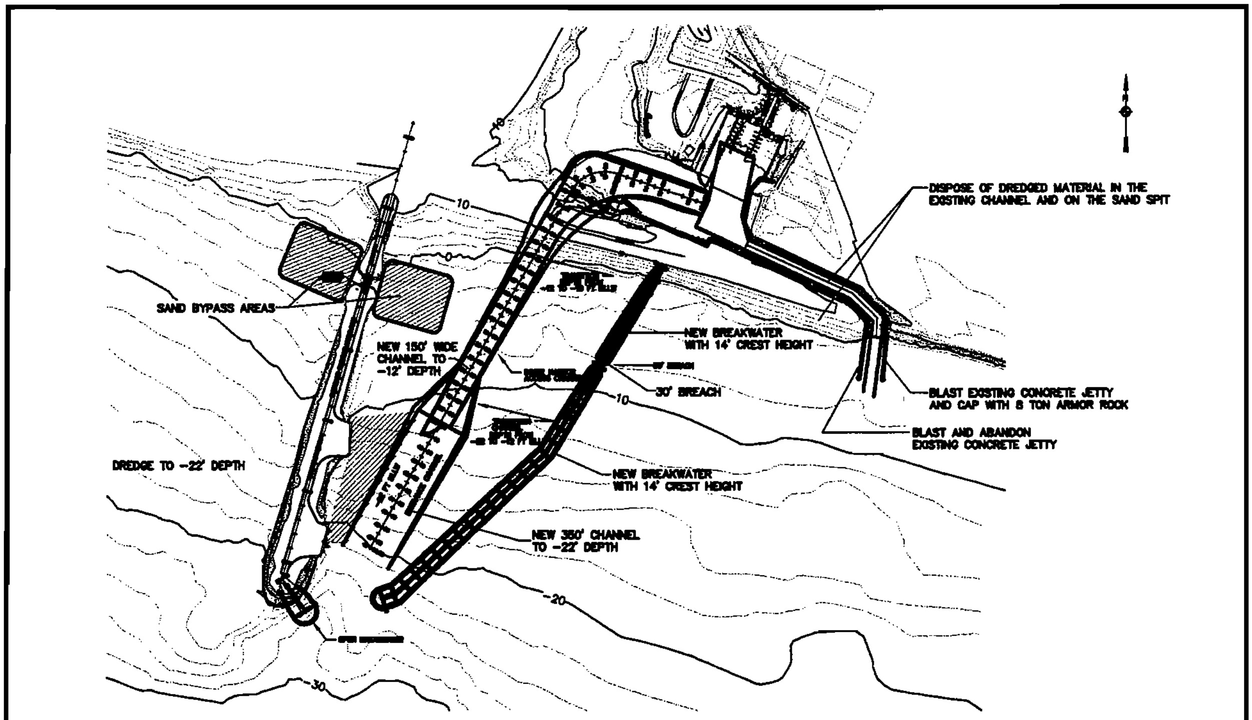


ALASKA DISTRICT CORPS OF ENGINEERS CIVIL WORKS BRANCH	ALTERNATIVE K PLAN "J" BUT WITH CAUSEWAY EXTENSION NAVIGATION IMPROVEMENTS, NOME, ALASKA	12

- **Plan L -** Plan L, in figure 13, is again an iteration of plan I. It is identical to plan K except for a sand bypass scheme incorporated into the design. The removal of sand on either side of the fish breach in the causeway would both minimize tip shoaling at the end of the causeway and prevent the buildup of sediments within the quiescent area. Sand bypass activities would also insure that the breach remains open to allow passage of marine life, thereby improving near-shore fish habitat.

- **Plan M -** Plan M, in figure 14, is the final iteration of plan I. This plan is exactly the same as plan L except that the crest height of the breakwater structure is increased to +5.2 m (MLLW). Major support for increasing the breakwater height comes from the prospect of increasing usable time at the causeway cells. However, physical modeling showed that increasing the crest height from +4.0 m to +5.2 m MLLW did not gain any additional benefits for better protection of the causeway cells from waves.

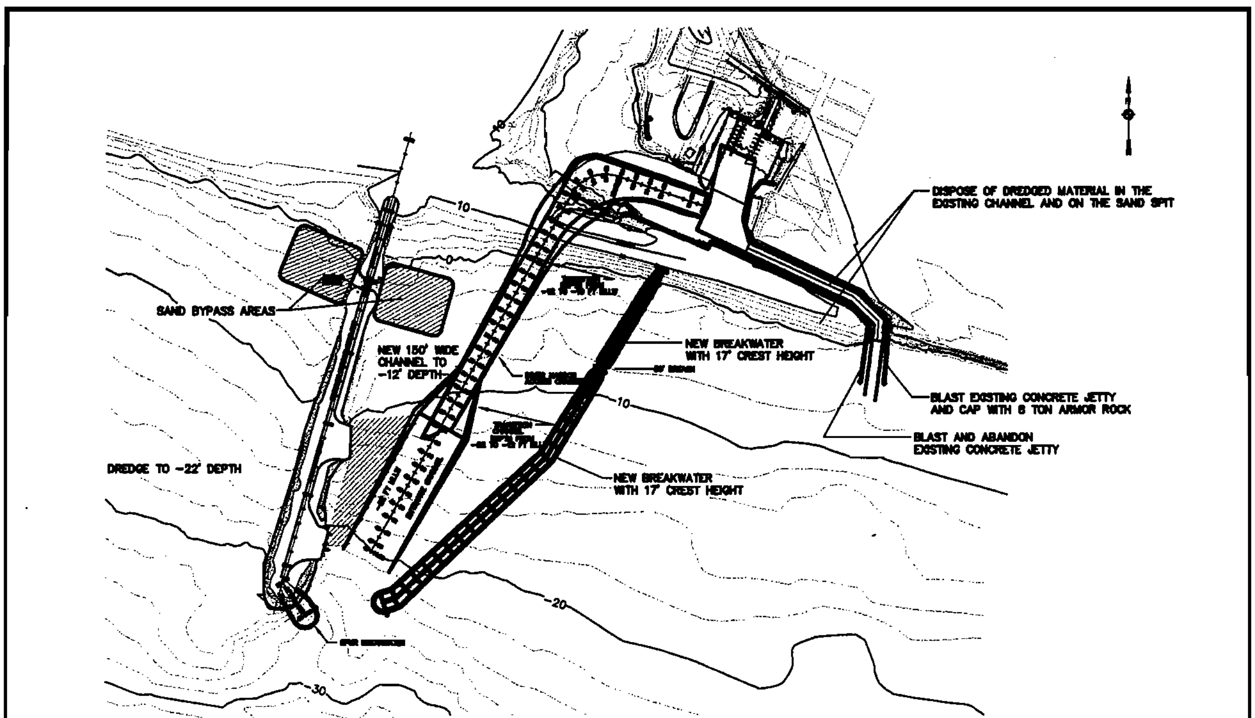
- **Plan N -** This is the no-action alternative. The existing navigation project at Nome is pictured in figure 1.



ALASKA DISTRICT
CORPS OF ENGINEERS
CIVIL WORKS BRANCH

ALTERNATIVE L
PLAN "K" BUT WITH A SAND BYPASS ADDED
NAVIGATION IMPROVEMENTS, NOME, ALASKA

13



ALASKA DISTRICT
CORPS OF ENGINEERS
CIVIL WORKS BRANCH

ALTERNATIVE M
PLAN "L" BUT WITH THE BREAKWATER DESIGNED TO A CREST HEIGHT OF +17'
NAVIGATION IMPROVEMENTS, NOME, ALASKA

14

3.5 Procedure for Evaluating Alternative Plans

All plans were evaluated based on local needs, economic viability, constructability, and environmental impacts. They were first filtered based on engineering and environmental criteria to ensure that the plans remaining under consideration were of sound design and environmentally acceptable. Remaining alternatives were then evaluated based on the level of net benefits obtained and the effectiveness of the plan at addressing local needs and concerns. This process was employed to ensure that the NED plan identified is functional, economically viable, environmentally acceptable, and the plan best able to meet the long-term needs of the local sponsor.

First, a group judgment process was used to screen out alternatives clearly not applicable to the site. Fundamental coastal engineering concepts were used in combination with site conditions and local needs to eliminate numerous alternatives. With the general magnitude of sediment transport known, all structures that would exacerbate the already difficult maintenance potential were eliminated. Knowledge of wave periods required that other alternatives be removed from consideration. Ice forces put demands on other solutions, and these were also eliminated from further study. This is a partial list of features that were eliminated:

- Detached breakwater structures
- Articulated mat
- Floating breakwaters
- Submerged groins
- An array of wave power generators
- Low-mass or thin-walled structures
- Development of unique dredging plant
- Shifting or relocation of dredged material disposal areas

After eliminating alternatives that had little to no application at the project site, an array of more likely alternatives was left. Navigation features in the alternatives selected for further evaluation included these:

- Attached breakwater structures

- Jetty structures
- Breakwater spurs
- Channel relocation

Filtering of these more likely alternatives was performed using an alternative comparison matrix as an expedient substitute for detailed benefit/cost analyses. The matrix evaluation procedure used a qualitative approach to assigning rankings within 13 categories for 14 alternatives. An interdisciplinary team including planners, engineers, model builders, commercial shippers, the local sponsor, and environmental experts participated in constructing the matrix and assigning the rankings. The matrix is shown in table 3.

The NED plan was a consensus choice made using the result of the rating process. Plan L was identified as the most likely NED plan. The same plan was also found to be the NED plan as the result of standard benefit/cost analysis, which showed it to be the alternative with maximum net benefits. Plan L appears to meet all the primary needs identified by the non-federal sponsor, while capturing the most available benefits of those alternatives evaluated.

TABLE 3.—*Comparison of alternatives for Nome harbor and facilities*

Plan	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**
Depth (m)														
Outer	-4.3	-4.3	-4.3	-2.4	-3.7	-4.3	-2.4	-3.7	-3.7	-6.7	-6.7	-6.7	-6.7	-2.4
Inner	-3.1	-3.1	-3.1	-2.4	-2.4	-3.1	-2.4	-3.1	-3.1	-3.1	-3.1	-3.1	-3.1	-2.4
Construct. cost (millions of $)	10	13	4	8.6	12	7	0.5	22	13	18.5	14.5	18.2	22	0
O&M cost/yr ($000)	300	300	200	200	200	200	200	200	200	200	200	440	440	200
Evaluation (1=best, 10=worst)	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**
O&M	10	10	10	10	8	10	10	1	1	1	1	3	3	10
Wave protection	10	8	10	10	8	10	10	5	5	5	3	1	1	10
Alignment	10	2	10	10	1	7	1	1	1	1	1	1	1	10
Width	5	1	10	10	1	5	1	1	1		1	1	1	10
Safety	9	2	10	10	8	8	9	5	5	4	2	1	1	10
Contaminants														
Petroleum	5	8	5	5	8	5	1	3	3	5	4	3	3	1
Arsenic	10	1	10	5	5	10	4	7	5	4	4	4	4	1
Fish pass near shore	3	7	7	5	10	3	5	8	4	5	5	1	1	1
Accommodate increased use														
Harbor	10	5	10	10	10	10	10	1	1	1	1	1	1	10+
Causeway	10	10	10	10	10	10	9	10	9	4	4	1	1	10
Circulation	2	2	10	10	10	10	10	10	10	2	2	2	2	1
Shoreline impacts	10	10	10	10	10	10	10	10	10	10	10	3	3	10

Notes: Evaluation was by team consensus. The conclusion that plan L was more responsive to planning objectives without unconscionable increases in cost or in environmental impacts made weighting of variables unnecessary.

Definitions of plans:

A: New channel next to existing, with spending beach.
B: New channel off causeway with breakwater.
C: Harbor outside riverbed in Nome Spit.
D: Major rehabilitation of existing project.
E: Channel through spit with breakwater/revetment.
F: Channel through spit.
G: Additional causeway cell only.
H: Channel through spit with new breakwaters extending past depth of closure.
I: Channel through spit with single breakwater extending past depth of closure.
J: Plan I, but with –22' depth at the causeway.
K: Plan J, but with causeway extension.
L: Plan K, but with a sand bypass added.
M: Plan L, but with the breakwater designed to a crest height of +17'.
N: No action.

4. BENEFIT EVALUATION

Federal interest in a project is identified through an analysis or assessment of the net benefits expected to accrue as a result of the project being brought to fruition. An incremental benefit analysis was performed for this potential project to clearly identify the optimum level of navigation improvements. Of the three separable actions discussed in this section, two can be assembled as the project with the greatest net benefits. It is assumed in the analysis that in the absence of a Federal project, the Nome harbor would be rehabilitated for continued use in its present configuration. In other words, the analysis uses major rehabilitation as the without-project condition.

4.1 Improvements to Entrance Channel

4.1.1 Entrance Problems Remaining After Major Rehabilitation.

Despite annual dredging, shoaling of the entrance channel and inner harbor has historically restricted vessel use to less than the authorized depth of 2.4 m. Tugs and barges regularly using the inner harbor have drafts of 2.3 m, landing craft have drafts of 1.5 m, and fishing boats have drafts of 1.5 m. Even immediately after the channel is dredged in the spring, commercial vessels cannot load to their maximum potential without risk of bottoming out in the 2.4-m channel. Before the end of the navigation season, the channel shoals to about 1 m.

Impassability of the entrance will continue to impact commercial fishermen and commercial shippers. During periods when the entrance is not usable, potential users must wait in the harbor or at sea. Frequently, boats running low on fuel or anticipating worse conditions such as ice or breaking seas will risk the entry. Often the entrance is negotiated, but not without the vessel striking the jetty or a wing wall, or bottoming out in the channel. Economic costs associated with the entrance, even after major rehabilitation, will be high because vessels will still strike bottom repeatedly and also ram the sheet pile during use of the channel in adverse conditions. The entrance will be at less than the authorized depth for a major part of every season. Therefore more than half of the trips will be through an under-depth channel, even when storm conditions are not present.

Events at the entrance will result in damages in the following categories, each of which is presented separately in Appendix B, Economic Analysis: Fishing fleet damage from anchoring out, fishing fleet damage using Nome Harbor, and tug and barge damage.

4.1.2 Present Operating Practice.

Present vessel operating practices at Nome vary from time to time as the channel shoals, as wave activity varies, and as navigation conditions change at ports serviced by Nome. There is an attempt to maintain about 0.6 m of water under vessel keels under quiescent wave conditions and an additional allowance for wave activity at both the causeway docks and the inner harbor. The shallow depth at the inner harbor seldom allows attainment of both of these conditions, and at times neither condition is met. Shoaling at the entrance and the present draft of the fleet require that many vessels stand offshore and await favorable wave conditions. The alternative to waiting offshore is to enter and sustain damages. It is critical that harbors serviced by Nome be supplied when navigation conditions at those harbors are favorable for resupply; thus vessel operators often load light and risk high-damage crossings from the inner harbor. The purpose of the improvements would be the elimination of delays, damages, and light loading. Present practice at the causeway docks is to try to maintain 2 feet of underkeel clearance and an adequate allowance for wave activity (about two-thirds the wave height). Vessels do not now approach the docks when wave heights at sea exceed about 1 m.

4.1.3 Benefits of Entrance Improvement.

Most of the benefits for improvement of the entrance can be achieved by providing adequate channel depths throughout the season and by improving conditions so that entrance problems are minimized. In effect, the proposed project would allow unhindered use up to 95 percent of the navigation season. If this level of protection can be achieved and all related damages can be prevented, median annual benefits would be $2,321,900, as shown in table 4.

Benefits for varying degrees of improvement are presented in the discussion of project maximization. A detailed breakdown of these benefits can be found in appendix B.

TABLE 4.—*Summary of benefits from improvements to entrance channel*

Category	Annual benefit ($000)
Fishing fleet damage, anchoring out	254.7
Fishing fleet damage, project-related	784.8
Lost time	89.1
Tug and barge damage	234.0
Light loading	15.5
Reduced long-term delay	97.0
Saved cost of major rehabilitation	611.2
Reduced O&M dredging	357.8
TOTAL	$2,444.1
Less residual wave and blowdown effect at 5%, so Benefit = **$2,321,900**	

4.1.4 Costs of Entrance Improvement.

All project work needed to construct and maintain the entrance channel to a depth of 3 m and all costs of the jetty are required for improvement of the entrance. The direct cost of features not included in the cost of improving the entrance total $5,336,000. These features are:

- Stub breakwater, feature number 10-303*, at a direct cost of $1,416,000;
- Dock approach, feature number 12-6, at a direct cost of $853,000;
- Sediment trap, feature number 12-8, at a direct cost of $1,272,000; and
- Structural causeway construction and relocations, feature numbers 12 and 02, at a direct cost of $1,795,100.

Adjustment for contingencies and preconstruction engineering and design (PED), at 16 percent and 15 percent respectively, result in a cost of $6,447,000 for these excluded features. The total construction cost of the NED project is $24,224,000; thus the cost of the entrance improvement would be $24,224,000 - $6,447,000 = $17,777,000. Annual investment cost of the entrance improvement, including interest and O&M, is $1,863,000.

Scaling of the NED plan required estimating the costs of projects providing greater and lesser depths. Incremental costs at various depths were arrived at by using the

* Feature numbers are from the M-CACES cost estimate, summarized in appendix D.

unit cost of the NED plan without the causeway work included, and varying the quantities to reflect different depths. A project with 0.6 m less depth would save \$14,500 annually, and a project with 0.6 m greater depth would add \$29,000 annually over the cost of the NED plan.

4.2 Causeway Improvements

Proposed improvements to the causeway stand alone as separable elements. The causeway can be left alone or modified, with identifiable impacts on engineering, economic, or environmental aspects of the existing harbor or other proposed improvements to it. Therefore, the merits of any modifications to the causeway can be evaluated on a next-added basis.

4.2.1 Without-Project Conditions.

The appropriate "without-project condition" for evaluation of the causeway as an increment is a project with major rehabilitation in place and improved entrance conditions. Those aspects of the proposed plan have benefits clearly in excess of their costs, and merits independent of improvements to the causeway. Lighters would benefit little from causeway improvements, as their needs are met by first-added improvements to the inner harbor entrance. However, improvements to the causeway would have economic effects on oceangoing line-haul barges and deep-water fishing boats that use the causeway as a transfer station.

The without-project condition includes a processing facility that would be used by vessels able to access the inner harbor facility to unload. Due to restrictive channel depths, deeper-draft vessels in the +30.7-m size that make up the bulk of the deep-water offshore crab fleet are unable to reach the processing facilities inside the harbor. At present, the causeway loading/offloading cells are susceptible to adverse wave conditions, which cause interruptions during their use by the offshore crab fleet and oceangoing equipment. During the end of the season, the prospect of delay due to wave activity at the causeway is so great that shippers and fishing boats often avoid using it.

4.2.2 Benefits of Causeway Improvement.

Median annual benefits are \$1,285,600, as shown in table 5. Benefits for other levels of improvement are presented in the discussion of project maximization.

TABLE 5.--*Summary of benefits for improving conditions at causeway*

Category	Annual benefit ($000)
Travel cost saving	238.2
Deadloss reduction	105.4
Leisure time	83.8
Lighters	18.0
Commercial shippers	840.2
TOTAL	$1285.6

4.2.3 Costs of Causeway Improvement.

Features associated with improvement of the causeway are identified as:

- Stub breakwater, feature number 10-303*, at a direct cost of $1,416,000;
- Dock approach, feature number 12-6, at a direct cost of $853,000;
- Sediment trap, feature number 12-8, at a direct cost of $1,272,000; and
- Structural causeway construction and relocations, feature numbers 12 and 02, at a direct cost of $1,795,100.

By adding PED and indirect costs and adjusting for interest during construction and amortization, an annual cost of $520,000 is obtained. For purposes of scaling, unit costs were adjusted to reflect incremental costs of various depths. A project at 0.6 m less depth than the NED plan would save $28,300 annually, while a project 0.6m deeper would add $29,000 annually.

4.3 Addition of a Cell to the Causeway

With or without all of the previously evaluated improvements in place, there would still be a delay problem at the causeway. The merits of adding a cell to the causeway were evaluated but could not be economically justified.

Delays at the causeway are most noticeable in the fall, when crabbers need to wait due to inadequate terminal space to accommodate all of the vessels immediately upon arrival. Vessel delays have been estimated at 108 to 162 hours.

* Feature numbers are from the M-CACES cost estimate, summarized in appendix D.

4.3.1 Benefits.

The addition of a cell was considered as an alternative to modifying the causeway. If a cell is added, it provides an additional moorage area to increase the number of moorage days. An additional cell would result in incremental benefits ranging from (63 h [hours] × $140) + (63 h × $15 × 4 crew) = **$12,600** to (95 h × $219) + (95 h × $15 × 4 crew) = **$26,500**. Weather-related delays would still be present.

Regarding addition of a cell on a last-added basis, a simulation was done to evaluate the effect of protection of two cells. The benefit was allocated to protection of each cell based on magnitude of the problem at each. Forty-three percent of delay problems are at the inner cell and 57 percent at the outer cell. This is probably an understatement of the benefit, especially for the third cell, but is inconsequential in terms of leading to any serious error in plan formulation. So the benefit for improved use of one cell is $552,800, two cells is $1,285,600, and three cells is $1,327,100.

4.3.2 Cost.

Cost of cell construction exceeds benefits that could be generated under the most optimistic conditions. Cell construction must be accompanied by a major dredging operation, as the only causeway area not now in use is the near-shore area, which is much shallower than the existing dock face. A detailed cost estimate was not done, because benefits could cover a capital cost of only about $375,000, and initial cost estimates were more than double the amount of potential benefits.

5. PROJECT MAXIMIZATION

5.1 Incremental Evaluation

The benefit evaluation, related fully in appendix B, demonstrates net benefits for two separate increments of the project after establishing major rehabilitation as the most likely without-project condition. A third increment, an additional causeway cell, was evaluated but was not justified. Increments that add net benefits are:

- **Improvement of Conditions at the Entrance -** This consists of deepening the 2.4-m authorized entrance depth to 3 m and expanding the channel dimensions to accommodate the present-day fleet. In addition to revised channel dimensions and alignment, the improvement includes a 910-m jetty to provide calmer waters at the entrance.

- **Improvement of Conditions at the Causeway -** The existing causeway would be modified by attachment of a 71.6-m spur breakwater at the seaward end. The existing causeway breach would be enlarged as part of a sand-bypassing plan, which would include a sediment trap.

5.2 NED Project Depth

In addition to the separable-increments aspect of the benefit evaluation, there is also the question of NED project depth. The depth is optimized to assure that adequate project dimensions are provided to accommodate the fleet in a way that maximizes overall net economic returns. If a project is scaled deeper than it needs to be, unnecessary construction and maintenance costs are incurred, and net benefits will not be at their maximum. If a project is not scaled deep enough, some net benefits that could otherwise be earned will not be realized. The issue of project depth in most cases is also a major cost concern.

In many cases, harbor development projects involve creating deeper harbors to accommodate deeper vessels, which offer lower unit shipping costs. With the improvements proposed for Nome Harbor, no major shifts are expected in fleet makeup. Economy-of-scale benefits, then, are not a major issue.

5.3 Evaluation Procedure

The benefit evaluation developed two ranges of benefits, lower and higher, where variations in development scenarios revealed outcome differences that could be large enough to impact decision making. From the high and the low range, median values were selected and used in formulation and justification. The median value of the potential benefits was used to anchor the upper end of two benefit curves: one for various depths of the entrance and jetty, and one for various depths of the causeway. For purposes of the incremental justification, a project-in-service date of year 2000 was assumed.

5.4 Inner Harbor Entrance Depth Evaluation

Regarding depth evaluation, there is no practical option for any of the users to wait for tides as a tradeoff against construction of a deeper channel, as the difference between MLLW and MHHW is only 0.49 m. In construction of the benefit curve, options for evaluation of the NED project depth range from the 2.4-m authorized depth of the existing project to the depth needed by the fishing fleet and lighter fleet to solve problems related to damage and delay. The majority of damage and delay problems are solved at a channel depth of 3 m, which would accommodate present users about 95 percent of the time.

Beyond a project depth of 3 m, incremental benefits would be earned during times when water is blown out of the harbor, but these occasions are relatively infrequent, and the increment constitutes only about 3 percent of the benefit evaluation. Project depth would have to be increased by an added 2 m to provide adequate depth during all blowdown events. At this scale of project (about 5 m) the entrance would be usable about 97 percent of the time, with interruptions remaining due to residual wave conditions not impacted by the jetty.

5.4.1 Benefits of Various Entrance Depths.

The procedure to determine NED depth involved generation of a benefit curve based on actual shipping practices. Data in support of practices was gathered from project users. There is a large variation in practices among users, with two prevailing points of view but no consensus. The two points of view reflect differing opinions and perceptions of channel depth uncertainty, differences in cargo carried, and differences in destinations served. They also reflect outlooks characteristic of different parts of the navigation season, when conditions might be drastically different. It was not possible to identify an operating practice that fit all operators through an entire season. Therefore, a benefit curve was calculated based on a mean of the two generalized operating practices.

Vessels may be loaded to less than their 2.3-m design draft for the following reasons:

- Lack of a full load for destination ports

- Shoaling of the channel, which makes normal loading impossible

- Light, bulky cargo, which may fill the vessel without drafting it to its design marks

- Compensation for vessel behavior in sea conditions

- Desire to minimize damages and maximize vessel control

For these operators, vessels capable of drafting 2.3 m would frequently be loaded only to 1.7 m. The operators would load light to clear the channel bottom, hoping for a channel depth of at least 2.3 m. With a channel depth of 2.3 m and a draft of 1.7 m, contact with the bottom is still a definite possibility in rough conditions.

According to conversations with users of the inner harbor at Nome, even with the above explanations for light loading, some operators will load their vessels to the design draft or at least intend to load to the design draft at every opportunity. Given a deeper project, they would use maximum vessel draft. With a fully loaded vessel, these users also stated a desire to minimize damages and provide channel bottom clearance for vessel behavior in sea conditions. They also stated a concern with the shoaling problem at Nome and often plan on an additional allowance for the uncertainty of the channel depth at any given time. Factors that influence these operators' vessel loading include:

- Cargo density allows a full load, to the extent channel depth is available.

- A full load is traded off against prospects of damage.

If the vessel has a full load at 2.3 m, it probably will not be able to use a 2.3-m channel, because the vessel will move about in waves and swell. Vessels that are fully loaded to 2.3 m ordinarily need to allow some clearance for behavior of the vessel. Allowance is needed for the boat to move up and down in the water and also for some clearance for bottom suction. In the past, some vessels loaded to 2.3 m had to be beached at Nome because they could not get into the harbor. Also, a vessel drafting 2.3 m can be expected to incur some damage practically any time of year.

These operators claim opportunities to load full will sometimes be reduced to partial loads to accommodate unknown channel depth. Channel depth varies between 2.4 m and 1 m during the season and would continue to vary as much after major rehabilitation. As the season progresses, operators increase allowances.

For these operators, referred to as the maximum load group, the following general operating practices prevail. Operators with vessels capable of drafting 2.3 m desire to load to 2.3 m. In a with-project condition, they would be expected to do this while still allowing about 0.6 m underkeel clearance, plus an allowance for uncertainty of the channel depth at Nome. These operators, then, would be hoping for a channel of 3.5 m, which would generally include tide, wind setup, river flow, a newly authorized project, and new dredging. In the without-project condition, this loading scenario is not practical due to potential damages, so most operators follow the light loading practice.

5.4.2 Incremental Cost of Entrance Improvement.

The total cost of the NED project less the items not related to improving the entrance (including their associated interest and PED) leave an annual cost of $1,863,000. Scaling of the NED plan required estimating the costs of projects providing greater and lesser depths. (This was further explained in subsection 4.1.4, Costs of Entrance Improvement.)

5.4.3 Cost-Versus-Benefit Analysis.

A single incremental depth-related benefits curve was developed, reflecting a median of the two practices of operators as discussed in subsection 5.4.1. The curve is shown in figure 15. Data for the curve is presented in table 6. The benefit curve is based on estimating benefits using the entire fleet. The optimization at 3 m is a result of a slight inflection in the cost curve at 3 m. The benefit curve is essentially a straight line between 2.9 m and 4.9 m.

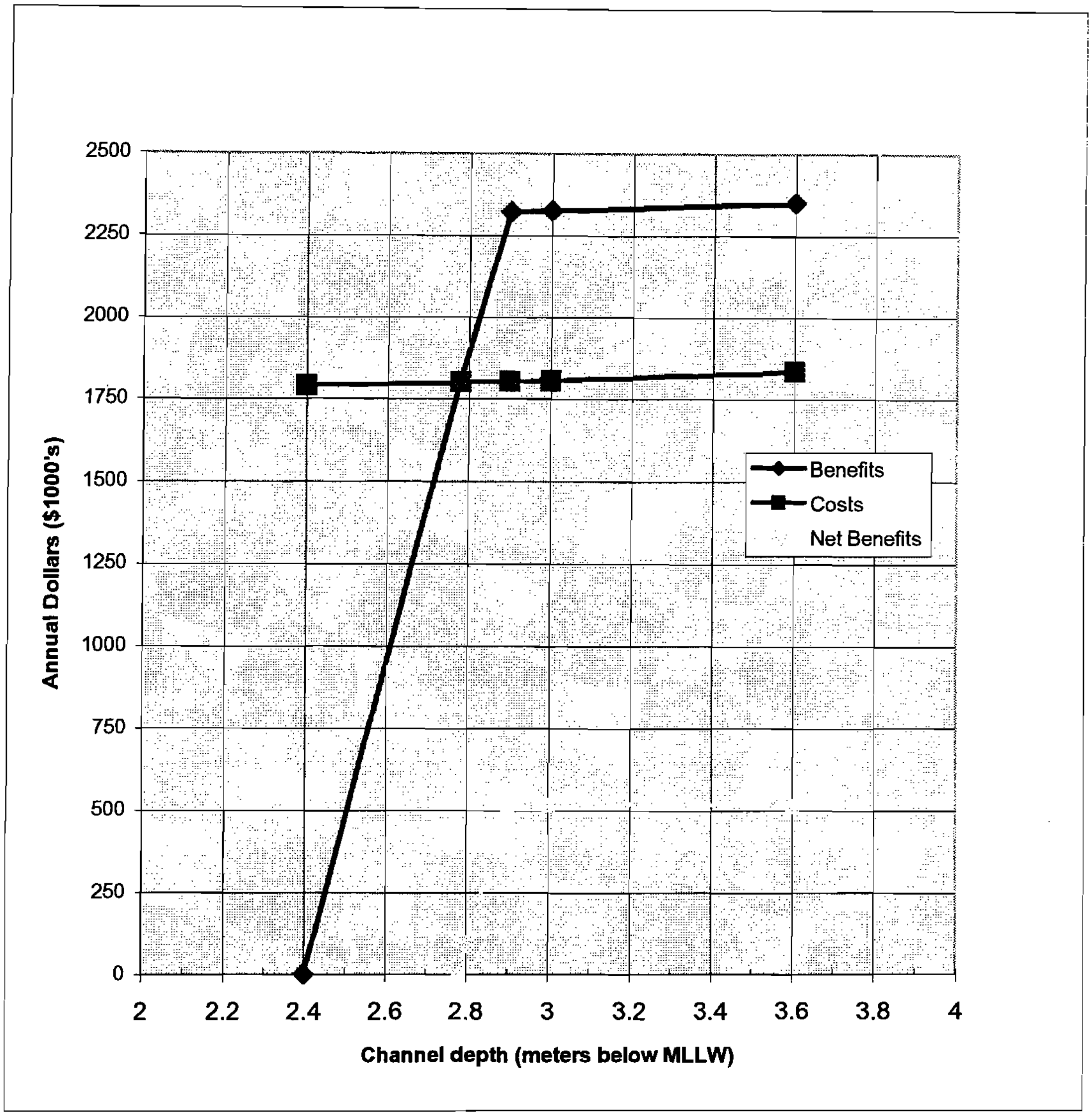


FIGURE 15.—Entrance channel optimization.

TABLE 6.--*Entrance optimization*

Entrance depth	2.4 m	2.9 m	3.0 m	3.6 m
Annual benefit ($000)	0	2,321.9	2,325.1	2,350.5
Annual cost ($000)	1,848	1,860	1,863	1,893
Net benefits ($000)	0	462	462	458

5.5 Causeway Depth Evaluation

Vessels of the fishing fleet that represent new users of the causeway will draft to 3.4 m. Without allowance of adequate depth for these new users, the fleet will not be induced to use the project, and benefits identified as $427,300 annually will not be realized. These are benefits for transportation cost savings, reduced deadloss, and time saved.

In addition to the new causeway users in the fishing fleet are the oceangoing tugs and barges, which draft to 5.5 m. With a deeper project, the oceangoing equipment would be less impacted by delays. Benefits associated with elimination of delays are $840,000 annually.

5.5.1 Benefits of Various Depths at Causeway.

The causeway fleet loads to maximum draft whenever possible. The cargo trips are very long, so vessels are loaded to maximum capacity. Depth at the causeway is reliable and predictable, but vessels still must adopt the standard practice of allowing for vertical excursion induced by sea conditions, and for effects of bottom suction during the approach. In this analysis, standard allowances of 0.6 m have been included. They are based on data gathered during preparation of channel design and are summarized in Appendix A, Hydraulic Design. The area adjacent to the causeway does not shoal, as does the entrance to the inner harbor. Operators do not need to allow for the possibility that the expected depth may not be there. For that reason, there is agreement among users that vessels are loaded to the maximum at every opportunity, and only one scenario is necessary to account for operating practice. Table 7 and Figure 16 provide a summary of the incremental depth analysis for the approach channel.

The lighter fleet also occasionally uses the causeway. Protection of the causeway would minimize damages to the lighters when tying up during rough conditions. Benefits associated with damage reduction, $18,000 annually, would be earned even if depth at the causeway were not increased, so they are not included in the incremental depth evaluation.

TABLE 7.—*Causeway optimization*

Depth at causeway	**4.7 m**	**6.0 m**	**6.7 m**	**7.3 m**	**8.6 m**
Annual benefit	$427,300	$1,000,000	$1,285,600	$1,297,600	$1,324,100
Annual cost	367,000	494,000	520,000	546,600	642,000
Net benefits	$60,300	$506,000	$765,600	$751,600	$682,100

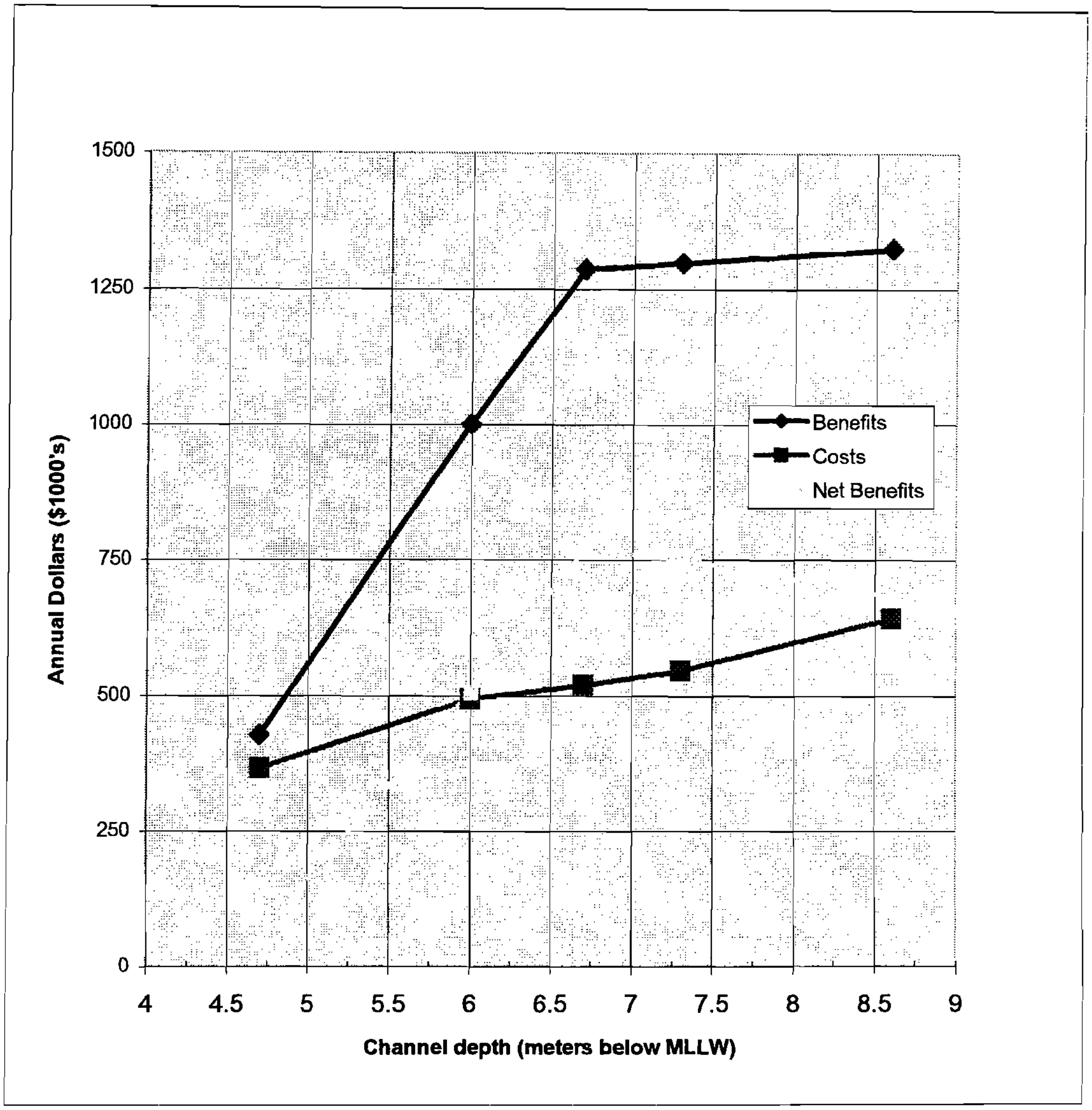


FIGURE 16.—Causeway optimization.

5.5.2 Incremental Cost of Causeway Improvement.

Features associated with improvement of the causeway were identified in subsection 4.2.3. Costs of these features (including their PED and indirect costs at a factor of 1.31) plus an adjustment for IDC and amortization yield an annual cost of $566,000. The cost and benefit differences at various depths are presented in table 7 and figure 16. The optimum depth for NED is clearly seen to be 6.7 m.

5.6 Optimum Plan

The plan that meets all planning objectives and provides maximum net benefits consists of an inner harbor at –3 m, an improved entrance with an extended jetty, and a –6.7-m entrance channel. The jetty and relocated entrance reduce project O&M cost, save the cost of major rehabilitation, and also provide the plan having the lowest overall cost. Modifications to the causeway and deepening of the channel alleviate congestion, damage, and delay problems for oceangoing commercial shippers and fishing boats. The annual benefit of the selected plan is $3,607,500, the annual cost is $2,323,000, and the benefit-to-cost ratio is 1.52 to 1. Table 8 displays the incremental costs and benefits of each of the two increments of the NED plan.

TABLE 8.—*NED plan incremental justification*

Project increment	Annual incremental benefit	Annual incremental cost	Net benefits
Improvement to jetty and entrance	$2,321,900	$1,863,000	$469,000
Protection of causeway	1,285,600	520,000	766,800
TOTAL	$3,607,500	$2,383,000	$1,225,500

5.7 Model Studies

5.7.1 Purpose of 3-D Model Study.

A three-dimensional physical model was constructed to analyze the functionality of navigation design alternatives being considered for Nome Harbor and to develop and optimize a basis for design. The model reproduced waves, wave-induced current patterns, and sediment transport patterns along several thousand feet of shoreline with and without improvement components. Specifically, the model was utilized to:

- Verify wave heights, currents, and sedimentation trends.
- Develop a basis for design to optimize the use of the existing harbor and causeway docks.
- Show how various developments affect wave-induced current patterns, sediment transport patterns, and wave activity in channels and the harbor area.
- Optimize lengths and heights of structures needed to control sediments and waves.

5.7.2 Test Conditions.

Wave periods of 9 and 12 seconds were used for general testing, while an extreme wave period of 24 seconds was used for survivability tests. Wave heights for general testing were limited to 1 and 2 meters. Water depths were generally at MHHW, except that infrequent storms were tested at the highest surge experienced, at +4 m MLLW. Five-meter waves with 25-second periods were used to simulate a 50-year event or an event which has a 2-percent chance of occurring during any given year.

5.7.3 Model Results.

Current measurements indicate that alongshore currents develop in both the east and west directions based on applied wave conditions. The alongshore currents are redirected seaward at the causeway, with the most severe rip currents developing along the west side of the causeway.

Current patterns and sediment movement demonstrated in the model indicate that any channel constructed in the active sediment transport zone (inside the depth of closure at –6.7 m MLLW) would be filled in rapidly and have the same maintenance and delay problems as the present channel.

Waves and wave-induced currents seemed to be influenced to the maximum beneficial effect with the east breakwater extended to the -6.7-m depth and the causeway extended by 99 meters.

A breakwater crest elevation of +4.3 m MLLW could be used without adversely impacting navigation or sedimentation. Lower elevations were not tested because dropping the core below 0 MLLW would adversely affect permeability and thus wave and sediment transmission.

6. RECOMMENDED PLAN

6.1 Plan Components

Plan L, shown in figure 17, was identified as the NED plan. This alternative has several key navigation features that increase and improve use of both the harbor and the causeway.

6.1.1 Rubblemound Breakwater.

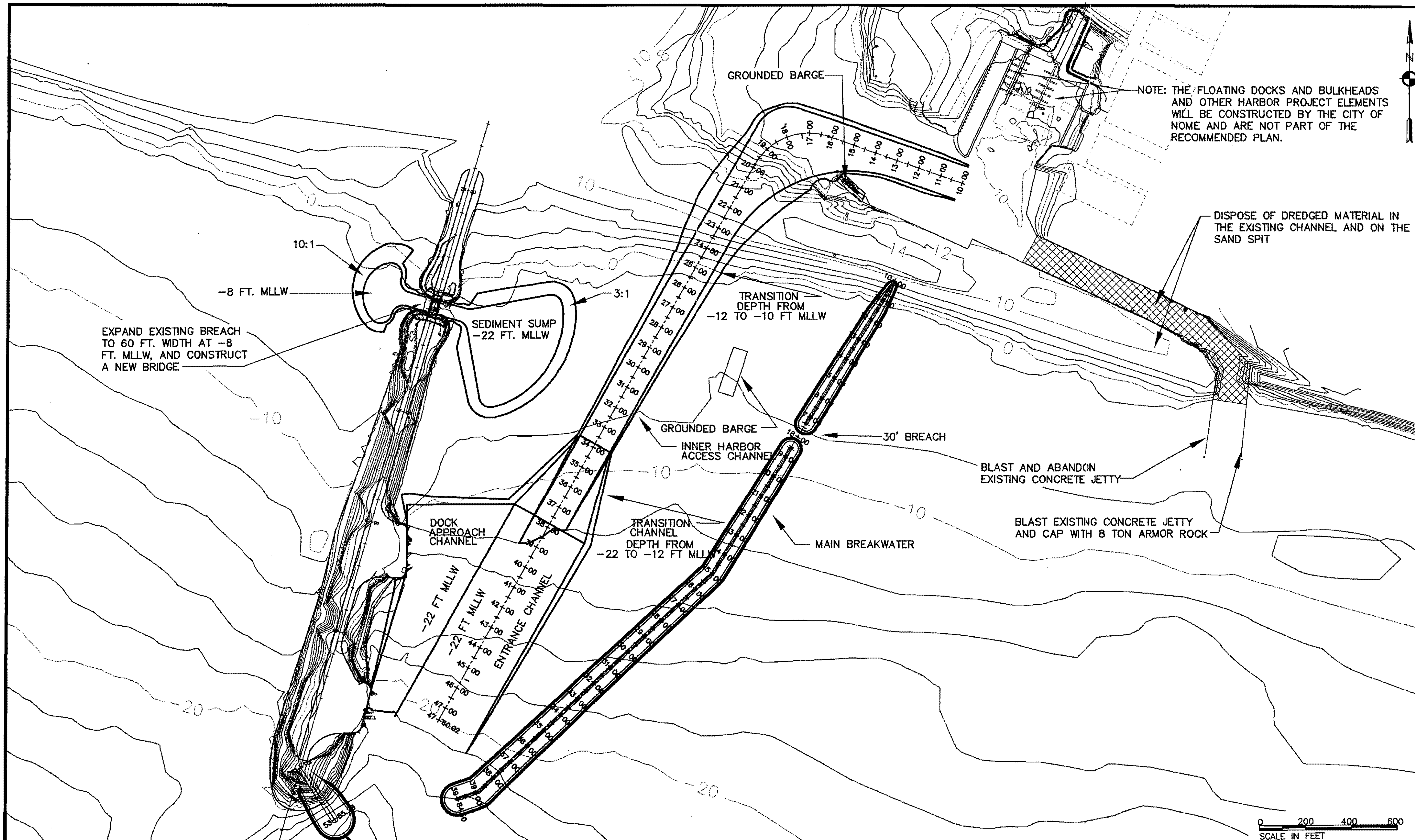
The primary navigation structure is a 910-m-long attached rubblemound breakwater located east of the causeway. The structure has a crest height of +4.3 m MLLW and extends into water depths of approximately -6.7 m MLLW. A dogleg is designed into the structure approximately 450 m out, with the seaward end angling more toward the causeway structure. A breach would be constructed in the breakwater approximately 240 m out in water depths of -2.5 m MLLW, to allow the passage of fish moving alongshore. A design cross section for the main breakwater is shown in figure 18. Its crest elevation was established on the basis of the core height required to control the transmission of both wave energy and sediments. The structure width was designed to resist ice forces through high cross-sectional mass. A crest elevation of +4.3 m MLLW was found to provide adequate protection for the navigable channel and causeway loading cells.

6.1.2 Causeway Spur.

A 70-m-long rubblemound spur extending out from the end of the causeway, angling toward the southeast, would be constructed. The crest elevation of the spur would be +4.3 m MLLW. A design cross section for the spur breakwater is also shown in figure 18. The height of the structure was developed to prevent wave transmission and withstand ice forces.

6.1.3 Channel Design.

The navigation channel would pass through the spit between the causeway and the breakwater structures. The first 450 m of the channel, starting in the estuary and extending seaward, would be constructed to a depth of -3.04 m MLLW and a width of 45.7 m. At this point, a channel transition section would be constructed, leading to a 276-m length of channel dredged to –3.7 m MLLW. Another channel transition to -6.7 m would be dredged, and the remaining 320 m of channel would be dredged to a



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RECOMMENDED PLAN
NAVIGATION IMPROVEMENTS, NOME, ALASKA

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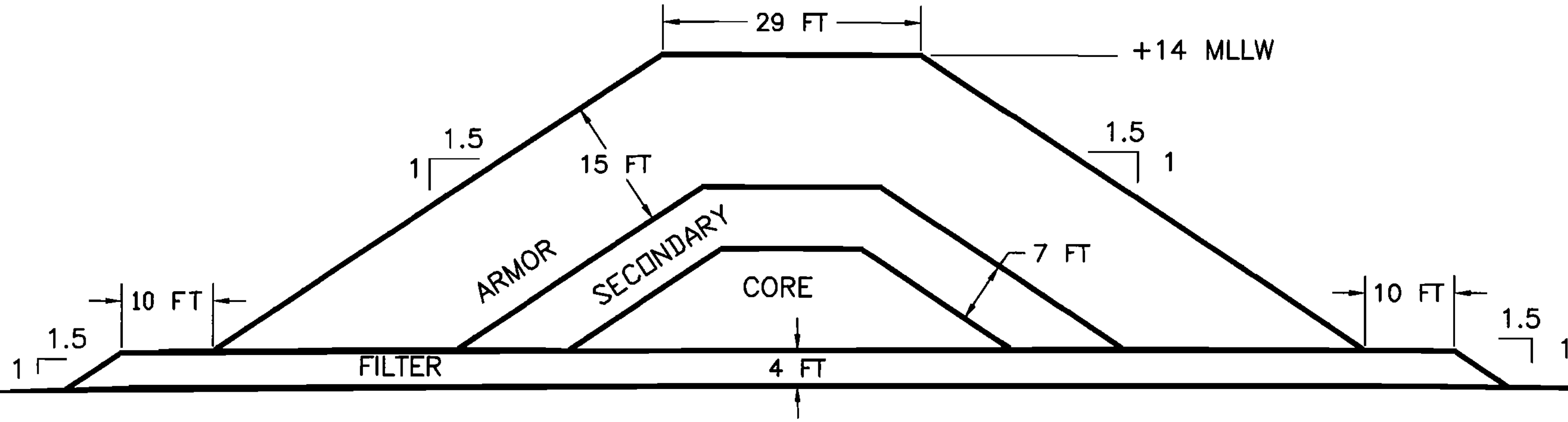
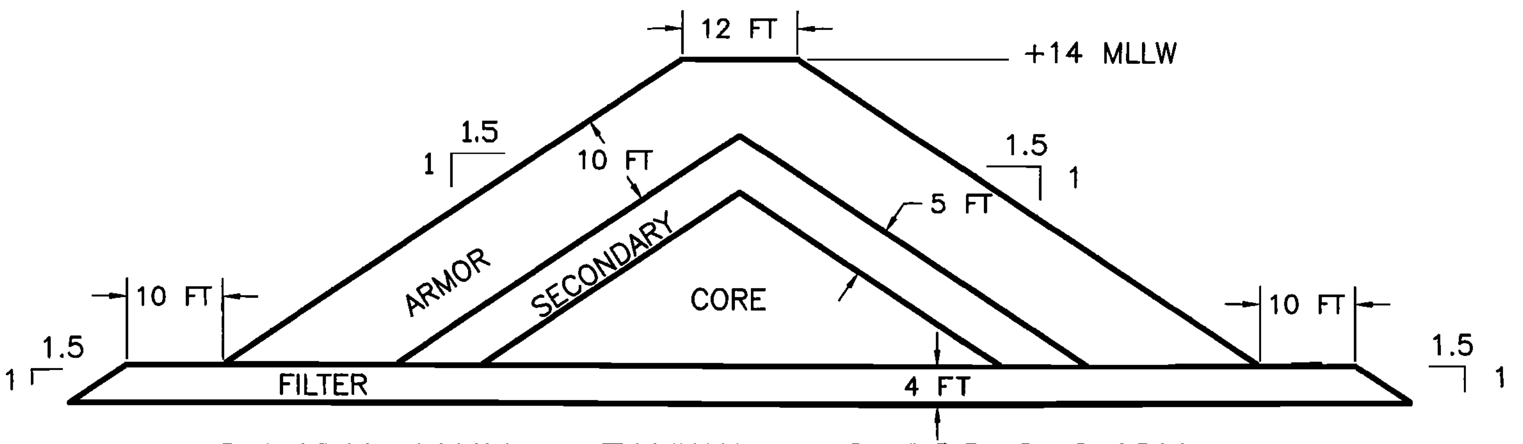


TYPICAL SPUR BREAKWATER CROSS SECTION



TYPICAL MAIN BREAKWATER CROSS SECTION

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depth of -6.7 m MLLW and a width of 107 m. Channel design cross sections are illustrated in figure 19. Details of the channel design, channel depth optimization, and operating practices are described in Appendix A, Hydraulic Design, and Appendix B, Economic Analysis. In brief, the depths are optimized for the present user fleet. The depths allow 0.6 m of underkeel clearance for calm water operation and include an allowance of two-thirds the wave height when there is wave activity. These tolerances fall within the boundaries of recommended Corps practices and are desired by the local operators. Channel widths were established by model studies and local recommendations, and also fall within the boundaries of recommended Corps practices. The harbor was optimized with input from the non-federal sponsor and marine operators. Don Stultz of Crowley Marine, a longtime user of the project, helped with turn layouts, depth requirements, and channel widths. He remained on the site during initial phases of modeling to aid with the layout. Other participants from the city verified dominant wave directions and some aspects of sedimentation.

6.1.4 Sediment Trap.

A sediment trap and bypass system is included to prevent the tip shoal at the end of the causeway from becoming larger. Two sediment "sumps" would be constructed, one on either side of the breach in the causeway.

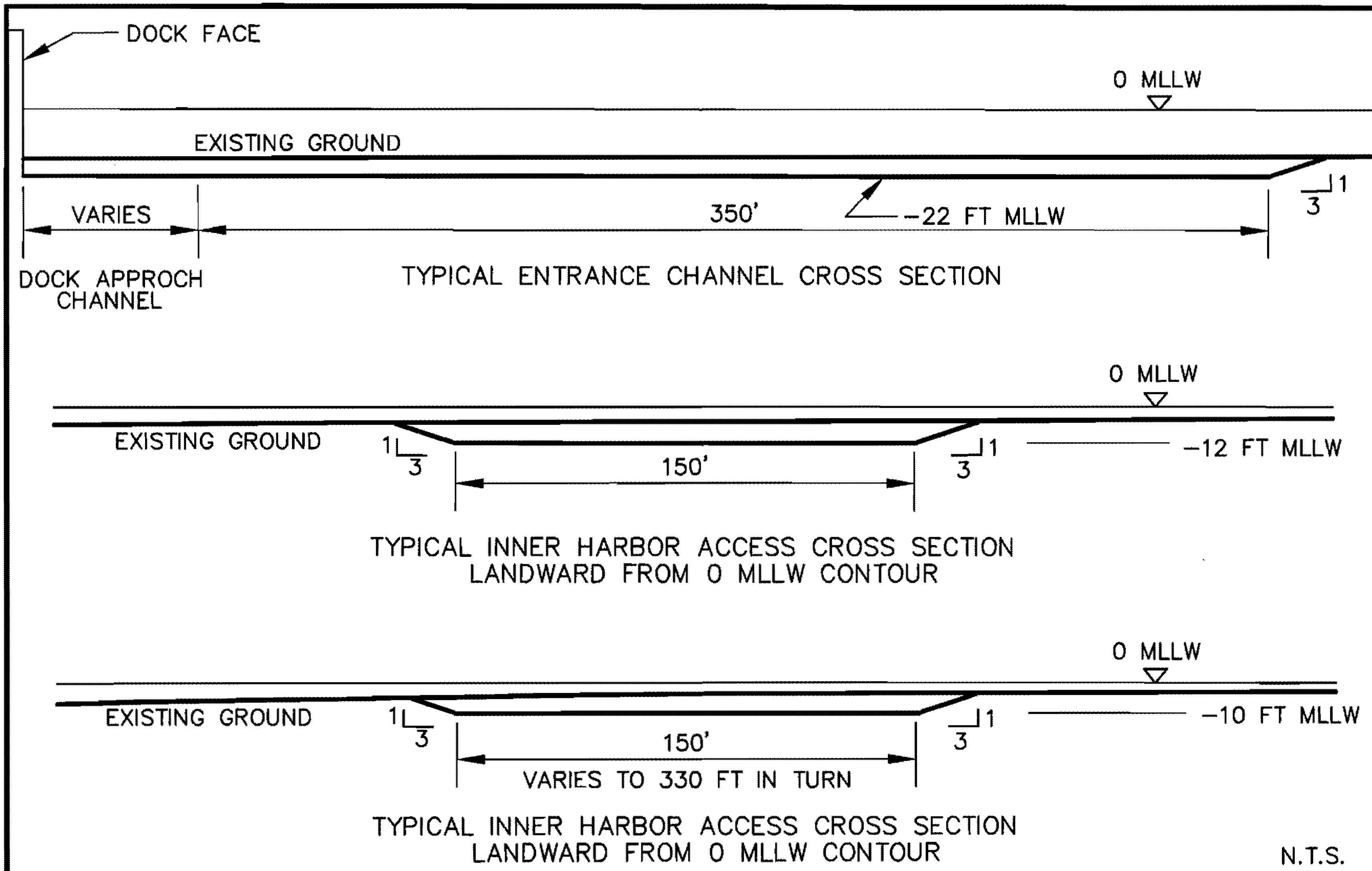
6.2 Environmental Considerations

6.2.1 Impacts on Listed Species.

Impact of the project is localized to an existing shipping channel and harbor entrance, with related impacts at a nearby quarry. None of the physical impacts associated with construction or maintenance are measurably related to any species listed as endangered or threatened, or the habitat of these species.

6.2.2 Effects To Be Mitigated.

Project effects on the environment include negligible noise and dust; road deterioration from construction equipment; possible localized, short-term, minor turbidity during construction; and entrapment of juvenile anadromous fish from dredging operations.



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TYPICAL CHANNEL CROSS SECTIONS
NAVIGATION IMPROVEMENTS, NOME, ALASKA

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6.2.3 Mitigation Planning.

Incremental cost evaluation techniques/practices resulted in the development of a cost-effective mitigation strategy. The strategy maximizes avoidance of impact through use of procedures that also appear to offer the lowest cost on an incremental and a total-cost basis.

Noise, Dust, and Road Deterioration. Contractors will be given the option of working during winter conditions and maximizing use of heavy equipment on ice surfaces not requiring city streets. Any summer use of local roads will be accompanied by a watering system to keep down the dust. Roads will be restored to preconstruction condition.

Turbidity. Contractors will be informed of standards, and runoff at disposal areas will be monitored during times of active use. Containment areas will be modified if runoff problems are observed.

Anadromous Fish Entrapment. Dredging activity will be restricted to windows necessary to avoid juvenile fish mortality.

In-Water Blasting. In-water blasting is avoided through construction sequencing that schedules the possibility for any blasting activity during fast ice conditions of the winter months.

6.2.4 Disposal of Contaminated Dredged Material.

Of 19 soil samples taken during 1997 by a contractor working for the city of Nome, arsenic was detected at concentrations of 5 to 260 mg/kg. The concentration of arsenic in all samples, except two offshore samples, exceeded the mean concentration of arsenic in Alaska soils (6.7mg/kg). The only other metal of concern was mercury, which was found to be above the Marine Sediment Quality Standards (0.41 mg/kg) in two of the boring samples, AP-1001 (1.7 mg/kg) and AP-1003 (0.61 mg/kg). Although no regulations specify the maximum concentration of potentially hazardous compounds in dredged soils in Alaska, measures will be taken to properly dispose of any materials clearly hazardous. Contaminated sediments will be handled and confined in accordance with a disposal plan that has been developed with the EPA. This will most likely involve the use of silt barriers during dredging and disposal of material in an approved lined area. This area would be capped and contoured to be contiguous with the surrounding landscape.

6.3 Cost Estimate

6.3.1 Construction Cost Estimate.

Total project cost at an October 1997 price level is $25,544,000. A detailed summary of the cost estimate is provided in appendix D.

For purposes of economic evaluation, constant dollars are used in the benefit estimate and the cost estimate. The appropriate construction cost estimate for purposes of economic evaluation is therefore $25,544,000. Estimated interest during construction is added to this amount to determine investment cost. The investment cost is amortized over a 50-year period using an administratively set 7-1/8-percent interest rate, and annual operation and maintenance (O&M) cost is added to the annualized investment cost to determine total annual cost.

6.3.2 Interest During Construction.

Interest at 7-1/8 percent is added to the cost estimate to account for the opportunity cost of funds between the time they are expended and the time benefits began to be earned. The interest rate is administratively set. The actual construction schedule is unknown at present, but indications are that the project can be completed within a 24-month construction period. Expenditures are estimated to be generally uniform during the period, so interest during construction is estimated to be $1,550,000.

6.3.3 Annual Cost.

Annual NED investment cost, including interest during construction, is $1,880,000. Total annual cost, based on a 50-year economic life, 7-1/8 percent interest, February 1998 price levels, and annual O&M estimated at $440,000, is $2,320,000.

6.4 Risk and Uncertainty

For this project, risk and uncertainty arise from the use of numerous complex social, economic, and natural variables that themselves have no absolute value typical of all cases. Other uncertainty is inherent in imperfect data and in analytical procedures that are designed to reasonably estimate rather than calculate with certainty and precision. Results have been reviewed to remove uncertainty associated with measurement and procedural errors.

The following variables are considered to have quantifiable bands of uncertainty and are addressed in this report:

- Delay cost of oceangoing crab vessels
- Norton Sound red king crab harvest
- Halibut harvest
- Halibut bycatch value
- Crab prices
- Equilibrium fleet size, and income thresholds
- Opportunity cost of time
- Delay cost of oceangoing equipment
- Dock standby cost
- Delay cost for lighters
- Project-related delays
- Alternative cost of air freight
- Operating costs for different size vessels
- Crab deadloss
- Vessel values
- Repair costs
- Value of subsistence harvest
- Norton Sound biomass
- Consequences of late season delay
- Damage reduction to cargo

- Prevention of vessel loss
- Operation and maintenance cost

In some cases, uncertainty was accommodated by using a probabilistic approach involving simulations to estimate expected values. In others, a range of values was used to demonstrate impacts on plan evaluation. Where a range of values was used, the ranges represent what could be considered reasonable higher and lower limits. The ranges are supported by analysis, data, and the collective subjective input from informed and reliable individuals having expertise in a given area. In no case were ranges developed based on input from a single individual or single data source.

High and low values of the various ranges were carried through the benefit evaluation. Plans were evaluated using a median value, but plan formulation would not be impacted by exclusive use of either the lower or higher range. The cumulative impact of the lower range estimates for all other variables accounts for a variation in benefits of the NED plan by 16 percent.

6.5 Plan Implementation

6.5.1 Construction Sequence.

Construction of the recommended plan is expected to take two seasons, each starting in April and ending in December. It is expected that during the first construction season, both the main breakwater and the spur structure added to the end of the causeway would be completed. Quarrying should begin no later than 30 days after the award of the project, with the first stones being placed following the ice breakup in Norton Sound. Widening of the causeway breach and replacement of the structural causeway would take place in the fall of the first year immediately after major use of the causeway is over for the season. Completion of modifications to the breach would be accomplished prior to the beginning of the next season to minimize the impact on causeway operations.

During the second construction season, the channel and the sediment capture basins would be constructed. Removal of any portions of the existing project would be carried out in the fall of the year.

6.5.2 Operation, Maintenance, and Replacement.

The annual operation and maintenance cost estimate of $440,000 is calculated as shown in table 9. The non-federal sponsor's O&M costs are shown in table 10.

TABLE 9.--*Federal operation and maintenance cost estimate*

Item	Equivalent annual cost
Mobilization	$104,000
Navigation aids	1,000
Surveys	20,000
Dredging of 10,000 yd^3 annually	50,000
Dredging of 10,000 yd^3 every 10 years	4,100
Dredging of 60,000 yd^3 annually	240,000
Major maintenance at year 35	21,400
TOTAL	$440,000

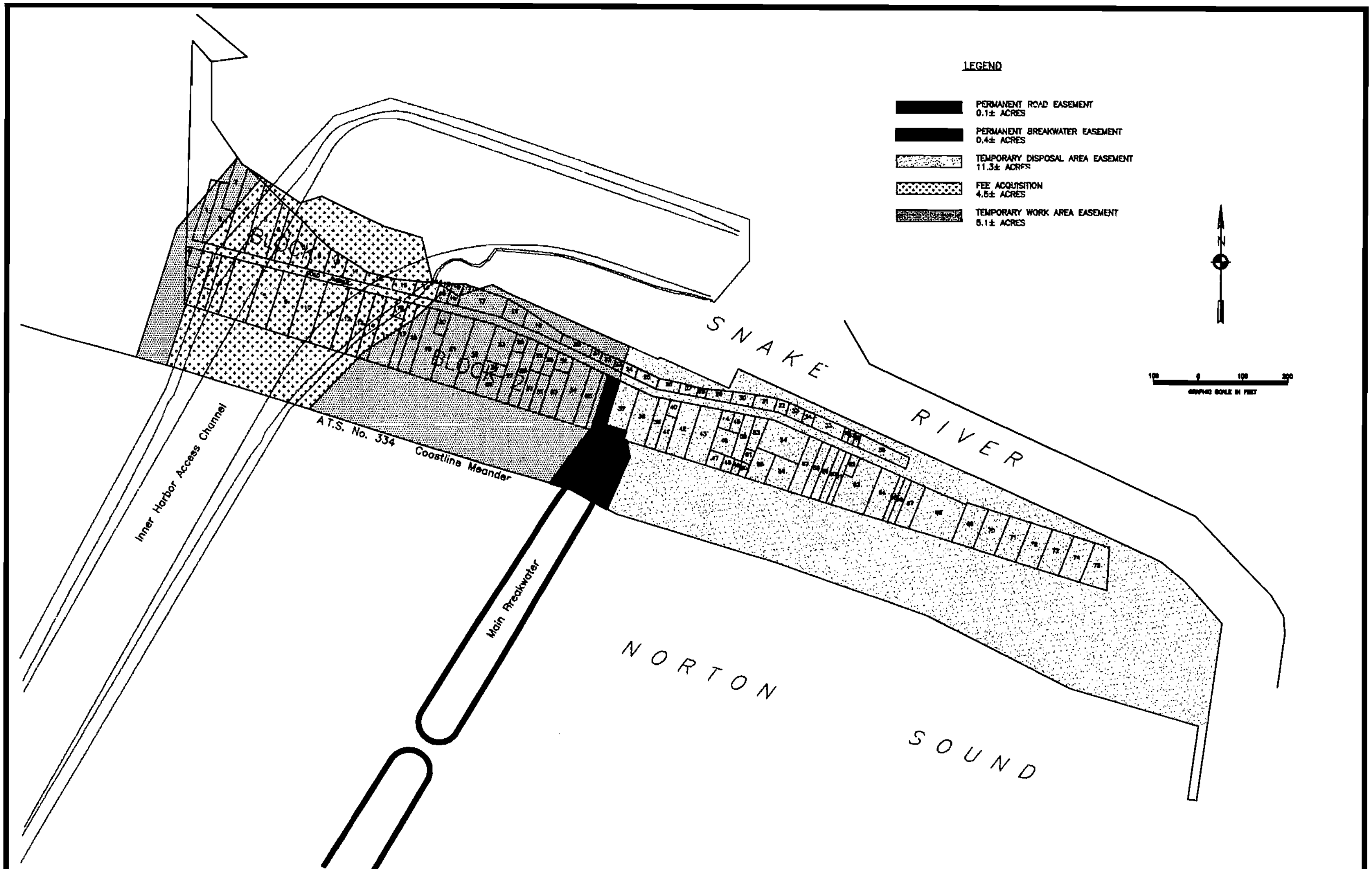
TABLE 10.—*Non-federal sponsor's operation and maintenance cost estimate*

Item	Equivalent annual cost
Harbor dredging, 10,000 yd^3 every 10 years	$4,100
Causeway dock berth dredging	0
TOTAL	$4,100

6.5.3 Real Property Interests.

Real Property Interests Required for General Navigational Features of the Project. Public access is currently available to the project site. The sponsor would provide all lands necessary for the Federal portion of the project. These involve all uplands required for the new entrance channel, breakwater, and disposal areas. The land requirements are (1) fee simple interest for the channel, (2) a temporary (2-year) work area easement, (3) a temporary (2-year) easement for a disposal area, (4) a permanent easement for the breakwater, and (5) a permanent easement for access to the breakwater. The required upland interests are shown in figure 20.

No interest is required for lands below mean high water, as these areas are subject to the Federal right of navigational servitude. An existing sewer main would need to be relocated to a greater depth in order to pass under the new channel, but would stay within its existing right-of-way. Five Public Law (P.L.) 91-646 relocations (relocation of persons) are anticipated. The required standard estates are shown in appendix E.



ALASKA DISTRICT
CORPS OF ENGINEERS
CIVIL WORKS BRANCH

REQUIRED REAL ESTATE INTERESTS

NAVIGATION IMPROVEMENTS, NOME, ALASKA

20

Current Ownership. General title information is based solely on city assessment records; an official title search has not been performed. It is anticipated that the ownership status will change before project award. There is a mixture of private and city-owned property within the project limits. There are about 121 separate lots. Of these, the sponsor currently owns 23 lots, and the remaining 98 lots are owned by 16 different private owners. The attitude of the landowners towards the project is generally positive. The surface and subsurface estates are owned separately on the unplatted lands. The city owns the surface; the regional Native corporation owns the subsurface. There are no known federally owned lands within the project area. All other project areas lie below the mean high water line and are subject to the Federal right of navigational servitude. The city sponsor owns all tidelands affected by the project.

Improvements. Five marginal cabin residences are situated on lots 12, 13, 14, 17, and 18, Block Two. The cabins have no utility services. Water is carried in, sewage is carried out, there is no electricity, and heat is from wood stoves. These are owned by the city, subject to a life estate interest held by the current occupants. These interests will need to be acquired and the occupants relocated in accordance with P.L. 91-646. The availability of replacement housing is limited; there is an anticipated need for last-resort housing benefits.

Mineral Activity. There is no known mineral activity occurring above mean high water, and no acquisitions of mineral interest are anticipated. However, it is not uncommon in Nome for a title search to reveal the existence of old mining claims that cloud title and can complicate the real estate acquisition process.

Relocation of Roads and Utilities. A sewer main line lies within the platted roadway. The line would be relocated to a greater depth within the existing right-of-way to run under the new channel. No new rights-of way acquisitions are anticipated. There are no other known utility relocations. The new channel would sever Gold Street (a platted but undeveloped road). Physical access would be restored by filling the existing channel. The sponsor would provide legal access across the filled channel to ensure access to the properties on the spit. Real estate costs associated with these relocations are relatively small and are included with administrative expenses. An attorney's opinion of compensability has not been completed.

Local Sponsor's Acquisition Experience. The sponsor was provided with a real estate information packet during the reconnaissance phase. The city's experience and ability to acquire real estate has been evaluated and rated as moderately capable. The city has the legal authority to condemn lands for public purposes; however, it is anticipated it will require contractor support to complete acquisitions and relocations in a manner complying with P.L. 91-646.

Contaminated Materials. The current plan indicates that any contaminated soils would be encapsulated within the filled channel disposal area in accordance with current regulations. It is not anticipated that the presence of any HTW's would adversely affect acquisition.

Schedule. Due to the number of separate parcels, ownerships, and P.L. 91-646 relocations, acquisition should be scheduled at least 6-8 months after the date of the Project Cooperation Agreement to give the sponsor the time necessary to provide the needed real estate. The local sponsor concurs with this general schedule.

Summary and Cost Estimate. A summary of the required real estate interests for the Nome project is presented in table 11, and the baseline real estate cost estimate is shown in table 12.

TABLE 11.—*Summary of required real estate interests*

Feature	Acres	Owner	Interest
Areas Above Mean High Water:			
Channel	4.5	City/private	Fee (Estate #1)
Breakwater tie-in	0.4	City/private	Permanent Easement (Estate #9)
Breakwater access road	0.1	Private	Permanent Easement (Estate #11)
Work and staging area	5.1	City/private	Temporary Easement (Estate #15)
Disposal area	11.3	City/private	Temporary Easement (Estate #15)
Areas Below Mean High Water:			
Channel, breakwaters, disposal area	N/A	City	Navigational servitude

TABLE 12.—*Baseline real estate cost estimate*

Item	Cost
Payments for real estate	$715,000
P.L. 91-646 relocations	125,000
Administrative costs	100,000
Total real estate costs	**$940,000**

6.5.4 Cost Apportionment.

Following the completion of the feasibility study and pending a positive review, the General Investigation can move into the Plans and Specifications phase once a Project Cooperation Agreement (PCA) has been signed. A signed PCA indicates that the local sponsor is aware of and prepared to meet the financial obligations of the construction phase. Construction costs for the project, which include Plans and Specifications, would be apportioned in accordance with the Water Resources Development Act (WRDA) of 1986. The fully funded cost apportionment for project features is summarized in table 13.

TABLE 13.—*Apportionment of construction costs*

	Construction cost contribution (%)	
Portion of project	**Federal**	**Local**
General Navigation Features (includes entrance channel, dock approach channel, and breakwater)	80	20[a]
Local features (includes floats, mooring basin, and 100-foot berthing area adjacent to causeway dock)	0	100
Coast Guard navigation aids	100	0

[a] Non-federal interests must provide cash contributions toward the cost for construction of the general navigation features (GNF) of the project, paid during construction (PDC) as follows: for project depths of up to 6.1 m - 10%; for project depths over 6.1 m and up to 13.7 m - 25%, and for project depths exceeding 13.7 m - 50%. For all depths, they must provide an additional cash contribution equal to 10% of GNF cost (which may be financed over a period not exceeding 30 years), against which the sponsor's costs for LERRD (except utilities) shall be credited.

Note**:** Costs for general navigation features include associated costs, such as mobilization.

The initial construction cost of the General Navigation Features is 80 percent for the initial Federal investment and 20 percent for the initial local share. The non-federal sponsor must also contribute an additional 10 percent, plus interest, during a period not to exceed 30 years after completion of the General Navigation Features. The sponsor would be credited toward this 10-percent cost with the value of lands, easements, rights-of-way, utility relocations, and dredge spoil disposal areas (LERRD) necessary for construction, operation, and maintenance of the general navigation features.

The Federal Government would assume 100 percent of the operation and maintenance costs for the breakwater and entrance channel. The non-federal sponsor would assume all other operation and maintenance costs.

In addition to the sponsor's share of costs for General Navigation Features, the sponsor is responsible for costs associated with other NED and non-NED features. The Pertinent Data table in the front of this report provides a summary of all shared costs.

6.5.5 Financial Plan.

In a letter to the Corps (included in appendix F), the city of Nome indicated that it is aware of the estimated cost of construction for the NED plan, 20 percent of which it is responsible for, and is strongly committed to seeing the project through to construction. The city intends to finance the majority of its cost share with a grant from the State of Alaska through the Alaska Department of Transportation and Public Facilities' (ADOT&PF) program of matching funds for Corps projects. A letter to the city of Nome from the ADOT&PF suggests that strong support exists at the State level for the project and that funds would likely be available for the project, barring major budgetary setbacks. This letter is provided in appendix F.

The balance of the local match would be generated through revenue bonds. Debt service on these bonds would be met through several revenue-generating measures, including but not limited to port tariff rate adjustments, increased port use, port land leases, and prospective increased revenues from the newly constructed small boat harbor. Also, the Alaska Industrial Development and Export Authority (AIDEA) has expressed a strong interest in the project. On February 18, 1998, AIDEA passed a resolution to amend its authorization bill to include up to $30 million for forward funding of the navigation improvement project at Nome. This is a very significant step toward keeping the project on a fast track to construction.

7. PUBLIC INVOLVEMENT

7.1 Meetings

Throughout the course of the study, the local sponsor has worked closely with the study team to see that local needs, concerns, and comments are addressed by the final product. As a result, the NED plan is viewed by all involved to be the best alternative capable of meeting the needs of both Nome and the communities that rely on Nome as a transportation hub. The primary meetings that helped to bring the NED plan to fruition are listed here.

Nov 6, 1996 – Meeting at the District office between the Corps, the local sponsor, and a representative from Senator Ted Stevens' office. The meeting focused on outlining the possibilities available to expedite the project so that construction could begin as soon as possible. Authorization in the 1998 WRDA with construction in 1999 was established as the study goal.

May 15, 1997 – Public meeting in Nome.

July 16, 1997 - Meeting in Nome between the Corps and the Nome city engineer and harbormaster to discuss the expansion and improvement of the Nome small boat harbor.

November 4, 1997 – Meeting at the District office between the Corps and Mike Yanez (Nome city manager) to discuss the status of the project and to address cost overruns on survey work.

November 13, 1997 - Meeting between the Nome city engineer, the Corps, and Woodward-Clyde to discuss the geotechnical scope of work.

December 15, 1997 - Study status briefing in Nome. Present were the Corps, Nome City Council, and other city representatives. Alternatives and approximate costs were presented to insure that local interests, concerns, and input were known prior to physical modeling.

January 15-26, 1998– Physical modeling of the project at the Waterways Research Station (WES) in Vicksburg, MS. During testing and data acquisition, representatives from the city of Nome attended to help verify that model results were consistent with physical observations.

February 18, 1998 - Meeting with the Nome city engineer to discuss the status of the project and answer questions concerning the draft cost estimate and NED plan.

7.2 Consultation Requirements

This study has been coordinated with all relevant Federal and State agencies. Information on this coordination is provided in the Environmental Assessment (EA) published with this report. Pertinent correspondence is presented in appendix 3 of the EA and in appendix F. Navigation improvement plans will be in full compliance with all requirements when the final EA is accepted.

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

The studies documented in this report indicate that Federal construction of navigational improvements as described in the recommended plan is technically possible, economically justified, and environmentally and socially acceptable. Plan L was found to be the best for maximizing net benefits; thus it was designated the NED plan. The city of Nome is willing to act as local sponsor for the project and fulfill all the necessary local cooperation requirements. Thus it is concluded that plan L, the recommended plan, should be pursued by the United States in cooperation with the city of Nome.

8.2 Recommendations

I hereby recommend that the improvements for marine navigation at Nome, Alaska, be constructed as described in the recommended plan in this report. Of the total first cost, the Federal Government will contribute an estimated $20,183,000, and $440,000 annually for Federal maintenance, provided that prior to construction the local sponsor agrees to:

a. Provide and maintain, at its own expense, the local service facilities, consisting of the mooring basin and the mooring facilities.

b. Provide all lands, easements, rights-of-way, and perform or ensure the performance of all relocations determined by the Federal Government to be necessary for the construction, operation, maintenance, repair, replacement, and rehabilitation of the general navigation features (including all lands, easements, and rights-of-way, and relocations necessary for dredged material disposal facilities) and the local service facilities.

c. Provide, during the period of construction, a cash contribution equal to the following percentages of the total cost of construction of the general navigation features which include the construction of land-based and aquatic dredged material disposal facilities that are necessary for the disposal of dredged material required for project construction, operation, or maintenance and for which a contract for the facility's construction or improvement was not awarded on or before October 12, 1996:

(1) 10 percent of the costs attributable to dredging to a depth not in excess of 20 feet;

(2) 25 percent of the costs attributable to dredging to a depth in excess of 20 feet but not in excess of 45 feet;

(3) 50 percent of the costs attributable to dredging to a depth in excess of 45 feet.

d. Repay with interest, over a period not to exceed 30 years following completion of the period of construction of the Project, an additional 0 to 10 percent of the total cost of construction of general navigation features depending upon the amount of credit given for the value of lands, easements, rights-of-way, relocations, and borrow and dredged or excavated material disposal areas provided by the Non-Federal Sponsor for the general navigation features. If the amount of credit exceeds 10% of the total cost of construction of the general navigation features, the Non-federal Sponsor shall not be required to make any contribution under this paragraph, nor shall it be entitled to any refund for the value of lands, easements, right-of-way, relocations, and dredged or excavated material disposal areas, in excess of 10% of the total cost of construction of the general navigation features.

e. For so long as the Project remains authorized, operate and maintain the local service facilities and any dredged or excavated material disposal areas, in a manner compatible with the Project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government.

f. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the Non-Federal Sponsor owns or controls for access to the general navigation features for the purpose of inspection, and, if necessary, for the purpose of operating and maintaining the general navigation features.

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

h. Keep, and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the Project, for a minimum of three years after completion of the accounting for which such books, records, documents, and other evidence is required, to the extent and in such detail as will properly reflect total cost of construction of the general navigation features, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 CFR Section 33.20.

i. Perform, or cause to be performed, any investigations for hazardous substances as are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601-9675, that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the construction, operation, and maintenance of the general navigation features. However, for lands that the Government determines to be subject to the navigation servitude, only the Government shall perform such investigations unless the Federal Government provides the Non-Federal Sponsor with prior specific written direction, in which case the Non-Federal Sponsor shall perform such investigations in accordance with such written direction.

j. Assume complete financial responsibility, as between the Federal Government and the Non-Federal Sponsor, for all necessary cleanup and response costs of any CERCLA-regulated materials located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the construction, operation, or maintenance of the general navigation features.

k. To the maximum extent practicable, perform its obligations in a manner that will not cause liability to arise under CERCLA.

l. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way, required for construction, operation, and maintenance, of the general navigation features, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act.

m. Comply with all applicable Federal and State laws and regulations, including, but not limited to, Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 USC 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army".

n. Provide a cash contribution equal to the following percentages of total historic preservation mitigation and data recovery costs attributable to commercial navigation that are in excess of one percent of the total amount authorized to be appropriated for commercial navigation:

(1) 10 percent of the costs attributable to dredging to a depth not in excess of 20 feet;

(2) 25 percent of the costs attributable to dredging to a depth in excess of 20 feet but not in excess of 45 feet;

(3) 50 percent of the costs attributable to dredging to a depth in excess of 45 feet.

o. Enter into an agreement which provides, prior to construction, 25 percent of preconstruction engineering and design (PED) costs;

p. Provide, during construction, any additional funds needed to cover the non-federal share of PED costs;

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

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

Date: 22 July '98

SHELDON L. JAHN
Colonel, Corps of Engineers
District Engineer

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LaBelle, Joseph C. *et al.* 1983. *Alaska Marine Ice Atlas,* Arctic Environmental Information and Data Center, University of Alaska.

National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce. 1983 (Jan). *United States Coast Pilot, Pacific and Arctic Coasts Alaska: Cape Spencer to Beaufort Sea,* 11th ed. Washington, DC.

Other references are in section 1.4, Previous Studies.

DEPARTMENT OF THE ARMY
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FINDING OF NO SIGNIFICANT IMPACT
AND
ENVIRONMENTAL ASSESSMENT

NAVIGATION IMPROVEMENTS
NOME, ALASKA

April 1998

NAVIGATION IMPROVEMENTS
NOME, ALASKA

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FINDING OF NO SIGNIFICANT IMPACT

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

Navigation Improvements
Nome, Alaska

The navigation system for Nome Harbor in Nome, Alaska, is being expanded to satisfy additional moorage needs and to protect vessels currently using the Nome causeway. The navigation improvements, referred to as the preferred alternative and described in the attached April 1998 Environmental Assessment, will be constructed at the sand spit in Nome. Work will entail (1) constructing a 925-meter-long breakwater parallel to the causeway; (2) dredging a new entrance channel through the sand spit and into the existing harbor in the Snake River; and (3) implementing a sand bypass management program. Approximately 140,000 cubic meters (m^3) of rock (consisting of armor rock, secondary rock, and core material) will be required to construct the breakwater to a +4.2 meters MLLW elevation. Approximately 360,000 m^3 of dredged material would be excavated to build the entrance channel and turning basin. An additional 120,000 m^3 will be dredged to form a sediment bypass management basin. The dredged material will be placed at three different locations; the existing sand spit to an elevation of +6 meters MLLW to reduce overtopping during storms; in the approved EPA disposal site; and in the existing channel (approximately 75,000 m^3 of fill).

An estimated 20,000 m^3 of material contaminated with arsenic was found in the area to be excavated. This material will be disposed of in a lined disposal site in the existing channel. The existing channel will be blocked at both ends, and a geotextile fabric, which would retain the fines and allow the water to pass, will be placed on the bottom and sides of the blocked entrance channel. The contaminated material will be capped with at least 1 meter of clean material. The area will be platted with the city of Nome to ensure the integrity of the cap is maintained.

Construction of the navigation improvements will contribute to the future growth of Nome and will provide more timely and less expensive services to the 26 outlying villages that depend on Nome as a transportation hub. Adverse environmental effects will include direct impacts to approximately 19 hectares of marine habitat within the project footprint, minor increases in turbidity levels during periods of work, and a reduction in the net productivity of the site.

Work will not affect any sites eligible for inclusion in the National Register of Historic Places, nor will the project affect any threatened or endangered species or their critical habitat. These determinations have been coordinated with the State Historic Preservation Office, the U.S. Fish and Wildlife Service (USFWS), and the National Marine Fisheries Service (NMFS).

All appropriate and practicable mitigation measures have been incorporated into the project and include (a) designing the navigation improvements to maximize the safe use of the causeway and provide access to the existing small boat harbor, while minimizing the project footprint; (b) constructing the breakwater prior to dredging the basin to help contain any sediment plume; using a silt curtain for in-water work between April 15 and June 15; (c) coordinating construction of the harbor with the city of Nome to avoid conflicts with subsistence fisheries and commercial activities; (d) developing a quarry development plan to be reviewed by State and Federal resource agencies; and (e) design a sediment management program that will ensure that both the fisheries breaches at the causeway and breakwater are always at their designed dimensions.

The EA, an evaluation under Section 404(b)(1) of the Clean Water Act and an unsigned Finding of No Significant Impact was circulated for public review in April 1998. There were no adverse comments on the proposed action or the environmental evaluation. The action is consistent with State and local coastal zone management programs to the maximum extent practicable. The accompanying environmental assessment supports the conclusion that the project does not constitute a major Federal action significantly affecting the quality of the human environment. Therefore, an environmental impact statement is not necessary to construct the navigation improvements in Nome, Alaska.

Sheldon L. Jahn
Colonel, Corps of Engineers
District Engineer

30 June 98
Date

Navigation Improvements
Nome, Alaska

1.0 PURPOSE AND NEED FOR THE PROPOSED ACTION

Harbor use in Nome has undergone radical changes in the past 2 years. In 1995, the North Pacific Fishery Management Council made Norton Sound a super-exclusive registration area. This change in fisheries policy prevented vessels that fish for crab in Norton Sound from fishing for crab in any other area, driving large vessels away and creating a niche for small fishing boats. In 1993, no permits were issued to local fishermen in the Sound. In 1994, 30 vessels had permits, and in 1995, 45 vessels purchased permits.

Community Development Quotas (CDQs) were developed in 1992 to provide fish allocations to Bering Sea communities. This program has expanded through the years from a single-species allocation to an allocation that in 1998 will allot up to 7.5 percent of the total allowable catch for all species in the Bering Sea. Currently, up to 25 Nome basin permit holders fish for the Community Development Group.

The present navigation facilities at Nome are no longer functionally adequate for the current fleet. The harbor must also accommodate small tug and barge traffic because Nome is the transportation and commodities hub for northwest Alaska, with a land and water area about four times as large as the state of Virginia. The tug and barge operation at Nome directly affects 26 villages that depend on the barge for the vast majority of their goods and heating oil.

The objectives listed below were identified as possible navigation improvements.

a. Restore the project as authorized by replacing components defining the existing authorized navigation system. This would require repairing or removing the concrete jetties that front the channel and abandoning or reconstructing the failing steel sheet-pile revetment.

b. Improve inner harbor access by improving channel alignment and increasing channel depth.

c. Develop a maintainable inner harbor access channel with adequate dimensions to handle the user fleet.

d. Improve the effective use-time of the causeway docks. Potential improvements include decreased wave activity, increased depths, and decreased currents. Develop a protected zone to allow tugs to change over from the towing mode to docking configuration.

e. Identify littoral sediment transport and Snake River sediment transport trends to minimize operations and maintain a new navigation channel and optimize use at project depths. Combined with this, develop a realistic maintenance plan that allows project benefits to be realized.

f. Determine the effects of a new navigation channel on circulation and wave action as related to the city of Nome's harbor expansion plans.

g. To the extent possible, minimize dredging and maintenance costs. Several possible methods to minimize costs include decreasing dredging and establishing a program that reduces lost time due to weather or wave delays. Where cost effective, develop structural controls for sedimentation.

h. Minimize any negative environmental impacts of the existing or new project.

2.0 STUDY AUTHORITY

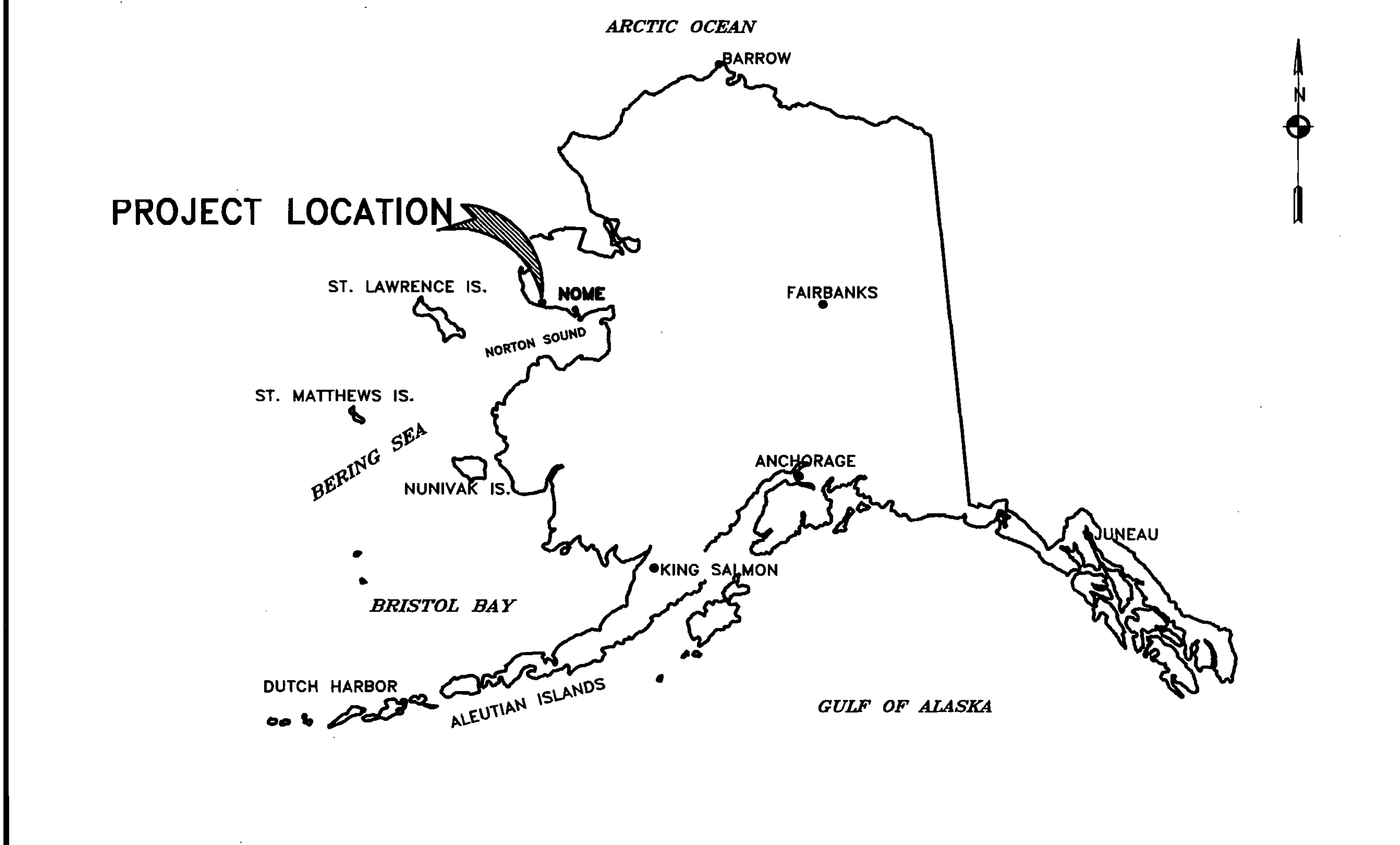
This General Investigation study is authorized by a resolution adopted December 2, 1970 by the House Public Works Committee. The resolution, known as the "Rivers and Harbors in Alaska" resolution, reads in part:

> *Resolved by the Committee on Public Works of the House of Representatives. United States, that the Board of Engineers for Rivers and Harbors is hereby requested to review the reports of the Chief of Engineers on Rivers and Harbors in Alaska, published as House Document Numbered 414, 83rd Congress, 2nd session Northwestern Alaska, published as House Document Numbered 99, 86th Congress, 1st Session...and other pertinent reports, with a view to determining whether any modifications of the recommendations contained therein are advisable at the present time.*

3.0 EXISTING CONDITIONS

3.1 Project Site Description

Nome is on the Seward Peninsula in western Alaska (figure EA-1). It is the transportation and commercial hub of northwest Alaska. Nome is accessible only by air and water and cannot be reached by road or rail from any major city. A local road system leads to three small neighboring villages. Mining, fishing, and tourism are the major industries in Nome.



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LOCATION AND VICINITY MAP

NAVIGATION IMPROVEMENTS, NOME, ALASKA

EA–1

Nome Harbor is on Norton Sound at the mouth of the Snake River. The original Federal project, authorized in 1917, was among the first Corps of Engineers navigation projects in Alaska. It provided for a 102-meter-long east jetty, a 140-meter-long west jetty, and a 2.5-meter-deep by 23-meter-wide by 587-meter-long entrance channel extending from Norton Sound to a turning basin up the Snake River. The basin was 2.5 meters deep and approximately 76 meters by 183 meters in area. Dredging of the channel and basin were completed in 1922. Construction of the jetties (originally concrete and timber structures) was completed in 1923. In addition, approximately 975 linear meters of steel sheet-pile wall were constructed and lined the entrance channel and eastern side of the turning basin.

Due to extensive ice and storm damage, the east and west jetties were constructed (with concrete and steel) in 1940 to a modified length of 73 meters and 122 meters, respectively. The east jetty was repaired in 1954, and both were again repaired in 1965. Emergency repairs to the steel sheet-pile wall were accomplished in 1985 and 1986. The existing Federal project is shown in figure EA-2.

An 823-meter-long causeway, constructed in mid-1980, extends into Norton Sound west of the harbor entrance. It is a rubblemound structure that includes two vertical sheet-pile docks on the east side for vessel off-loading and berthing. The facilities were designed and built for cargo and petroleum vessels 122 meters long and greater, and for cruise ships that load and unload passengers. The depth at the causeway facilities is about 6.3 meters. A breach in the causeway, close to its shoreward end, allows nearshore waterflow for fish migration and shoreline accessibility for small boats. The design depth through the breach is 2.4 meters. A stone revetment is located along the shoreline east of the existing harbor entrance. Construction of the 1,020-meter-long revetment was completed in 1951 to protect the shoreline from erosion.

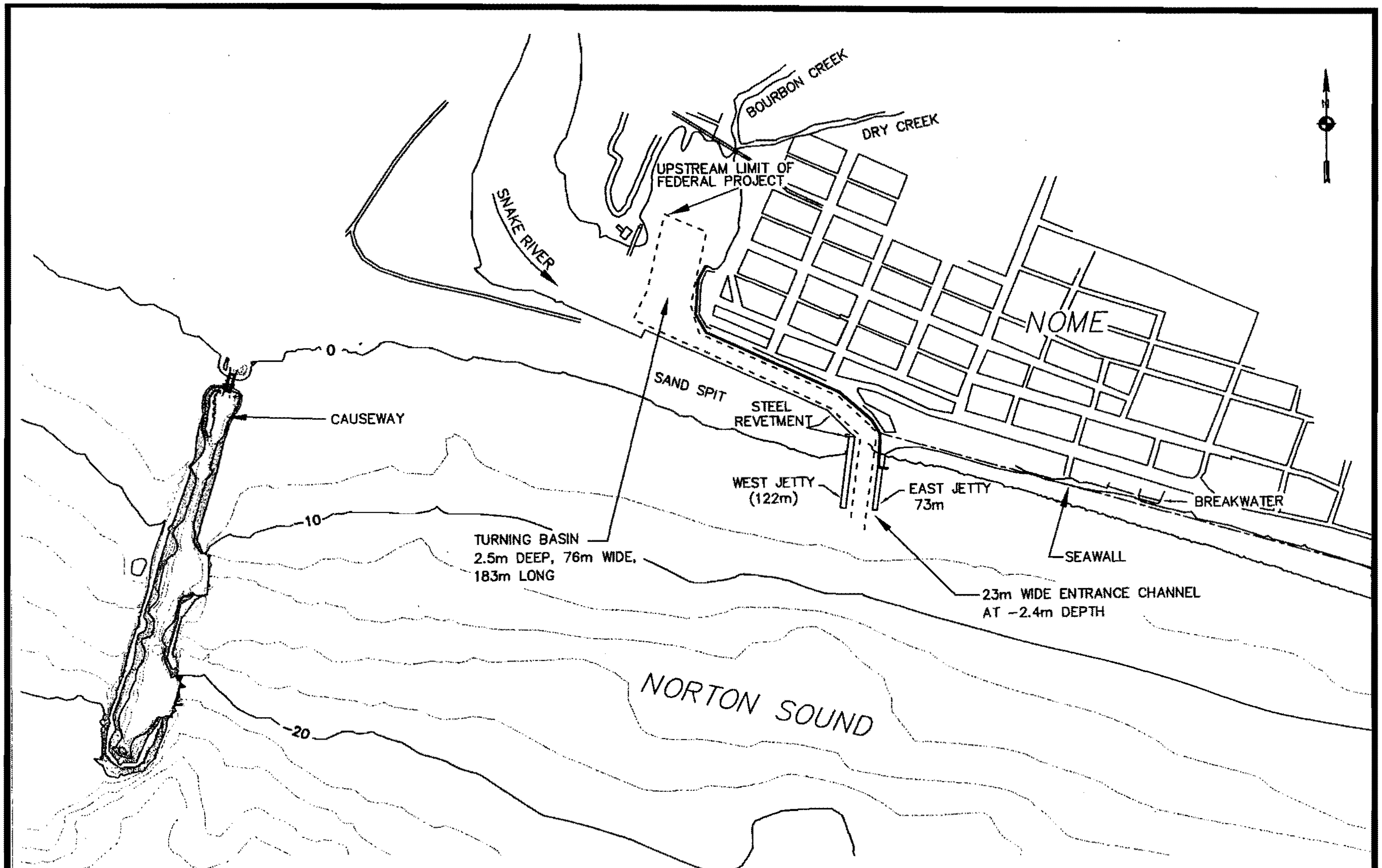
3.2 Physical Environment, Terrestrial

3.1.1 Climate.

Nome's climate is influenced by both maritime and continental conditions. In summer, the maritime dominates, shifting to a mostly continental climate in the winter when Norton Sound freezes. Snow falls between November and May, with an average annual snowfall of 22 centimeters (cm). It rains from June through August, with an average annual rainfall of about 37 cm. Normal winter temperatures range from -24° C to -7° C. The Nome area is known for intense storms that usually arrive from the southwest. Intense storms also come from the south and southeast. According to Nome residents, the severe damage-causing storm of October 1992 attacked from the south-southeast direction.

3.1.2 Topography and Soils (Coastal Area).

Beaches, coastal plains, high hills, and watercourses are the major topographical features of the Nome area. Because of the relatively low wave energy along the coast



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PROJECT AREA MAP
NAVIGATION IMPROVEMENTS, NOME, ALASKA

EA-2

at Nome, beach sediment is distributed at random. There are no clearly defined areas where sand or gravel of similar size is regularly deposited. Because beach sediments are deposited over time, the shoreline is a dynamic and changing environment. In Nome, at least six distinct geologic or ancient beach sites are known to exist inshore from the present beach on the coastal plain. These ancient beaches are the sites of placer gold deposits, which played an important part in Nome's history and economy.

The coastal plain is about 4 miles wide and is a nearly level crescent-shaped lowland extending from Cape Nome to the hills west of Cripple River. The plain is underlain by deposits laid down over time by ocean currents and by watercourses. These deposits consist of silt, interstratified fine sand, well-rounded gravels, and beds of angular fragments. The mantle overlaying the lower deposits is made up of silty loessial (wind-laid) deposits ranging from a few centimeters to up to a meter thick. Permafrost extends to depths of several meters. The coastal plain area is covered by moist tundra and the soil is generally classified as Histic Pergelic Cryaquepts, a loamy, gently sloping soil association.

High hills border the coastal plain and range to about 300 meters in elevation. They are formed by folded and faulted interbedded schists and limestones of the Nome group. The hills' soils in general consist of rubble or gravel and overlie bedrock at shallow depths and are generally classified as Pergelic Cryumbrepts, a very gravelly, hilly to steep association. Features caused by frost action are common and include stone nets (rings of large stones surrounding a central area of finer debris), frost boils (small frost-heaved and cracked knolls), and solifluction lobes (created from water-saturated ground slowly flowing down the hills). The lower slopes have soils formed in gravelly deposits laid down by streams or moved by soil creep from steeper, higher slopes.

3.1.3 Snake River.

The Snake River runs from the northeast to the southwest, flowing through the currently authorized turning basin and then passing through the existing sheet-pile-lined navigation channel and out into Norton Sound. The approximate drainage area of the Snake River is 225 square kilometers. The discharge of the Snake River is less than 14 cubic meters per second (m^3/s) on average, except for June. The highest daily mean recorded was 105 m^3/s in June 1966. At a U.S. Geological Survey stream-gauging station 8 kilometers northeast of Nome, the mean annual flow has been approximately 5.3 m^3/s. The typical peak annual flow results from snowmelt in early May. Summer rains bring progressively lower discharge peak flows, and flow continues to decline through the winter. The 1991 water-year graph for discharge of the Snake River through Nome shows a peak of 220 m^3/s during early May. The Snake River, because of its short-period spring high discharges, with estimated velocities exceeding 3.1 m/s and sediment introduced by ice scouring, has the potential to transport sediment loads if the upstream material types are fine sand and silt.

A gauging station was re-established on the Snake River from May to October 1997 to determine flows and sediment discharge relationships. Measurements are shown below. These discharges throughout the summer months show a below average discharge, which coincides with the local residents observations. The average annual sediment discharge from the Snake River is estimated at < 300 m^3 per year

Sediment concentration is the weight of dry sediment in a water-sediment mixture per volume of mixture and is expressed in milligrams/liter (mg/l). The total rate of sediment transport is the sum of contributions from bedload and suspended load. Sediment load transport can be divided into bedload and suspended load, where bedload is the material moving on or near the bed, with particles moving intermittently by rolling, sliding, or jumping.

The bedload rate varies according to river velocity and the correspondingly shear stress. Washload consists of the finest particles in the suspended load that are continuously maintained in suspension by flow turbulence. Washload is determined from upstream sources and is relatively independent of flow discharge. However, greater discharge may contribute to greater washload because of more erosion.

A deposition-dominated environment is characterized by a region of relatively low bedshear stress in which the rate of supply of sediment to the bed significantly exceeds the rate of removal by erosion.

Therefore, under normal low flow conditions, the Snake River does not contribute a significant amount of sediment. The river is probably typical of many of Alaska's rivers and streams, with the greatest 10 percent of the flow rates contributing 90 percent of the sediment.

Dry and Bourbon Creeks. These creeks merge and then flow through existing culverts beneath West Third Avenue into the northern portion of the city of Nome's harbor basin. Their discharge patterns are probably similar to the Snake River's because they are within the same drainage basin. As indicated in the data above, the spot discharge measurement shows small discharges. Therefore, these creeks have a minor influence on the upper basin under average flow conditions and would not facilitate circulation in the new harbor area.

Estuary. Norton Sound and the lower reach of the Snake River form an estuary, an area of interaction between salt and fresh water. Because of the minimal freshwater flow, the system is stratified, with most of the freshwater passing near the surface and saltwater intruding landward along the bottom. Flow strengths are minor and little water is exchanged due to the stratification. Modest tides also limit water exchange, and flushing within the estuary is minimal.

Saltwater intrusion does not appear to play an important part in estuary sedimentation. Density currents tend to move marine sediments upstream along the bottom, and marine sediments entering the estuary may become trapped. The downstream region that experiences heavy shoaling is at the point of no net flow because of the low velocities and lack of transport capabilities. The apparent location of marine sediment entrapment at Nome is in the first few hundred meters inside the jetties. Upland suspended sediments appear to deposit in the vicinity of the mooring basin and the downstream extent of Snake River bedload transport is upstream of the mooring basin.

The extent of saltwater advance up the Snake River has not been measured. Saltwater advance up the Snake River will, however, occur until the tidal flow can no longer overcome the river flow in conjunction with the riverbed elevation. This location at most times will be well upstream of the harbor complex.

3.3 Physical Setting, Marine

3.3.1 General

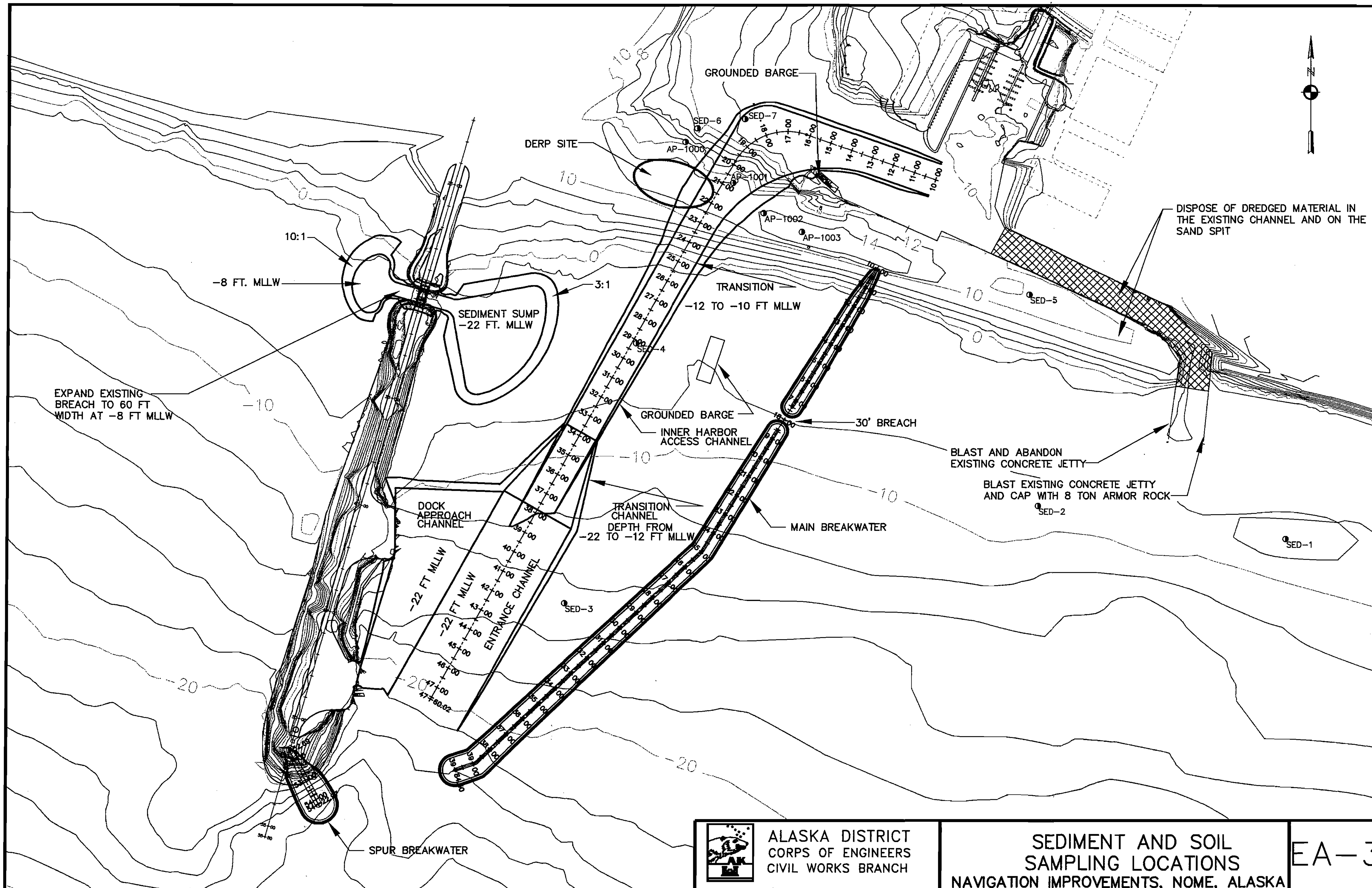
Geological information relevant to the proposed project includes bathymetry, bottom and sediment characteristics, and dredged material characteristics. Bathymetry provides information on bottom stability, persistence of sediment mounds, and shoaling.

3.3.2 Sediment Characteristics

The city of Nome, in conjunction with the proposed action, contracted for sediment analysis in the project area. Figure EA-3 shows the sample sites. Grain-size descriptions of the subsurface soil samples tend to be more course grained than the offshore sediment samples. Although the soil-testing laboratory described all the samples as sand with or without silt and gravel, the field description of the samples indicate greater difference. The subsurface soil samples were generally described as predominantly medium sand, while the offshore sediment samples were described as fine sand. While there was some variability in the descriptions of the subsurface soil samples, the four offshore sediment samples were nearly identical (fine sand).

Based on the blow counts and the visual identification, the subsurface soil samples are characterized as loose. Another indication of the looseness of the soils is that heaving sands were encountered in each of the borings drilled. The heaving sands prevented sampling more than 3 meters below the water table.

Subsurface drill logs from Harding Lawson Associates along the causeway alignment indicate that substrate to the –6.7 meters MLLW is gray gravelly silty sand and occasional clean sand and silty gravel (Holocene *Recent* Deposits). A quantity of soils are classified as "gray gravelly sands and silty gravel," and "medium dense to very dense," "...containing angular rock fragments (Glacial Till)."


GROUNDED BARGE
DERP SITE
SED-6
SED-7
AP-1000
AP-1001
AP-1002
AP-1003
10:1
-8 FT. MLLW
3:1
SEDIMENT SUMP
-22 FT. MLLW
EXPAND EXISTING BREACH TO 60 FT WIDTH AT -8 FT MLLW
TRANSITION
-12 TO -10 FT MLLW
SED-4
SED-5
DISPOSE OF DREDGED MATERIAL IN THE EXISTING CHANNEL AND ON THE SAND SPIT
GROUNDED BARGE
INNER HARBOR ACCESS CHANNEL
30' BREACH
BLAST AND ABANDON EXISTING CONCRETE JETTY
BLAST EXISTING CONCRETE JETTY AND CAP WITH 8 TON ARMOR ROCK
DOCK APPROACH CHANNEL
TRANSITION CHANNEL DEPTH FROM -22 TO -12 FT MLLW
MAIN BREAKWATER
SED-2
SED-1
-22 FT MLLW
-22 FT MLLW
ENTRANCE CHANNEL
SED-3
SPUR BREAKWATER
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SEDIMENT AND SOIL SAMPLING LOCATIONS
NAVIGATION IMPROVEMENTS, NOME, ALASKA
EA-3

3.3.3 Tides, Surges, and Currents.

Tides. Tidal range at Nome is relatively narrow. The maximum tidal range is 0.7 meters, with an average range of 0.5 meters. The lowest predicted tide is –0.1 meters.

Surge. Nome experiences both positive and negative surges. Positive surges are increases in water elevations caused by a combination of relatively low pressure and wind-driven transport of seawater over the relatively shallow and large unobstructed waters of Norton Sound, in conjunction with tidal elevation. The amount of rise increases shoreward to a maximum level at the shoreline. The shoreline that fronts Nome is highly susceptible to storm surge. Reportedly, the storm surge during a November 1974 storm was 3.7 meters at Nome. Negative surges are caused by offshore winds that reduce the depth of water available for vessel operation. Nome residents report that the northern part of the existing turning basin has gone dry because of wind set-down of water.

Ice-covered surges are also a hazard if water flows through cracks in the ice or when floating ice raises above the landfast ice and is pushed on shore by wind or current forces.

Waves. The project area is exposed to waves approaching from a 180-degree southern sector ranging from east to west. The longest fetch is from a southwest approach that passes through the window between St. Lawrence Island and the Alaska mainland (figure 1). The destructive 1974 storm, which caused an estimated $12 million in property damage, propagated waves from this direction. Due to the construction of the causeway, the new project site is protected from the southwest wave attack. However, the possibility exists of wave refraction around the end of the causeway.

No wave measurements were available near the proposed project site, so a numerical hindcast was proposed. The wave climate at the entrance channel to the harbor was calculated using wind fields from the National Center of Environmental Prediction and the National Center of Atmospheric Research Reanalysis Projects and Corps of Engineers wave models. Wave results were verified using data from a National Oceanic and Atmosphere Administration wave buoy in the Bering Sea. Table EA-1 shows the percentages wave heights, wave periods and wave direction during for the ice-free season at Nome.

Table EA-1. Wave Climate at Nome Harbor.

Wave Height (meters)	Percent	Wave Period (seconds)	Percent	Wave Direction (Compass)	Percent
1	91.5	6	26	90°-120°	0.6
2	6	9	49	120°-150°	8.5
3	1.3	12	21	150°-180°	24.6
4	0.3	15	4	180°-210°	66.3
				210°-240°	0.0
				240°-270	0.0

Also, users of the harbor and city officials verified that the numerically generated wave heights and directions were representative of what Nome experienced.

Wave heights and directions obtained from the numerical modeling effort were used as input to a physical model of Nome harbor. The physical model is a three-dimensional, 1 to 90 (model to prototype) scale model of Nome harbor and the nearshore bathymetry. Using this model, a detailed analysis of various navigation alternatives was conducted and results used to select the optimum design. Detailed information about the modeling effort will be available upon request following the completion of the Waterways Experiment Station Study final report .

Currents. Bottom circulation off Nome is caused by a combination of regional currents, tidal currents, wave action, and (occasionally) motions from wind-driven and storm surges. Regional currents are commonly toward the west, resulting in a counterclockwise gyre in western Norton Sound. The speed of this prevailing flow is relatively low compared with other water motions, and a measurement of about 50 kilometers south of Nome showed a speed of 8 cm/s.

Nearshore currents are quite site specific. Current direction and velocities were taken using the physical model at all wave heights, periods, and directions for the existing condition.

3.4 Chemical Environment

3.4.1 Water Column

Dissolved Oxygen. Hood and Burrell (1974) reported that dissolved oxygen concentrations in the waters of northern Norton Sound were uniformly high, as expected in waters of high primary productivity. Frequent summer storms mix the shallow waters thoroughly, and prevent creation of a seasonal pycnocline. Thus, dissolved oxygen levels in bottom waters are similar to surface values. The effect of the winter-spring ice cover on dissolved oxygen levels is not known.

pH. The levels of pH in Norton Sound range from 7.744 to 8.073, well within the normal summer limits found in other coastal areas at northern latitudes.

Organic Carbon. Levels of dissolved organic carbon in seven water samples collected near Nome were uniform, ranging from 2.0 to 2.68 mg C/liter (Hood and Burrell, 1974). Particulate organic matter in the same samples was much lower and ranged from 0.090 to 0.197 mg C/liter. Concentrations were higher in Norton Sound than those in the southern Bering Sea and Chukchi Sea, but well within the range of other oceanic waters.

Nutrients. The waters of Norton Sound are extremely productive and support extensive phytoplankton growth throughout the summer. Sources of nutrients include freshwater runoff and coastal upwelling. Nitrogen depletion in the summer seems to limit phytoplankton growth in Norton Sound. Phosphorus and silic acid are present in excess. Nutrient concentrations have not been measured during the winter; however, levels are expected to be high due to nutrient regeneration from bottom sediments.

Trace Metals. Total metal concentrations (dissolved and particulate) in Norton Sound are similar to those occurring on other oceanic areas. Levels of lead, cadmium, copper, and zinc are uniformly low (Hood and Burrell, 1974), and are typical of areas removed from known sources of pollution. The seasonality of trace metal levels in Norton Sound has not been determined. However, depletion of trace metals in nearshore waters during the summer might be expected due to the increased runoff from the Snake and Nome Rivers, and to the elevated levels of suspended matter that may act as metal scavengers.

Petroleum and Chlorinated Hydrocarbons. Detailed analyses of hydrocarbons in surface waters of Norton Sound revealed low levels (generally less than 1 *u*g/kg), primarily of biogenic (terrigenous and marine) hydrocarbons (Shaw, 1977). Petroleum hydrocarbons have not been measured but are expected to be quite low because the area is remote from known sources of pollution.

3.4.2 Sediments.

The proposed action would require the dredging of sediments from three distinct areas: the marine environment of nearshore Norton Sound, the upland area of the sand spit, and the sediments of the estuarine area of the Snake River.

Norton Sound Sediments. Norton Sound sediments have been analyzed for metals on several occasions: Sharma 1974; numerous analyses associated with the Bima dredge; and by Woodward-Clyde International-Americas in 1998 for this project. Table EA-2 shows the results of the chemical analysis.

It should be noted that the dredging and discharge of dredged material would not chemically treat or alter the material. The only source of metals is the natural sediment in which the metals occur in particulate form as part of the sediment matrix.

Table EA-2. Summary of Analytical Results for Metals, Nome Harbor Site Investigation

Laboratory:			Multichem Analytical Services								Alaska Test Lab	
			VOCs	SVOCs	TOC	Metals	Ammonia-Nitrogen	Nitrate-Nitrite as Nitrogen	Sulfate	Sulfide	Grain-size	Atterburg
Sample Location	Sample Depth (m)	Sample ID	8260A	8270B	9060	7000 Series	350.3M	353.3M	9035	9030	ASTM D-422	ASTM D-2216
SED-1	0-0.015	97NH-024SD	X	X	X	X	X	X	X	X	X	X
SED-2	0-0.015	97NH-025SD	X	X	X	X	X	X	X	X	X	X
SED-3	0-0.015	97NH-026SD	X	X	X	X	X	X	X	X	X	X
SED-4	0-0.015	97NH-027SD	X	X	X	X	X	X	X	X	X	X
SED-5	0-0.015	97NH-001SD	X	X	X	X					X	X
SED-6	0-0.015	97NH-002SD	X	X	X	X					X	X
SED-7	0-0.015	97NH-007SD	X	X	X	X	X	X	X	X	X	X
SED-8	0-0.015	97NH-008SD									X	X
AP-1000	0-0.61	97NH-003SB	X	X	X	X					X	X
AP-1000	1.52-2.13	97NH-004SB	X	X	X	X					X	X
AP-1000	3.05-3.66	97NH-005SB	X	X	X	X	X	X	X	X	X	X
AP-1000	4.57-5.18	97NH-006SB	X	X	X	X	X	X	X	X	X	X
AP-1001	0-0.61	97NH-009SB	X	X	X	X					X	X
AP-1001	1.52-2.13	97NH-010SB	X	X	X	X					X	X
AP-1001	3.05-3.66	97NH-011SB	X	X	X	X					X	X
AP-1001	4.57-5.18	97NH-012SB	X	X	X	X	X	X	X	X	X	X
AP-1001	5.49-6.10	97NH-013SB	X	X	X	X	X	X	X	X	X	X
AP-1002	0-0.61	97NH-014SB	X	X	X	X					X	X
AP-1002	1.52-2.13	97NH-015SB	X	X	X	X					X	X
AP-1002	3.05-3.66	97NH-016SB	X	X	X	X					X	X
AP-1002	4.57-5.18	97NH-017SB	X	X	X	X	X	X	X	X	X	X
AP-1002	6.10-6.71	97NH-018SB	X	X	X	X	X	X	X	X	X	X
AP-1003	0-0.61	97NH-019SB	X	X	X	X					X	X
AP-1003	1.52-2.13	97NH-020SB	X	X	X	X					X	X
AP-1003	3.05-3.66	97NH-021SB	X	X	X	X					X	X
AP-1003	4.57-5.18	97NH-022SB	X	X	X	X	X	X	X	X	X	X
AP-1003	6.10-6.71	97NH-023SB	X	X	X	X	X	X	X	X	X	X

Table EA-2. Summary of Analytical Results for Metals, Nome Harbor Site Investigation (continued)

Sample Location Sample Depth (m) Sample Date (1997) Sample ID	SED-6 Surface 8-Dec 97NH-002SD	AP-1000 1.52-2.13 9-Dec 97NH-004SB	AP-1000 3.05-3.66 9-Dec 97NH-005SB	AP-1000 4.57-5.18 9-Dec 97NH-006SB	AP-1001 1.52-2.13 11-Dec 97NH-010SB	Sediment Management Standards(b) SQS(c)	 CSL(d)	EPA RBC(e) Industrial	 Residential	PSDDA Level(h)
Benzoic Acid (mg/Kg)	0.012	ND (0.85)	ND (1.1)	ND (0.99)	ND (0.89)	650	650	1000000(f)	310000(f)	0.400
2-Methylnaphthalene (mg/Kg)	ND (0.22)	ND (0.17)	ND (0.21)	ND (0.20)	0.009 J(0.18)	38	64	--	--	--
Acenaphthylene (mg/Kg)	ND (0.22)	ND (0.17)	ND (0.21)	ND (0.20)	0.018 J(0.18)	66	66	--	--	0.210
Phenanthrene (mg/Kg)	0.026 J (1.1)	ND (0.17)	ND (0.21)	ND (0.20)	0.18	100	480	--	--	0.320
Anthracene (mg/Kg)	ND (0.22)	ND (0.17)	ND (0.21)	ND (0.20)	0.052 J(0.18)	220	1200	610000(f)	23000(f)	0.130
Di-n-butylphthalate (mg/Kg)	ND (0.22)	0.25	ND (0.21)	ND (0.20)	0.022 J(0.18)	220	1700	--	--	1.400
Fluoranthene (mg/Kg)	0.031 J(0.22)	ND (0.17)	ND (0.21)	ND (0.20)	0.66	160	1200	82000(f)	3100(f)	0.630
Pyrene (mg/Kg)	0.027 J(0.22)	ND (0.17)	ND (0.21)	ND (0.20)	0.61 J(0.18)	1000	1400	61000(f)	2300(f)	0.430
Benzo(a)anthracene (mg/Kg)	0.014 J(0.22)	ND (0.17)	ND (0.21)	ND (0.20)	0.41	110	270	7.8	0.88	0.450
Chrysene (mg/Kg)	0.016 J(0.22)	ND (0.17)	ND (0.21)	ND (0.20)	0.42	110	460	780	88	0.670
Benzo(total b and k)fluoranthene (mg/Kg)	ND (0.22)	ND (0.17)	ND (0.21)	ND (0.20)	0.50	230	450	7.8-78(g)	0.88-8.8(g)	0.800
Benzo(a)pyrene (mg/Kg)	0.014 J(0.22)	ND (0.17)	0.11 J(0.21)	0.027 J(0.20)	0.36	99	210	0.78	0.088	0.680
Indeno(1,2,3-CD)pyrene (mg/Kg)	ND (0.22)	ND (0.17)	ND (0.21)	ND (0.20)	0.19	34	88	7.8	0.88	0.069
Dibenzo(a,h)anthracene (mg/Kg)	ND (0.22)	ND (0.17)	ND (0.21)	ND (0.20)	0.10 J(0.18)	12	33	0.78	0.088	0.120
Benzo(g,h,i)perylene (mg/Kg)	ND (0.22)	ND (0.17)	ND (0.21)	ND (0.20)	0.20	31	78	--	--	0.540

Notes:

- ND Analyte Not Detected (Reporting Limit in Parentheses)
- J Estimated Value
- (a) Results for Bis (2-Ethylhexl) Phthalate are listed in Table 2
- (b) State of Washington Department of Ecology Sediment Management Standards
- (c) Marine Sediment Quality Standards
- (d) Marine Sediment Cleanup Screening Levels
- (e) EPA 1997, EPA Region III Risk-Based ConcentrationTable, based on direct human soil ingestion
- (f) Based on non-carcinogenic value
- (g) Lower value is for Benzo(b)fluoranthene, and higher value is for Benzo(k)fluoranthene while analytical value provides total for Benzo(b and k)fluoranthene
- (h) Screening Levels, Puget Sound Dredged Disposal Analysis, April 1997

Table EA-2. Summary of Analytical Results for Metals, Nome Harbor Site Investigation (continued)

Sample Date 1997	Sample ID	Sample Location	Sample Depth (m)	Bis (2-Ethylhexyl) Phthalate (mg/Kg)
22-Dec	97NH-024SD	SED-1	0-0.015	0.019*
22-Dec	97NH-025SD	SED-2	0-0.015	0.024*
22-Dec	97NH-026SD	SED-3	0-0.015	0.060*
22-Dec	97NH-027SD	SED-4	0-0.015	0.027*
8-Dec	97NH-001SD	SED-5	0-0.015	0.025**
8-Dec	97NH-002SD	SED-6	0-0.015	0.065**
10-Dec	97NH-007SB	SED-7	0-0.015	0.071**
9-Dec	97NH-003SB	AP-1000	0-0.61	0.052**
9-Dec	97NH-004SB	AP-1000	1.52-2.13	0.059**
9-Dec	97NH-005SB	AP-1000	3.05-3.66	0.025**
9-Dec	97NH-006SB	AP-1000	4.57-5.18	ND (0.20)**
11-Dec	97NH-009SB	AP-1001	0-0.61	0.010***
11-Dec	97NH-010SB	AP-1001	1.52-2.13	0.020***
11-Dec	97NH-011SB	AP-1001	3.05-3.66	0.030***
11-Dec	97NH-012SB	AP-1001	4.57-5.18	0.037***
11-Dec	97NH-013SB	AP-1001	5.49-6.10	0.015***
11-Dec	97NH-014SB	AP-1002	0-0.61	0.11***
11-Dec	97NH-015SB	AP-1002	1.52-2.13	0.010***
11-Dec	97NH-016SB	AP-1002	3.05-3.66	0.019***
11-Dec	97NH-017SB	AP-1002	4.57-5.18	0.025***
11-Dec	97NH-018SB	AP-1002	6.10-6.71	0.043***
11-Dec	97NH-019SB	AP-1003	0-0.61	0.029***
11-Dec	97NH-020SB	AP-1003	1.52-2.13	0.059***
11-Dec	97NH-021SB	AP-1003	3.05-3.66	0.017***
11-Dec	97NH-022SB	AP-1003	4.57-5.18	0.014***
11-Dec	97NH-023SB	AP-1003	6.10-6.71	0.43***

NOTES:

ND Analyte not detected (reporting limit in parentheses)
* 0.019 mg/Kg Bis (2-Ethylhexyl) Phthalate detected in laboratory blank
** 0.032 mg/Kg Bis (2-Ethylhexyl) Phthalate detected in laboratory blank
*** 0.015 mg/Kg Bis (2-Ethylhexyl) Phthalate detected in laboratory blank

Table EA-2. Summary of Analytical Results for Metals, Nome Harbor Site Investigation (continued)

Reference Values				Arsenic (mg/Kg)	Barium (mg/Kg)	Cadmium (mg/Kg)	Chromium (mg/Kg)	Copper (mg/Kg)	Lead (mg/Kg)	Mercury (mg/Kg)	Selenium (mg/Kg)	Silver (mg/Kg)
Mean in Alaska Soil(a)				6.7	595	--	50(d)	24	12	--	--	--
EPA Industrial Soil RBC(b)				610	140000	1000	10000(e)	82000	--	610	10000	10000
EPA Residential Soil RBC(b)				23	5500	39	390(e)	3100	--	23	390	390
Marine Sediment Quality Standard(c)				57	--	5.1	260	390	450	0.41	--	6.1
Marine Sediment Cleanup Screening Level(c)				93	--	6.7	270	390	530	0.59	--	6.1
Sample Date (1997)	**Sample ID**	**Sample Location**	**Sample Depth (m)**	**Arsenic (mg/Kg)**	**Barium (mg/Kg)**	**Cadmium (mg/Kg)**	**Chromium(d) (mg/Kg)**	**Copper (mg/Kg)**	**Lead (mg/Kg)**	**Mercury (mg/Kg)**	**Selenium (mg/Kg)**	**Silver (mg/Kg)**
22-Dec	97NH-024SD	SED-1	0-0.015	14	11	ND (0.33)	4.7	3.0	2.1	ND (0.11)	ND (0.34)	ND (0.67)
22-Dec	97NH-025SD	SED-2	0-0.015	5.1	5.6	ND (0.32)	4.9	2.3	ND (1.9)	ND (0.13)	ND (0.32)	ND (0.64)
22-Dec	97NH-026SD	SED-3	0-0.015	6.5	8.0	ND (0.37)	5.7	2.6	ND (2.2)	ND (0.14)	ND (0.36)	ND (0.73)
22-Dec	97NH-027SD	SED-4	0-0.015	11	6.6	ND (0.39)	5.2	2.4	2.7	ND (0.15)	ND (0.37)	ND (0.77)
8-Dec	97NH-001SD	SED-5	0-0.015	26	7.4	ND (0.51)	8.4	5.2	5.1	ND (0.11)	ND (0.26)	ND (0.51)
8-Dec	97NH-002SD	SED-6	0-0.015	35	21	ND (0.62)	13	11	25	ND (0.13)	ND (0.33)	ND (0.62)
10-Dec	97NH-007SD	SED-7	0-0.015	210	45	ND (2.7)	22	23	12	0.20	ND (0.49)	ND (1.1)
9-Dec	97NH-003SB	AP-1000	0-0.61	29	8.3	ND (1.2)	10	12	6.1	ND (0.11)	ND (0.26)	ND (0.50)
9-Dec	97NH-004SB	AP-1000	1.52-2.13	32	13	ND (0.49)	8.4	6.3	3.1	ND (0.10)	ND (0.26)	ND (0.49)
9-Dec	97NH-005SB	AP-1000	3.05-3.66	43	28	ND (0.62)	18	14	6.6	ND (0.12)	ND (0.33)	ND (0.62)
9-Dec	97NH-006SB	AP-1000	4.57-5.18	98	17	ND (1.5)	13	8.9	5.1	ND (0.11)	ND (0.29)	ND (0.61)
11-Dec	97NH-009SB	AP-1001	0-0.61	35	8.3	ND (0.27)	6.5	10	5.7	ND (0.11)	ND (0.52)	ND (0.53)
11-Dec	97NH-010SB	AP-1001	1.52-2.13	21	47	ND (0.28)	8.7	11	52	1.7	ND (0.26)	ND (0.55)
11-Dec	97NH-011SB	AP-1001	3.05-3.66	29	12	ND (0.25)	8.4	6.8	4.2	ND (0.094)	ND (0.26)	ND (0.51)
11-Dec	97NH-012SB	AP-1001	4.57-5.18	26	11	ND (0.31)	8.6	7.1	3.4	ND (0.12)	ND (0.29)	ND (0.61)
11-Dec	97NH-013SB	AP-1001	5.49-6.10	93	15	ND (0.62)	13	10	5.2	ND (0.11)	ND (0.30)	ND (0.62)
11-Dec	97NH-014SB	AP-1002	0-0.61	33	12	ND (0.27)	8.6	7.5	7.1	0.27	ND (0.27)	ND (0.54)
11-Dec	97NH-015SB	AP-1002	1.52-2.13	23	9.6	ND (0.26)	9.3	6.1	3.1	ND (0.10)	ND (0.25)	ND (0.51)
11-Dec	97NH-016SB	AP-1002	3.05-3.66	26	8.0	ND (0.26)	7.7	5.8	3.0	ND (0.11)	ND (0.25)	ND (0.51)
11-Dec	97NH-017SB	AP-1002	4.57-5.18	47	15	ND (0.29)	4.7	6.7	4.3	ND (0.11)	ND (0.30)	ND (0.59)
11-Dec	97NH-018SB	AP-1002	6.10-6.71	110	24	ND (0.59)	16	11	6.6	ND (0.12)	ND (0.30)	ND (0.59)
11-Dec	97NH-019SB	AP-1003	0-0.61	31	33	ND (0.26)	12	8.1	18	ND (0.099)	ND (0.25)	ND (0.53)
11-Dec	97NH-020SB	AP-1003	1.52-2.13	40	13	ND (0.26)	6.8	9.9	11	0.61	ND (0.26)	ND (0.51)
11-Dec	97NH-021SB	AP-1003	3.05-3.66	22	20	ND (0.25)	7.3	11	4.1	ND (0.097)	ND (0.25)	ND (0.51)
11-Dec	97NH-022SB	AP-1003	4.57-5.18	35	8.6	ND (0.55)	9.4	14	6.2	ND (0.11)	ND (0.27)	ND (0.55)
11-Dec	97NH-023SB	AP-1003	6.10-6.71	260	25	ND (0.56)	11	7.3	4.4	ND (0.11)	ND (0.29)	ND (0.56)

NOTES:

-- Value not established

(a) Arbogast, et al., 1987, Geometric mean for Alaska soils and surficial materials

(b) EPA 1997, EPA Region III Risk-Based Concentration (RBC) Table, based on direct human soil ingestion. Metals RBCs are based on non-carcinogenic values.

(c) State of Washington Department of Ecology Sediment Management Standards

(d) Value is for total chromium

(e) Value is for chromium IV

ND Analyte not detected (reporting limit in parentheses)

Table EA-2. Summary of Analytical Results for Metals, Nome Harbor Site Investigation (continued)

Sample Date (1997)	Sample ID	Sample Location	Sample Depth (m)	Total Organic Carbon (% carbon)	Ammonia Nitrogen (mg/Kg)	Nitrate/Nitrite as Nitrogen (mg/Kg)	Sulfate (mg/Kg)	Sulfide (mg/Kg)	Percent Moisture	Frost Classification*
22-Dec	97NH-024SD	SED-1	0-0.015	0.14	ND (0.26)	0.74	280	ND (0.7)	21.0	NFS
22-Dec	97NH-025SD	SED-2	0-0.015	0.15	ND (0.26)	0.72	460	ND (0.84)	21.0	NFS
22-Dec	97NH-026SD	SED-3	0-0.015	0.15	ND (0.25)	3.7	410	ND (0.76)	30.0	NFS
22-Dec	97NH-027SD	SED-4	0-0.015	0.14	ND (0.27)	0.77	250	ND (0.78)	30.0	NFS
8-Dec	97NH-001SD	SED-5	0-0.015	0.24	--	--	--	--	4.1	NFS
8-Dec	97NH-002SD	SED-6	0-0.015	0.88	--	--	--	--	23.0	PFS-F2
10-Dec	97NH-007SD	SED-7	0-0.015	1.2	14	ND (0.25)	400	510	50.0	PFS-S2
10-Dec	97NH-008SD	SED-8	0-0.015	--	--	--	--	--	--	NFS
9-Dec	97NH-003SB	AP-1000	0-0.61	0.24	--	--	--	--	4.1	NFS
9-Dec	97NH-004SB	AP-1000	1.52-2.13	0.31	--	--	--	--	2.5	PFS-S2
9-Dec	97NH-005SB	AP-1000	3.05-3.66	0.62	0.33	0.53	30	ND (0.8)	22.0	F2
9-Dec	97NH-006SB	AP-1000	4.57-5.18	0.35	0.27	ND (0.25)	10	ND (0.7)	16.0	PFS-F2
11-Dec	97NH-009SB	AP-1001	0-0.61	0.28	--	--	--	--	3.3	PFS-S2
11-Dec	97NH-010SB	AP-1001	1.52-2.13	1.7	--	--	--	--	6.7	PFS-F2
11-Dec	97NH-011SB	AP-1001	3.05-3.66	0.30	--	--	--	--	3.1	NFS
11-Dec	97NH-012SB	AP-1001	4.57-5.18	0.39	ND (0.23)	0.96	22	ND (0.64)	16.0	NFS
11-Dec	97NH-013SB	AP-1001	5.49-6.10	0.34	ND (0.24)	1.3	22	ND (0.65)	16.0	PFS-S2
11-Dec	97NH-014SB	AP-1002	0-0.61	0.31	--	--	--	--	5.4	PFS-S2
11-Dec	97NH-015SB	AP-1002	1.52-2.13	0.27	--	--	--	--	4.4	NFS
11-Dec	97NH-016SB	AP-1002	3.05-3.66	0.27	--	--	--	--	3.2	NFS
11-Dec	97NH-017SB	AP-1002	4.57-5.18	0.23	ND (0.22)	0.48	58	ND (0.62)	13.0	NFS
11-Dec	97NH-018SB	AP-1002	6.10-6.71	0.40	0.32	0.31	130	ND (0.73)	17.0	PFS-S2
11-Dec	97NH-019SB	AP-1003	0-0.61	0.37	--	--	--	--	3.0	PFS-S2
11-Dec	97NH-020SB	AP-1003	1.52-2.13	0.28	--	--	--	--	3.4	PFS-F2
11-Dec	97NH-021SB	AP-1003	3.05-3.66	0.30	--	--	--	--	2.5	NFS
11-Dec	97NH-022SB	AP-1003	4.57-5.18	0.29	ND (0.21)	0.27	130	ND (0.76)	12.0	NFS
11-Dec	97NH-023SB	AP-1003	6.10-6.71	0.38	0.48	ND (0.25)	120	ND (0.7)	14.0	PFS-S2

NOTES:

-- Not Analyzed

ND Analyte not detected (reporting limit in parentheses)

* The system used for frost classification is documented at the beginning of Appendix C

Any elevation in chemical levels from a dredging operation would indicate that the chemical compounds would become solubilized during the dredging process. If they are not solubilized, they would merely be redeposited at the disposal sites.

Sand Spit Sediments. Samples taken on the sand spit are indicated in figure EA-3. These samples were taken at locations with the highest potential for the presence of contaminated material and in the area of the potential entrance channel. The Alaska District established the sample locations, chemicals to be analyzed, and sample numbers with the concurrence of the U.S. Environmental Protection Agency, Region 10, Dredged Material Management Section. Results of the analyses are in table EA-2.

The Alaska District took and analyzed sediment samples in 1986 under the Defense Environmental Restoration Program for the cleanup of formerly use military sites. The military used a portion of the spit (figure EA-3) as a petroleum drum collection area. The soil analysis indicates that this area is above regulatory standards for certain methods of disposal. Results of the analyses are in table EA-3.

There is no indication that sediment analyses of the Snake River upstream of the existing boat harbor have been taken. The two sample sites were selected as representative of the chemical compounds found in the part of the Snake River that would be impacted by the proposed action.

3.5 EPA Disposal Site

The U.S. Environmental Protection Agency (EPA) disposal sites were designed for the disposal of dredged material. The sites were designed to provide the most environmentally acceptable ocean location for the disposal of materials dredged from the Nome, Alaska harbor area. The Nome coastal area is under the regulatory jurisdiction of EPA, in accordance with the requirements of the Marine Protection, Research, and Sanctuaries Act (MPRSA) of 1972, as amended.

The EPA prepared an environmental impact statement (EIS) to assess the impacts of using the dredged material disposal area. The Record of Decision was signed in 1992 and the disposal sites are officially authorized for use by harbor related dredged material. The EIS concluded that because of the relatively small amount of dredged material disposed of annually in relation to the disposal site size, the effects are expected to be minimal within the disposal sites and non-existent outside the site boundaries. The sites have been used since 1923 without reported effects on the ecosystem.

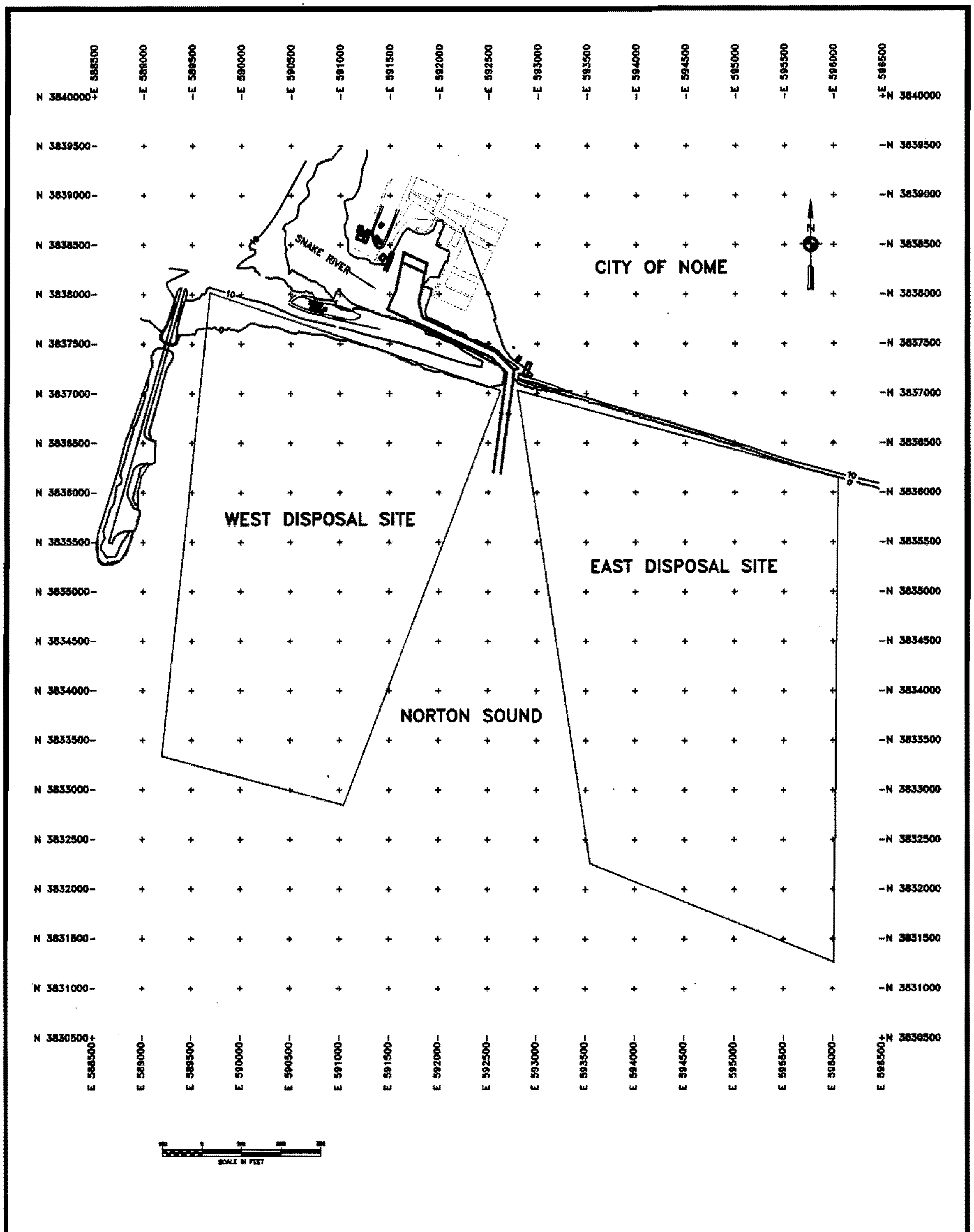
The disposal sites are located on either side of the existing harbor entrance channel and stretch from the beach past the –11 meter contour (figure EA-4).

Table EA-3. Summary of Soil Sampling Results, Concentrations of Organic Compounds, Chemical Contamination Report, Seward Peninsula Project

	ANALYSES BY ARDL, INC.						ANALYSES BY QA LAB	CONTAMINATION LEVELS OF CONCERN
VOLATILE ORGANIC COMPOUNDS	1-S1 BKG	1-S1RE	1-S2	1-S3	1-S3RE	1-S4 (S3)	1-S4 (S3)	
Methylene Chloride	59 B	12	**	*	**	**	**	-
Benzene	ND	ND	ND	*	7	ND	ND	300
Tetrachloroethylene	ND	ND	ND	*	30	31	ND	-
Toluene	ND	ND	6	*	37	ND	ND	300
m-Xylene	ND	ND	ND	*	10	ND	*	-
o & p-Xylene	9	ND	ND	*	12	ND	*	-
Total Xylenes	9	ND	ND	*	22	ND	ND	1,000
SEMI-VOLATILE ORGANIC COMPOUNDS								
Naphthalene	ND	*	ND	ND	*	ND	170 J	-
2-Methylnaphthalene	ND	*	ND	ND	*	ND	95 J	-
Acenaphthylene	ND	*	ND	ND	*	ND	130 J	-
Acenaphthene	ND	*	ND	ND	*	ND	625 J	-
Dibenzofuran	ND	*	ND	ND	*	ND	250 J	-
Fluorene	ND	*	ND	ND	*	300 J	2,130 J	-
Phenanthrene	ND	*	ND	260 J	*	3,600	19,800	-
Anthracene	ND	*	ND	41 J	*	680	4,100	-
Fluoranthene	ND	*	ND	370 J	*	3,800	25,600	-
Pyrene	ND	*	46 J	530	*	5,200	32,000	-
Benzo(a)anthracene	ND	*	ND	ND	*	2,100	14,500	-
Chrysene	ND	*	ND	200 J	*	2,100	13,600	-
Benzo(b)fluoranthene	ND	*	ND	ND	*	2,300	7,900	-
Benzo(k)fluoranthene	ND	*	ND	ND	*	ND	7,100	-
Benzo(a)pyrene	ND	*	ND	ND	*	1,800	12,800	-
Indeno(1,2,3-cd)pyrene	ND	*	ND	ND	*	940	7,900	-
Benzo(g,h,i)perylene	ND	*	ND	ND	*	940	6,500	-
Total PNA's (2)	ND	*	46 J	1,401 J	*	23,760 J	154,950 J	10,000
TOTAL PETROLEUM HYDROCARBONS								
Other Fuel	NA	NA	NA	NA	NA	NA	9	100,000

Table EA-3. Summary of Soil Sampling Results, Concentrations of Organic Compounds, Chemical Contamination Report, Seward Peninsula Project (continued)

TOTAL METALS	ANALYSES BY ARDL, INC.				ANALYSES BY QA LAB		CONTAMINATION LEVELS OF CONCERN
	1-S1 BKG	1-S2	1-S3	1-S4 (S3)	1-S1 (S1)	1-S4 (S3)	
Arsenic	7.2	6.4	17	18	31	37.8	NA
Barium	12	170	110	100	13.8	198	NA
Cadmium	ND	1.1	ND	ND	ND	ND	NA
Chromium	8.5	8.8	15	11	12.6	15.2	NA
Lead	6.9	58	250	120	9.1	92.0	NA
Mercury	ND	0.16	1	1.0	ND	ND	NA
Selenium	0.95	1.1	1.2	1.2	ND	ND	NA



ALASKA DISTRICT
CORPS OF ENGINEERS
CIVIL WORKS BRANCH

EPA APPROVED
DISPOSAL SITES

NAVIGATION IMPROVEMENTS, NOME, ALASKA

EA-4

3.6 Biological Setting, Terrestrial

The entire project, except for the sand spit, is within the aquatic environment. Only a brief description of the terrestrial resources in the Nome area is included.

Two big game species are found near Nome: moose and grizzly bear. The numbers of both species were drastically reduced during the gold rush in the early 1900's. The numbers of both species are close to the carrying capacity of the range. During winter months moose move into river valleys to forage on willows and birch. Numbers are low in the Snake River drainage because of snowmachine traffic.

Grizzly bear numbers are probably close to the carrying capacity of the range. They are rarely seen near Nome, but are frequently seen in May and early June along the beaches to the west opposite Sledge Island.

Several species of furbearers are found in the area. Wolves have been found throughout the Seward Peninsula, but the greatest numbers are in the eastern region. They are very rarely seen in the Nome area.

Red foxes are found throughout the Seward Peninsula and in the Nome area. They are omnivorous and feed on small mammals, such as mice, lemmings, and hares; birds; eggs; invertebrates; plants; and carrion. Nome residents trap foxes in winter; foxes are the most important fur species in the area.

Few birds are year-round residents of the Nome area; those found year-round include rock and willow ptarmigan, hawk owls, snowy owls, and possibly ravens.

3.7 Biological Setting, Marine

3.7.1 General.

The water and benthic environments that would be influenced by the proposed project include the nearshore environs of Norton Sound and the riverine/estuarine habitats of the Snake River.

State and Federal agencies, the University of Alaska, and private environmental and engineering consulting firms have conducted several studies on the aquatic biological communities of Norton Sound. This section provides a very brief overview of communities that need to be considered in evaluating potential effects of the construction and operation and maintenance of the proposed project.

3.7.2 Plankton.

Phytoplankton and zooplankton are key components of all pelagic communities, including those in Norton Sound. They are important to the offshore and coastal ecosystems in Norton Sound because they constitute a major portion of the food base for pelagic and benthic food webs, they influence nutrient dynamics, and the zooplankton include larval forms of commercially harvested species.

Phytoplankton are a main food source for zooplankton, which in turn are consumed by many other species. In the outershelf and oceanic domains of the eastern Bering Sea, zooplankton graze on at least 20 to 30 percent and occasionally up to 100 percent of the daily phytoplankton production. Energy is thus transferred directly to higher trophic levels within the pelagic zone. In contrast, the inefficient grazers of the middle and coastal shelf regions of the eastern Bering Sea remove less than 10 percent of the daily plant production, such that a substantial amount of organic matter settles to the bottom where it is incorporated into benthic food webs. Zooplankton such as mysids, euphausiids, and copepods are important prey of the birds, mammals, and fishes of the eastern Bering Sea and presumably Norton Sound. Microplankton are an important food resource for larval fishes. Larval pollok depend entirely on pelagic food species, and juveniles feed heavily upon large copepods. Copepods are also a primary prey of least auklets and a principal prey of fin and bowhead whales. Parakeet and crested auklets feed mainly on euphausiids, which are also a major food item for fin, humpback, minke, and bowhead whales.

3.7.3 Benthic Invertebrates.

Site-specific studies have not been conducted at the project site; however, one study by Feder and Mueller, 1974, evaluated the infaunal and sessile epifaunal benthic species in the general vicinity of the proposed project. Benthic invertebrates inhabiting the study area encompassed 10 phyla, with echinoderms (sea stars, sea cucumbers, sea urchins, and brittle stars) being the most common and contributing the greatest biomass. Other common invertebrate species were soft coral, clam (*Astarte borealis*), and several species of shrimp (*Pandalus*). In general, the species are typical of those occurring in well-oxygenated, high-energy, sandy-gravelly-rocky sediment regimes.

WestGold sampled sand substrates at six locations from the Penny River to just east of Nome in September 1985. Stations S1, C1, and D1 were at elevations –2.4 to –3.7 meters MLLW and S2, C2, and D2 at –7 to –7.6 meters MLLW. The 1985 results yielded 75 separate invertebrate taxa representing 10 phyla. The most numerous species were polychaete worms (32 species), amphipods (13 species), cumaceans (6 species), clams (5 species), and snails (5 species).

Sampling generally yielded fewer invertebrate taxa and numbers of organisms at the shallow stations than at the deeper locations. The number of taxa unique to shallow and deep stations was 14 and 28, respectively; 33 taxa were common to both depth strata. The proposed project would include dredging from the uplands to about –6.7 meters; the deeper stations are probably representative of outer limits of the project.

WestGold took samples from the same stations in June 1986. In general, taxa from the shallow and intermediate stations were consistent with taxa from these stations in September 1985. Based upon the June sampling, the number of taxa, density, and biomass were generally lower at the shallow stations. The exception was at shallow station D1, which had a higher density and subsequent biomass of the polychaete *Magelona sacculata*. Polychaete worms accounted for an average 68 percent of the total invertebrate density in sand substrate at all stations. WestGold continued to sample stations C2 and S2 in June 1987 and June 1988. WestGold concluded that infaunal taxa showed trends through time. Taxa consistently dominating C2 in the 4 years of sampling included three species of polychaete worms, two bivalves, and the sand dollar. Although the density of S2 substrate in 1988 approximated densities there in other years, the biomass was much reduced. This is because dominant organisms in 1988 were the minute, young-of-the-year bivalves. The polychaete work *Magelona sacculata* was the most abundant from 1985 through 1987; only 13 individuals/m^2 were found there in 1988. Polychaetes accounted for only 13.5 percent of the station density in 1988.

Bottom disturbance from ice scouring or gouging is presumably common to depths approaching 12.2 meters. Investigations relative to the offshore placer mining project near Nome have revealed some probable benthic disturbance from ice (Rusanowski et al., 1985-1987). The ice scouring that occurs during winter months, coupled with frequent storms that impact shallower waters (<9 meters) during open-water months, undoubtedly plays a major role in the composition, distribution, and abundance of the benthic biota in the shallow waters of Norton Sound.

3.7.4 Marine Mammals.

Four of the more common marine mammals found in Norton Sound are the ringed seal, bearded seal, spotted seal, and beluga whale. Less common species are Pacific walrus and polar bear. Species peripheral to Norton Sound but common to outer reaches of the area include the killer, minke, bowhead and gray whales, and the ribbon seal.

The ringed seal is the most abundant and widely distributed. Ringed seals are migratory and leave their winter habitat zones of land-fast ice in the spring to follow the retreating ice pack northward. Most of the seals spend their summer period in the Chukchi or Beaufort Seas. Breeding occurs from mid-April through May; pups are born the following year from mid-March through April. Both breeding and pupping occurs in the land-fast ice zone.

The bearded seal is found throughout the area where suitable ice conditions exist, *e.g.*, ice overlying shallow water for bottom feeding. They prefer ice that is in constant motion, avoiding shorefast ice areas. Migratory behavior indicates that bearded seals wintering south of the Bering Strait-Norton Sound region actively migrate northward in March and April, well ahead of ice decay and recession. By late June, most seals have passed through the Bering Strait.

Spotted seals are distributed throughout Norton Sound in nearshore waters during the ice-free and early fall period. Haul-out areas within Norton Sound include Stuart Island, Besboro Island, Cape Denbigh, Cape Darby, Rocky Point, and Safety Sound.

During winter, spotted seals are closely associated with the ice edge south of Norton Sound; they follow it northward and landward to rest and feed during the summer.

Beluga whales are found throughout the Norton Sound coastal areas during the summer months. They appear nearshore with the onset of herring spawning in early summer and feed on these as well as a wide variety of other fish congregating or migrating nearshore. The winter distribution of these whales is restricted to regions of open water or young ice.

Pacific walrus are closely associated with loose pack ice; winter distribution is restricted by heavy pack ice. The majority of the walrus winter in the St. Lawrence-St. Matthew area. The walrus leave the wintering area in late March to migrate to the summering feeding areas. Most walrus activity occurs in the outer Norton Sound area; Sledge and Besboro Islands are used occasionally as haul-out areas.

Polar bears enter the Norton Sound region in the fall with advancing ice and are found south of St. Lawrence Island. The Bering Sea polar bears are part of the Chukchi Sea population. Polar bears follow the southward migrations of prey species (predominantly ringed seals with some bearded seals and walrus taken).
There is very little marine mammal activity in the immediate area around Nome.

3.7.5 Birds.

Most birds in the Nome area have some interaction with the sea or estuarine areas. An immense variety of seabirds, shorebirds, waterfowl, raptors, and other birds make use of the Nome area, primarily during summer.

Sea Birds. The largest seabird colony near the Nome area is located on the Bluff Cliffs, east of Cape Nome about 80 kilometers east of Nome. Other seabird colonies in the Norton Sound area include Sledge Island (40 kilometers west of Nome), Square Rock, Rocky Point, Cape Darby, Bluff and Tonol, and Safety Sound. None of these colonies are near the tug and barge lanes. Bluff Cliffs, the largest of the sea bird colonies in the area, is within 60 kilometers of Cape Nome, which is the location of the local rock quarry.

The most common seabirds include two species of murres (common and thick-billed), black-legged kittiwake, horned and tufted puffins, and glaucous gulls. Smaller numbers of other alcids are also present. Seasonal seabird occurrence (breeding, nesting, and feeding activities) in Norton Sound is generally from May through September. The majority of the seabird species in the area prey on fish during nesting season with sand lance, juvenile cod, and prickleback being important food species.

Coastal Birds. Pintail duck, American widgeon, greater scaup, Taverner's Canada goose, Pacific brant, and whistling swan occur in the coastal areas around Nome. The coastal habitats are also used by about 30 species of shorebirds, with the most common being semipalmated sandpiper, western sandpiper, and dunlin. The high use coastal areas closest to the project area include Golovin Bay/Fish River Delta, and

Safety Sound. There are several species of local (Alaska) concern that are present in Norton Sound. These included emperor goose, cackling Canada Goose, black brant, American golden plover, whimbrel, red knot, black turnstone, western sandpiper, rock sandpiper, dunlin, and bristle-thighed curlew.

3.7.6 Fish.

Demersal Fish. Demersal fish (also called groundfish or bottomfish) are represented by 51 species in Norton Sound. Saffron and arctic cod represent the cod family. Flat fish species include starry flounder, yellowfin sole, and Alaska plaice. Several species of sculpin are also present, with the plain sculpin the most common. Saffron cod (also known as tom cod) are the dominant species at the project area and are an important species for several situations. Saffron cod generally move from offshore to inshore in the fall, spend the winter and spawn nearshore, and then move offshore during the summer. This species is an important subsistence resource throughout the area and is harvested during the winter. They are also an important marine mammal food source and are a known predator to juvenile salmonids.

Pelagic Fish. Important pelagic fish of Norton Sound include salmon, herring, toothed (rainbow) smelt, and capelin. Herring spawning is primarily intertidal and shallow subtidal in Norton Sound. Rockweed is the dominant vegetation and spawning substrate, although spawning also occurs on bare rock. In subtidal areas, eel grass is the likely spawning substrate. Herring eggs hatch in 2 to 3 weeks as planktonic larvae, then metamorphose to juveniles in 6 to 10 weeks. Toothed smelt are common throughout Norton Sound. They are an anadromous fish that spawns mainly on aquatic plants and bare rock where the eggs adhere. Toothed smelt larvae are commonly found throughout the nearshore areas of Norton Sound.

Capelin exhibit characteristics very similar to herring in terms of spring spawning, migration timing, and utilization of the intertidal zone for spawning. Capelin, however, spawn on sandy beach areas and the eggs remain buried approximately 2 weeks before hatching. Their known and suspected spawning areas extend from Cape Rodney to the west to Cape Nome to the east. It is not known whether Capelin spawn at the project site.

Salmon are known to spawn in several of the streams in the Nome area, including the Snake River. Adult salmon migrate into Norton Sound from about mid-June through August.. Chinook are the earliest to appear, while coho salmon are the latest. Juvenile chum and pink salmon outmigrate in the spring from the previous fall spawning areas in freshwater to estuarine and nearshore areas. The fry may remain nearshore for several weeks before moving into ocean feeding areas. This is an important period; it allows the fish to adjust to the transition from a freshwater to a marine environment. Predation, temperatures, and food availability are basic factors influencing survival rates.

3.8 Archeology and History

3.8.1 Native History

Approximately 10 separate native tribes inhabited the Bering Straits area during the late 18th century. A tribe is defined as a group of people with a common language and culture who live within well-defined boundaries recognized by themselves and the contiguous tribes (Ellanna, 1980). Only a small percentage of the traditional tribal locations are occupied by communities today, though many abandoned villages and campsites are used for subsistence sites. Tribes in the Bering Straits spoke Inupiaq, either the Kawerak or Malemiut dialect, except on St. Lawrence Island where Siberian Yupik was spoken.

The Nome tribe had an estimated population of 900 in 1850 (Cole, 1984). The tribe existed within the Nome/Solomon territorial boundaries along the southeast coast of the Seward Peninsula, north to Cape Rodney and south to the bluff area. Bering Straits tribes were less nomadic than Canadian Eskimos, remaining in one place for several years before moving on. Shifts in location were primarily due to environmental or subsistence patterns; coastal erosion, storms, animal migration, or natural catastrophes could cause a tribe to move to a new location. The characteristic tribal settlement pattern was a primary village surrounded by several smaller satellite villages. The primary village was usually deserted in the summer, when residents were fishing, hunting, and food gathering. The old and very young would remain in large villages such as Nome.

Bering Straits tribes had three major subsistence patterns; whaling (primarily bowhead), caribou hunting, and small sea mammal hunting. Cape Nome seemed to be the dividing line between the large sea mammal and small sea mammal focus of hunting. The whaling subsistence pattern influenced social organization and politics; hunters used large skin boats and formed hunting crews. These tribes also developed skills in boat building and navigation, and established a captaincy for their expedition.

Social kinship was major importance in all aspects of tribal life. The principal communities always had a men's house or "kazgi" (sometimes called a "kashim"). Adolescent and adult males lived there, while the women and children lived independently in matrilocal dwellings. The kashim represented the center for inter- and intragroup politics, social control, and male socialization. Each kashim was affiliated with a boat crew. Males could change kashims if there was more than one within their community. There were roughly 15 kashims in the Bering Straits area, with one at Nome. Each kashim had a chief-like leader, or umealig, who, with the council, made major decisions about whaling. The "Messenger Feast" brought adjoining tribes together for celebration.

Prior to 1898, when the cry of gold echoed across the nation, there was a small, temporary Eskimo fish camp at the present Nome site. There, natives from King Island, Little Diomede, and adjacent mainland communities gathered during the summer. Several Eskimo village sites and camps are identified near the project area.

3.8.2 Non-Native History

At its peak in 1900, Nome was about 10 times the size it is today. The city appeared overnight. The city of Nome, at the mouth of the Snake River, began as the campsite for the first prospectors who arrived in the area in the fall and early winter of 1898. The townsite was not established as a port city, as there was no safe harbor for ships, and the mouth of the Snake River was dangerous even for small boats to enter. The reason for the site was its proximity to the rich gold claims of the Snake River tributaries. At the turn of the century, the city of Nome was about two blocks wide and 5 miles long with a population of about 25,000.

Tents and mining claims were established on all the beaches in the immediate area. Buildings and tents were packed along the sand spit by the fall of 1900. Several events occurred to end the gold rush; the easily worked beaches had largely been exhausted and methods to recover gold from offshore sources or upland sources were expensive and could not operate under the harsh weather conditions on the shores of Norton Sound. The final event that ended the Nome gold rush was the storm on September 12, 1900. The waves and 75-mile per hour winds destroyed or washed away almost everything on the beach and a good part of Nome's business district as well. The sand spit, which housed hundreds of tents and buildings, was washed away, with only a remnant of the spit remaining.

Nome remained a mining community with a stable population of about 5,000 for many years. Nome became recognized has having a strategic location for air routes. By 1939 five major airplane companies operated year-round air service in Nome. This strategic location for air routes from the United States to Asia prompted the military to build a garrison to protect the Nome airstrip. Construction started prior to the bombing of Pearl Harbor. The Nome airstrip served as a lend-lease base during the war years. The city was a key stop along a route to ferry bombers and fighters to the Soviet Union.

Today, Nome is the hub of northwest Alaska, providing services to 26 villages throughout the area. Nome supports a mining industry, has an active and growing tourist industry, and is the trade and cultural center of the area. The new fisheries allotments have provided for a growing fishing industry.

3.9 Coastal Zone Management

The Coastal Zone Management Act requires states to make consistency determinations for any federally constructed, licensed, or permitted activity affecting the coastal zone of a state with an approved coastal zone management program (CZMP). Under the Act, the applicants must submit a statement that the proposed activity complies with the state's approved CZMP and will be conducted in a manner consistent with the CZMP. The state then has the responsibility to either concur or object to the consistency determination.

Consistency certifications must include the following information:

Detailed description of the proposed activity and its associated facilities.

An assessment relating to the probable effects of the proposed and associated facilities to relevant elements of the CZMP.

A set of findings indicating that the proposed activity, its associated facilities, and their effects are consistent with relevant provisions of the CZMP.

The U.S. Department of Commerce in 1979 approved the Alaska Coastal Management Program (ACMP). The State coastal management policies and guidelines included in the ACMP are intended to be refined by local districts preparing district coastal management plans (CMP). Completed district CMP's must be approved first by the Alaska Coastal Policy Council and then by the U.S. Department of Commerce, either as a routine program implementation or as an amendment to the ACMP. Once approved by the U.S. Department of Commerce, district CMP's become the basis for Federal consistency determinations. The city of Nome has an approved coastal management plan.

Within this district, the city of Nome Coastal Management Plan incorporates the State policies and adds the following:

1. Tidelands and nearshore waters should be managed for habitat protection. Water-dependent and related shoreline developments should not disturb habitat. Maintenance and enhancement of fisheries should be given priority consideration when reviewing shoreline use proposals that might adversely impact fisheries habitat, migratory routes, and harvest of significant fish or shellfish species. Shorelines having banks, beaches, and beds critical to the preservation or enhancement of the fisheries resources should be maintained.

2. The Snake River estuary, adjacent uplands, and Dry and Bourbon Creeks should be managed to assure adequate waterflow, natural circulation patterns, and nutrient and oxygen levels. They should also be managed to avoid the discharge of toxic wastes and silt or destruction of productive habitat. Tideflats and wetlands should be managed to assure adequate waterflow, nutrient and oxygen levels, and to avoid adverse effects on natural drainage patterns or the destruction of important habitat.

3. The sand spit and the area north of the causeway have been designated as industrial by the Nome Coastal Management Plan. The plan also requires that development of properties adjacent to the Snake River or Norton Sound be facilities that are water related or water dependent.

The Nome Coastal Management Regulations implement certain objectives of the State Coastal Management Program. City, State and Federal agencies will use the

Coastal Management Regulations as the enforceable policies of the City of Nome Coastal Management Program. The Regulations take precedence over the Alaska Coastal Management Program to the extent that the Regulations address a topic raised by an ACMP standard. For topics not addressed by the Nome Regulations, the ACMP standards remain in effect.

The Nome Coastal Management Plan broke the area into functional use districts, which include; general use, industrial, open space, and resource development, with historical, and flood hazard overlays.

The proposed project is in the industrial district. The industrial district is intended to allow a wide range of industrial uses separate from established commercial and residential areas. The Coastal Management Plans has several standards which apply to the proposed harbor modification.

3.9.1 Dredge And Fill.

The placement of structures and the discharge of dredged or fill material into coastal waters, surface waters, and wetlands must comply with federal dredged and fill regulations. Shoreline fills or cuts shall be designed and located so that significant damage to natural resources or alteration of local currents and sediment and sand drift will not unduly endanger adjacent life, property or critical natural resource systems.

3.9.2 Piers, Docks, and Related Shoreland Construction.

Piers, docks, ports, harbors, marinas, wharves, causeways, any permanent floating structures or any related shoreline facility shall not preclude normal use of navigable waters. Such shoreline improvements and activities shall conform to the following standards:

a. Docks, marinas, wharves, causeways or other permanent floating structures shall be no more than ten percent of the width of a stream, measured at its normal high water elevation, without City and, where appropriate, Army Corps of Engineers approval. For structures exceeding ten percent of the width of a stream, the applicant shall demonstrate that normal navigation shall not be impeded.

b. Docks shall be the minimum length necessary to achieve the desired purpose

c. Where a single purpose dock is proposed, the reason why a cooperative use facility is impractical shall be stated. Where feasible, the cooperative use of docking, parking, cargo handling, and storage facilities should be undertaken.

d. Docks shall be designed to withstand ice movement or be designed for removal during winter months.

e. In order to protect shorelines the proposed activity shall not:

(1) Interfere with existing recreational use;

(2) Interfere with or harm the natural environs of any river or tidal water nor substantially harm any fish or wildlife habitat;

(3) Cause soil erosion or lower the quality of any water.

f. A proposed shoreline protection measure shall not:

(1) Cause increased erosion, shoaling or flooding, or other adverse impacts on adjacent property;

(2) Adversely affect significant natural spawning, rearing, or residency areas of aquatic life;

(3) Be permitted seaward of mean higher high water (MHHW), except in conjunction with an approved water-dependent or water-related commercial or industrial use;

(4) Restrict existing public access;

g. A proposed shoreline protection measure shall be:

(1) For a water-dependent or water-related commercial or industrial use:

(2) Constructed at a time that will minimize the impact on aquatic life;

(3) Constricted only if erosion seriously threatens established.

The proposed action fully complies with all applicable regulations and standards of the Nome Coastal Management Program. The proposed sand bypass system will allow the natural amounts of sand past the proposed breakwater and entrance channel as well as the causeway. The proposed boat harbor improvements are for water-related and water-dependent uses only, and being Federal facilities, are for use by the general public.

The proposed action is not within a mapped geophysical or recreational area. The breakwater and entrance channel have been sited to minimize the duplication of facilities, improve harbor use efficiencies, and minimize potential adverse environmental effects. Design and construction of the facilities would include maintained breaches in both the breakwater and causeway. To the extent practicable, the proposed navigation improvements comply with the State of Alaska and Nome

Coastal Management Program's policies, regulations and standards, including those regarding fish and wildlife, air and water quality, coastal development, subsistence, and cultural resources.

4.0 PHYSICAL MODEL

The city of Nome and the Alaska District agreed to use a physical model to assist in the harbor design for the proposed project. A coastal hydraulic model investigation of Nome Harbor was initiated by the U.S. Army Engineer Waterways Experiment Station (WES) to:

a. Study wave, current, and shoaling conditions for the existing harbor configuration.

b. Determine the impacts of a new entrance channel and harbor configuration on wave-induced current patterns and magnitudes, sediment transportation patterns, and wave conditions in the new channel and mooring area.

c. Optimize the length and alignment of a new breakwater structure required to provide adequate protection.

d. Determine the impacts of extending the existing causeway on waves, currents, and sediment movement.

e. Develop remedial plans for the alleviation of undesirable conditions as necessary.

f. Determine if design modifications to proposed plans could be made that would significantly reduce construction costs without sacrificing the desired level of protection.

The Nome harbor model was constructed to an undistorted linear scale of 1:90. A geometrically undistorted model was necessary to ensure accurate reproduction of wave and current patterns. Figure EA-2 shows the project site and existing conditions of the Nome Harbor and causeway.

The model was calibrated to the existing condition for wave heights, currents, and sediment patterns using available information. Four members of the Nome community (two councilpersons, the city engineer, and long-time user of the harbor and causeway facilities) visited the model to further calibrate the model. With the model calibrated, the model was run at different wave heights and directions during several atmospheric conditions for several of the alternatives. The model study was used to assist in the final design of the recommended plan.

5.0 ALTERNATIVES

During the feasibility phase of the project, 14 alternatives were investigated. Following initial analysis, eight alternatives were identified as being likely National Economic Development candidates. Five of the eight alternatives were variations of each other, and the environmental impacts associated with each were similar. They, therefore, were evaluated as one alternative from an environmental standpoint. Consequently, five alternatives are addressed in this EA: no-action, major rehabilitation of the existing project, the recommended plan, curved spending beach, and harbor adjacent to causeway.

5.1 No-Action Alternative

The no-action alternative would leave the harbor in its present condition and would allow the present project features to erode to a condition where the harbor is no longer usable. The Federal Government maintains the entrance channel, sheet-pile walls, and two jetties. The entrance channel and turning basin are dredged annually. The sheet-pile walls are maintained on an "as needed" basis. Some of the sheet pile was replaced in the 1980's and would need to be replaced entirely in the very near future. The jetties also need to be replaced.

Potential Environmental Impacts. The environmental impacts associated with the no-action alternative would be extremely negative for the socio-economics of Nome and the surrounding villages. The biological environment would not be affected. The Snake River would still flow at its present location. Since the inner harbor would not be used, there would be less likelihood of fuel spills or other harbor contaminants.

5.2 Major Rehabilitation of the Existing Project (Without Project Condition)

This alternative would repair and maintain the existing harbor in a usable condition. The sheet pile and the jetties would require reconstruction. Approximately 18,000 m^3 of material would be excavated to replace the 1,045 linear meters of sheet pile. About 6,500 m^3 of this material would be backfilled after the sheet pile was replaced. About 2,750 m^3 of 0.3-meter-diameter riprap and 1,500 m^3 of well-graded gravel fill would be needed to install and support the sheet pile.

The existing jetties have eroded and need to be repaired in the near future. The jetties were constructed with rock and capped with reinforced concrete. The rock has eroded leaving daylight below the concrete cap. To restore the jetties, the cap must be displaced, which will require blasting. The jetties would then be capped with 8-ton rock, using the blasted concrete cap as core material. The west jetty would require 3,100 m^3 of rock while the east jetty would require 5,100 m^3. Both jetties would be built to +3.8 meters MLLW.

This alternative would be expensive and the problem of access into the harbor would still be present. This alternative affords no protection to the docks on the causeway and does not address sediment management.

Potential Environmental Impacts. Environmental impacts associated with this alternative are minor impacts and would occur only during construction. The instream work would be performed after June 15, when the juvenile salmon have left the Snake River.

5.3 Recommended Plan

The recommended plan involves channel relocation, breakwater and causeway spur construction, and a sediment bypass system. It consists of the following three major features:

1. A relocated, deeper, wider, and extended access channel to the inner harbor. The inner harbor access channel would be protected from sediment infill by a 925-meter-long breakwater and would use the existing causeway as a west breakwater.

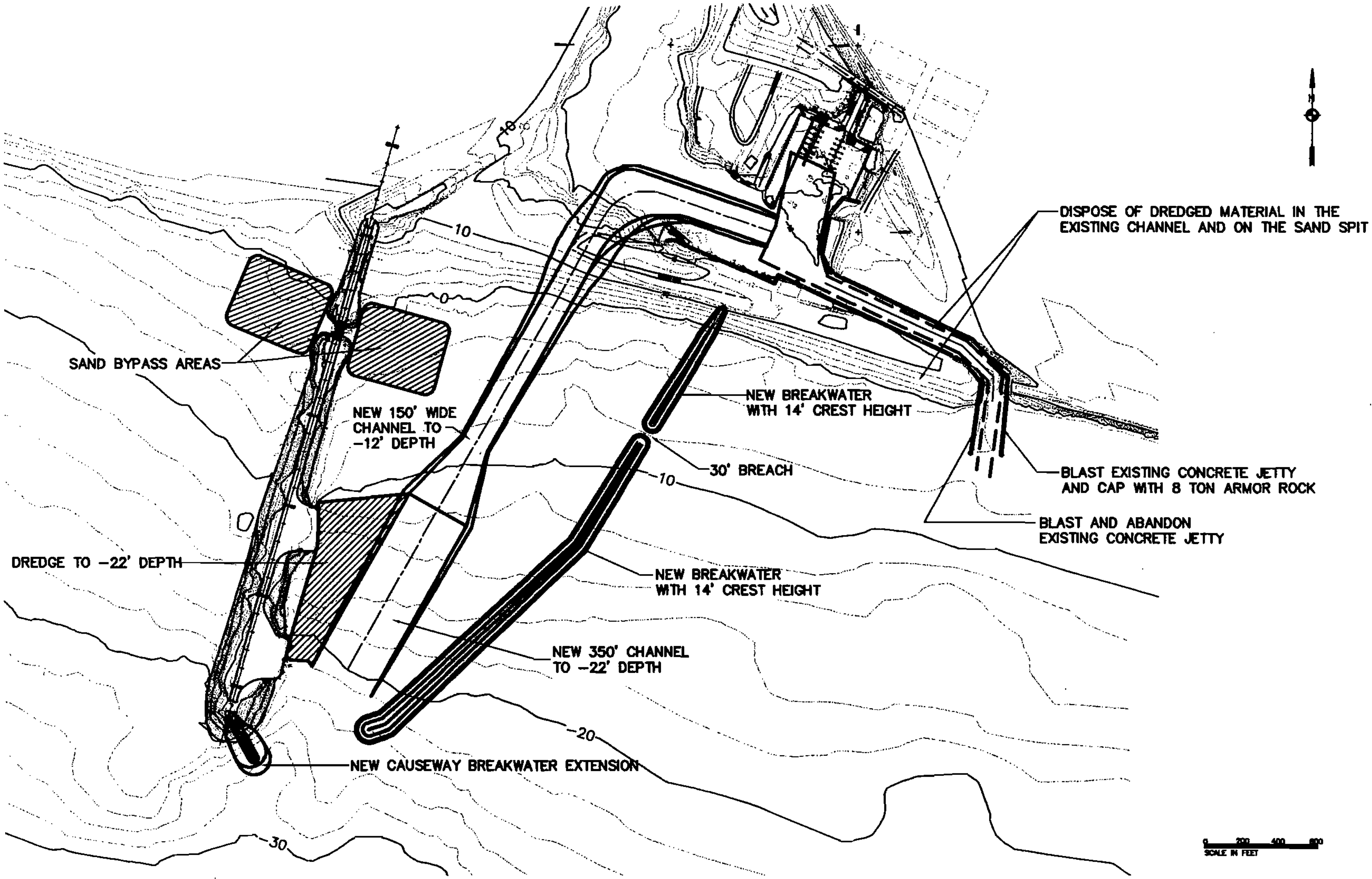
2. A 925-meter-long breakwater for added wave protection for the dock facilities at the non-federal causeway. The improved dock access and wave protection would consist of a 110-meter-wide channel to both inner and outer docks and a 72-meter extension to the causeway for wave protection.

3. A sediment management program that will bypass between 15,000 and 45,000 m^3 of sand from the west side of the causeway to the east side of the proposed breakwater.

The 925-meter-long breakwater has been designed to +4.2 meter MLLW and includes the following rock quantities:

Filter (foundation) rock	36,200 m^3
Core Rock	13,700 m^3
Secondary Rock	17,700 m^3
Armor Rock (8 ton)	60,800 m^3

The breakwater includes a 10-meter-wide breach at –2.5 meters MLLW to allow safe passage of juvenile salmonids. The breakwater would extend into depths of –7.5 meters MLLW to provide wave protection for the docks on the causeway. Several breakwater lengths and configurations were studied in the physical model. The proposed configuration was the least costly alternative that protected the dock areas. The proposed breakwater length also protects the entrance channel from shoaling (figure EA-5).



ALASKA DISTRICT
CORPS OF ENGINEERS
CIVIL WORKS BRANCH

ALTERNATIVE PLAN "L"
RECOMMENDED PLAN
NAVIGATION IMPROVEMENTS, NOME, ALASKA

EA-5

The physical model demonstrated that a breakwater extension attached to the causeway was required to provide additional wave protection for the docks. This breakwater extension would require 3,300 m^3 of filter rock, 1,400 m^3 of cove rock, 2,200 m^3 of secondary rock, and 9,700 m^3 of armor rock.

The channel would be dredged to a width of 110 meters and a depth of -6.7 meters MLLW for approximately 300 meters. The channel would then narrow to 50 meters and would be dredged to -3.7 meters MLLW. When the channel transitioned into the Snake River, the project depth would be -3 meters MLLW. Approximately 137,000 m^3 of material would be dredged from the 0 MLLW line, through the spit, and into the Snake River to meet the project depth and channel width. The channel seaward of the 0 MLLW line would require 223,000 m^3.

The –6.7 meters MLLW is called "depth of closure," where the invert of the channel depth is below where sediment movement occurs. This prevents sediment from entering the channel between the breakwater and causeway. The –6.7-meter-depth would ensure that maintenance dredging of the channel would not be required.

The outer channel width would also allow maneuvering space for tugs and barges to turn and use the docks. An additional area between the docks and the 110-meter-wide portion of the channel would be dredged to –6.7 meters MLLW to accommodate vessels using the non-Federal causeway docks.

The third feature is the establishment of a sediment maintenance bypass system. Bathometric surveys demonstrated that the causeway has interfered sediment transport along the coast in front of Nome. Approximately 300,000 m^3 of sand has accumulated around the causeway with 75 percent occurring on the west side. During high wave energy events, a rip current also transports sand along the western edge of the causeway. This material settles at the outer edge of the causeway, as indicated by the bulge in the contour line. This action can be seen in photographs (turbidity plume) and was demonstrated in the model. Incidentally, this settling of sand is occurring at about –6.7 MLLW, which coincides with depth of closure. The buildup of material at this location focuses the storm waves, causing the waves to bend around the causeway, which affects the docking areas. If material continues to build at this location, the docks would become less accessible, eventually allowing use of the docks only on the calmest days. The sands that nourished the beaches east of the causeway have been intercepted, and these beaches are being starved of material.

The sediment bypass consists of several actions. A 3-hectare sediment trap would be dredged on both sides of the causeway at the breach. The inside (east of the causeway) sediment management basin would be dredged to –6.7 meters MLLW, with the basin on the west side of the causeway dredged to –2.5 meters MLLW. This would require an initial dredging of about 110,000 m^3 of sand. This configuration would allow the sands to move from west of the causeway into the deeper sediment management basin. To ensure maximum sand transport through the causeway, the breach would be widened. The sediment management basin would allow a protected area for dredging between 15,000 and 45,000 m^3 annually. The sand would be piped to the EPA approved disposal sites east of the breakwater. The material would be disposed of out of the breakwater shadow, which would allow the material to be naturally transported to replenish the downdrift beaches.

The recommended plan would require dredging approximately 500,000 m^3 of material mainly classified as sand. The dredged material would be disposed of at two locations: on the sand spit and in the existing entrance channel.

The sand spit is between elevation +3.7 and +4.3 meters MLLW. Several storms in the past 25 years have generated waves that overtopped the spit. The majority of the dredged material would be placed on the spit to reduce overtopping. The dredged material would be placed to a 6-meter elevation and distributed seaward on a 10 horizontal to 1 vertical slope, (60 meters from approximately the middle of the spit). The material would extend to about the –1.2-meter MLLW contour. The dredged material would be disposed of in areas classified as uplands or would be within the EPA approved disposal site. The dredged disposal would begin near the entrance channel and continue east until all material is exhausted. If the sand spit was not large enough to hold the all the dredged material, the EPA authorized disposal area east of the existing entrance channel would be used.

Soil and sediment along the entrance channel alignment were tested for chemical compounds and heavy metals. Results of the chemical testing indicated that about 20,000 m^3 of material was calculated to be above screening levels (93 mg/kg) for arsenic. The arsenic was located on a hardpan layer at a depth of about 2 meters below the mud line. The portion of the hardpan layer that would be dredged for the entrance channel was present under the spit and seaward for several hundred feet. Portions of the sediment management basin were believed to contain contaminated material and would be treated as such.

The Alaska District encountered sediments with concentrations of arsenic at 180 mg/kg in the turning basin of the harbor in 1990. As per the Ocean Dumping Manual, the Alaska District performed bioassays on the material. The bioassays were not conclusive (portions of the test organisms were killed) and the material was deemed not suitable for open water disposal. The material was placed in a dredged area within the turning basin and capped with 1 meter of clean material.

Some concentrations of arsenic found in the December 1997 samples were up to 250 mg/kg. Some concentrations associated with the hardpan layer exceeded 200 mg/kg. Since the previous bioassays failed at concentrations 70 mg/kg less than the present samples, the probability of passing new bioassays would be low.

The Alaska District proposes to dispose of the arsenic contaminated material in the existing entrance channel. A Section 404 (b) (1) Evaluation covering this action is in appendix EA-1. The existing entrance channel would be plugged at both ends with clean dredged material. A contaminated dredged material cell would be established by using a bottom and side layer of geotextile material. The geotextile would be sized to allow water, but not sediments, to flow through the fibers. The contaminated material would be placed in the cell and covered with at least 1 meter of clean material. Monitoring wells would be placed at several locations established jointly with the Alaska District and EPA Region 10. These wells would be monitored on a scheduled basis to see if there was any arsenic migration. Monitoring wells would be used only in the absence of geotextile material. The Alaska District and EPA would establish measures to be taken if contaminant migration occurred. To prevent the contaminated material from being re-exposed if the area was developed, the location of the material would be platted with the city of Nome. The existing entrance channel can accommodate approximately 100,000 m^3 of material.

It appears that the arsenic encountered in the soil samples is of a natural origin. The area has not been dredged for gold in the past as indicated by the presence of the hardpan layer. However, whether the material is natural, man-made, or from gold mining operations, if it has toxic qualities that kill marine organisms, it is not suitable for open water disposal. The use of a confined disposal area is common practice when handling contaminated dredged material.

Potential Environmental Impacts. The recommended plan would alter approximately 20 hectares of sandy substrate ranging from subtidal to uplands. The alterations include changing 2.5 hectares of sandy habitat to subtidal, intertidal, and upland rocky habitat. Rocky habitat is scarce in the Nome area and the recommended alternative breakwater would provide at least 1.5 times more available surface habitat than the existing condition. It is not known if the increase in rocky habitat would be a positive impact. Generally, breakwaters are not as productive as natural rocky environs, and may or may not be as productive as the sandy substrate. With either instance, the loss of 2.5 hectares of sandy habitat or the gain of 2.5+ hectares of rocky habitat is a minor impact, whether positive or negative.

Dredging the channel would provide new aquatic habitat where the proposed entrance channel pierces the spit. Losses include filling the existing entrance channel, which is sheet-pile lined and provides poor habitat. The recommended alternative would have a minor beneficial impact over the existing condition.

Other channel dredging would probably change the substrate type slightly. There are no areas where the dredging would reach bedrock. The different water depth may change species assemblages from shallow water species to deeper water species. This impact would be slight.

The sediment management area would be maintained on a yearly basis. This precludes any long-term growth. Two and one half hectares of sandy habitat would be lost from biological productivity.

The most positive benefit associated with the preferred alternative is the Federal involvement in the maintenance of the breaches in the causeway and breakwater. The breach in the causeway was first constructed at –2.1 meters MLLW. The breach has not been maintained since it was constructed and is now at –1.2 meters MLLW. The sediment management program would occur on an annual basis and the breaches would be maintained at their designed depth and width.

The recommended plan would have minimal effects on the Snake River environs. Dredging the channel within the Snake River should provide additional overwintering areas for juvenile coho salmon; however, the existing entrance channel would be filled and lost from the aquatic environment.

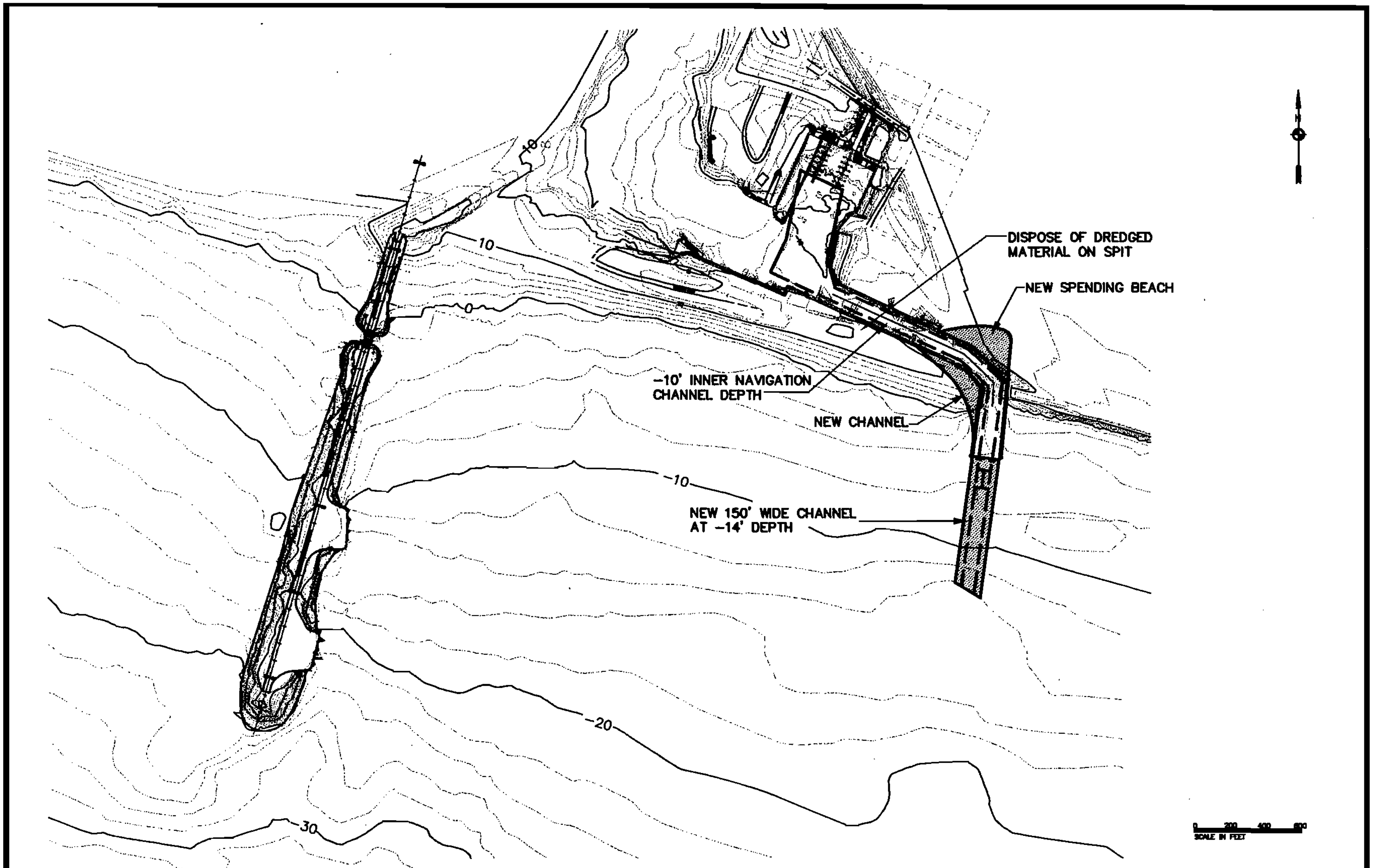
The recommended alternative would have no effect on water quality, flushing, or circulation of the inner harbor. No maintenance dredging is anticipated in any of the channels except in the sediment management basin. This should have a positive effect with the removal of potential impact to juvenile fishes from suction dredging. Dredging the sediment basin would not be a critical element in harbor use as in the existing entrance channel, and dredging could be scheduled later in the year when environmental risks were low.

Construction activities would have an adverse effect on the fish and wildlife resources of the project area. These impacts include water quality, noise, and air pollution. Water quality impacts include an increase in turbidity and/or suspended sediments in the water column and the release of an unknown but small quantity of arsenic during the dredging and dredged material disposal operation. Since an entrance channel would have to be open at all times during construction for vessel movement and Snake River streamflow, there would be in-water dredging of contaminated material. This would be kept to a minimum by dredging the spit area from the middle outward, essentially leaving a small plug at both ends of the channel through the spit.

The existing concrete jetties are in extreme need of repair and would have to be altered. The proposed plan is to blast and abandon the west jetty and blast and cap the east jetty with 2,000 m^3 of 8-ton rock. The blasting would require permission from the Alaska Department of Fish and Game (ADF&G) for the protection of aquatic resources. The Alaska District would suggest that no restrictions be placed on the blasting if it was accomplished during the winter months, maximum protection was used (air curtain and psi restrictions or no blasting), if the blasting occurred during either outmigration of juvenile salmon or spawning migration of salmonids, smelt, herring, capelin, etc., and psi restrictions were used during other open water periods.

5.4 Curved Channel with Spending Beach

This alternative consists of locating the entrance channel in approximately the same location and alignment as the existing authorized navigation channel (figure EA-6). This alternative has several limitations and was not the recommended alternative for the following reasons:



ALASKA DISTRICT
CORPS OF ENGINEERS
CIVIL WORKS BRANCH

ALTERNATIVE PLAN "A"
NEW CHANNEL NEXT TO EXISTING W/SPENDING BEACH
NAVIGATION IMPROVEMENTS, NOME, ALASKA

EA-6

1. Access to the entrance channel from vessels entering the harbor would be equivalent to the existing condition. The present harbor has limited access even during minor storms from the south.

2. To create a spending beach, prime marine related industrial property would have to be condemned and purchased by the local sponsor. Marine-related industrial property is very limited at Nome, and this alternative would have a negative effect.

3. This alternative would not provide any benefits to either navigation or moorage to vessels using the causeway.

The spending beach would require the removal of approximately 20,000 m^3 of material directly behind the curve in the entrance channel. The spending beach would be built to a 10 horizontal to1 vertical slope of 10,000 m^3 of rock, ranging from one-half kilogram to 1,000 kilograms.

The channel outside the existing jetties would be excavated to 50 meters wide, 225 meters long and to a depth of -4.2 meters MLLW. About 10,500 m^3 of material would be dredged and placed in the EPA disposal site.

An additional 1,700 m^3 would be excavated from the nose of the spit to round the channel approach. Approximately 21,000 m^3 of material would be excavated to widen and deepen the channel from the spending beach to the turning basin.

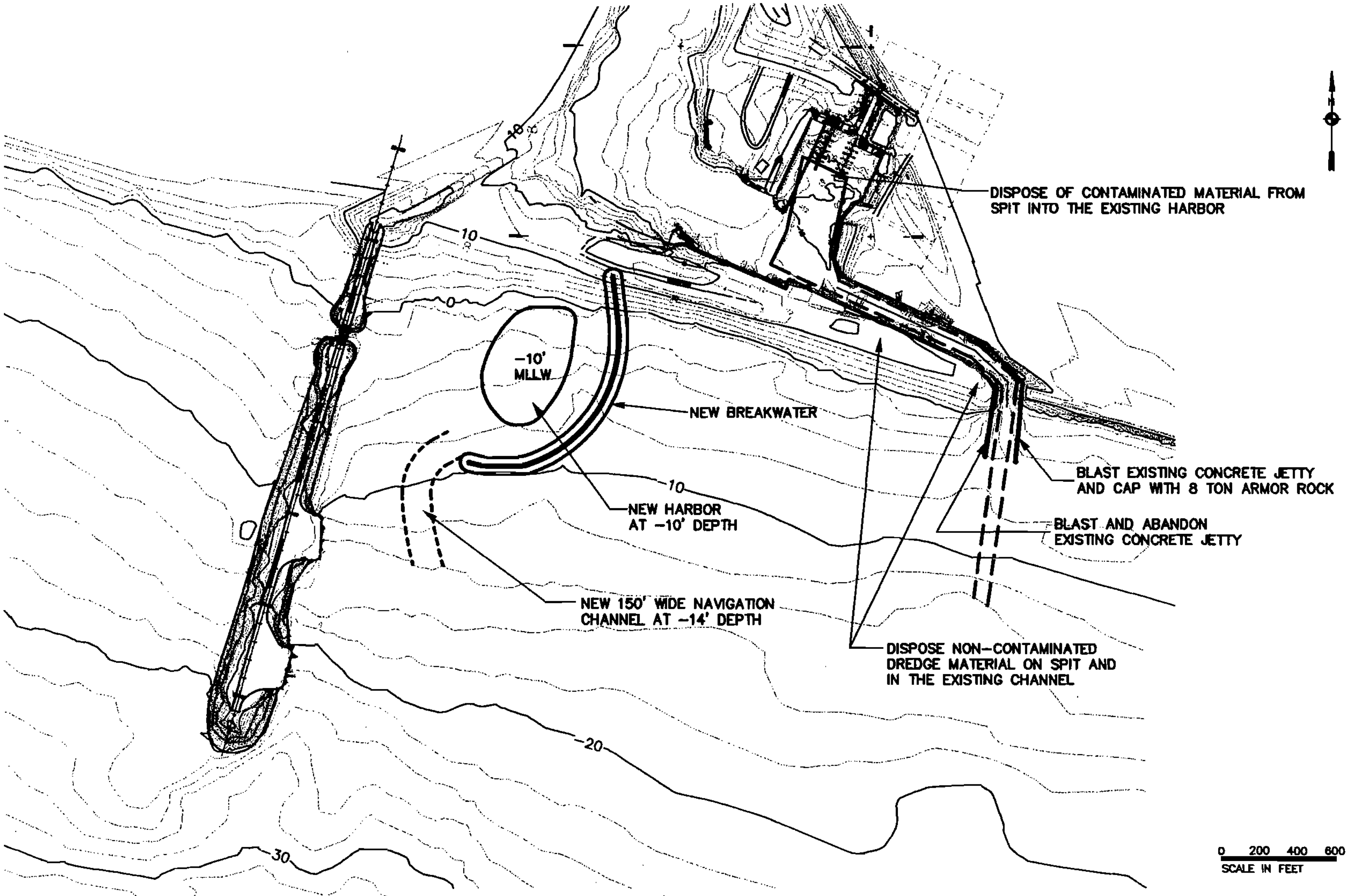
All the sheet pile would be removed and new sheet pile would be placed except for the areas fronting the spending beach. The existing jetties would be removed to complete the alternative.

Potential Environmental Impacts. This alternative would have the same environmental impacts on fish and wildlife resources as the existing harbor. These impacts would be minor. This alternative would have a positive social effect of eliminating the present dangers associated with the existing sheet-pile wall. The existing sheet-pile wall along River Street is not secured. The sheet pile comes even with the roadway without any fence or guardrail. If a person falls into the river at this location, the vertical sheet pile walls on both sides of the river make it impossible to reach shore and safety. Many people have drowned because of this.

5.5 Harbor Adjacent to Causeway

This alternative is to develop a harbor on the east side of the causeway (figure EA-7). This plan was not selected for the following reasons:

1. The project would not use the existing facilities in the inner harbor. The city has made improvements on the inner harbor that would be lost with this project.



ALASKA DISTRICT
CORPS OF ENGINEERS
CIVIL WORKS BRANCH

ALTERNATIVE PLAN "B"
NEW CHANNEL OFF CAUSEWAY W/BREAKWATER
NAVIGATION IMPROVEMENTS, NOME, ALASKA

EA-7

2. There is a greater concern for damage to vessels and the new harbor float system due to long-period swell and ice forces. The floats would probably need to be removed during the winter season.

3. Navigation conflicts could occur between harbor vessels and among vessels that now use the causeway's inner and outer sheet-pile docks. Access to both docks could be restricted with the construction of the rubblemound breakwater. The plan would provide limited uplands for development.

4. The fishing fleet would be exposed to a higher-energy wave and swell environment than with the proposed alternative. Vessels would have a higher risk of damage during extreme storms.

Potential Environmental Impacts. It appears that the adverse environmental effects would be minor. The placement of the breakwater and the dredging of about 180,000 m^3 of sediment would cause minor, short-term effects. Annual maintenance dredging would probably be required with this alternative.

5.6 Construction Methods

The project consists of placing the stone for the breakwater, dredging the entrance channel and sediment basin, and constructing the boat basin and other ancillary facilities. The Alaska District tends to allow the contractor to choose the construction method for the project, with restrictions. The contractor would build the breakwater and dredge the areas as described in the plans and specifications. Restrictions are usually project specific, such as timing restrictions for environmental or cultural/social resources, or special handling of materials. In this instance, the contractor may perform portions of the work during the winter or ice-free months. There are advantages and disadvantages to either action. This section addresses the impacts associated with both methods.

5.6.1 Winter Construction

The construction contractor could remove the ice along the breakwater alignment and place the core material. It is believed the contractor could place one third of the breakwater in this manner. Advantages to a winter operation include the availability of equipment (most construction operations are shut down during winter), ease in placement of the material, and access. A winter operation would allow the transportation of 150,000 m^3 of core material on the ice parallel to the shoreline. This would avoid using existing public roads and the necessary restrictions or construction of a haul road around the city. The placement of the core material during the winter months would have minor effects to the surrounding environs, with the exception of the footprint of the breakwater. Increases in turbidity would be minor, as the material would slowly enter the water with the melting and rotting of the ice. Impacts to the daily life of the residents of the community would be negligible. If the contractor constructed a winter road on the shorefast ice, all the material from the quarry could be moved and stockpiled on or near the sand spit.

The practice of dredging and disposing of dredged material when the sediment is frozen is used in several areas in Alaska. The dredged material is removed using land-based equipment such as backhoes and excavators. Some material is removed frozen and disposed of at the disposal site in a frozen state. There are several construction advantages to this type of operation: the use of land-based equipment and not being closed down because of waves, and the ease of disposal and containment of dredged material. As with the placement of material for the breakwater, equipment availability and equipment rental costs are more reasonable. From an environmental perspective, the winter operation would not interfere with most biological functions. The ice would be landfast to about –1.2 meters MLLW. There is little water movement under ice until about the –6 meter contour. Wave and wind generated longshore currents do not exist, and tidal action is depressed because of the pack ice. The material to be dredged is sand and gravel with minor amounts of fines. The turbidity plume would be small because there would be no forces to cause it to move and short term because of the nature of the bottom sediments. Since there would be no water exchange with the air, the small amount of dissolved oxygen would be depleted and not replenished. Oxygen dependent flora and fauna may succumb.

From an environmental and social aspect, a winter operation is preferable. Although the project area is not high in biological resources because of the constantly shifting sediment and sands, a winter operation would decrease potential impacts even further. From a social viewpoint, a winter operation is far superior. The ability to use the nearshore ice for access from the material site to the project site would reduce adverse effects to the community. A winter operation would employ construction personnel who normally could not find work during the winter months.

5.6.2 Summer Construction

The exact method of construction of the harbor improvements is not known. The following evaluation is for a certain method and does not reflect either the preferred method, the recommended method, or the required method. The breakwater would be constructed using land-based equipment. The core material would be end dumped from a dump truck. A crane would place the armor stone. This would require a crest width of about 6 meters to allow enough surface area for the crane to operate. The material would be removed to construct the breakwater breach upon completion of all other breakwater activities.

If the core, secondary, and armor stone were obtained from the Nome area, they would not be brought in by barge. A summer operation would require trucks to operate on existing roadways or haul roads. During construction of the causeway, a haul road was constructed to bypass the city. This road is also used when rock from the Nome quarry is taken to the causeway for off shipment. The number of truckloads of material required to build the breakwater would be dependent on the weight load limits on the bridges; many of the trucks cannot haul their capacity. It appears that there would be tens of thousands of truck trips using the roads around Nome. This many trips would cause a short-term increase in air borne particles since none of the roads are paved. If the particulate matter exceeded limits considered unsafe, the contractor would be required to reduce dust, probably by watering the roadway(s). The Corps/local sponsor would require the contractor to leave the road in the pre-project condition. However, the rock-laden trucks would cause road deterioration, which would have a negative effect on local traffic. Speed limits may be imposed on certain sections of the road for safety reasons

Negative impacts would occur to the community through the use of the road system leading to an increase in traffic, road deterioration, and a decrease in air quality. Rerouting the truck traffic, road grading, and road watering would help lessen these impacts.

The negative side for the construction contractor would be load limits, cost and availability of equipment, and extra measures required for maintaining community relations. All these impacts add to the cost of the project. The positive side of summer operation would be the decrease in vehicle/machine maintenance, less down time lost to extreme weather, and although Nome is not above the Arctic Circle, there is little day light in the winter and almost continuous sunlight in the summer.

Dredging in the summer months would require a barge-based operation with the exception of the dredging of the channel through the spit. Geotechnical information indicates the material to be dredged is sand and gravel on the top layer with hardpan starting at about 3 meters below the surface. The hardpan layer appears to follow the beach contour. The top material could either be dredged with a cutterhead dredge or a bucket dredge. Hardpan dredging may require a special bucket on a barge-mounted crane. The sequence in which the construction contractor would build the project is not known. If the breakwater was constructed first, the barge and dredging operation could operate during most of the summer months.

Adverse impacts associated with a summer dredging operation depend on the timing of the dredging and on the equipment used. Several studies have shown that fish species can be entrained into cutterhead (suction) dredges. The severity of impact of entrainment depends on the occurrence and density of fish species, siphon force, and volume of water being processed. The density of fish species at the project site depends on the spawning and hatching success of the pink and chum salmon from the Snake River, and to a lesser extent, to other anadromous streams in the immediate area. Pink and chum salmon emerge from the gravel and enter Norton Sound almost immediately. This occurs from mid-April to mid-June. The juvenile salmonids tend to hug the shoreline where they acclimate to the higher salinity found in ocean waters. The nearshore shallow water also provides protection from aquatic predators, which are not found in extremely shallow water. Studies in Puget Sound in Washington indicate juveniles migrate offshore at night where they actively feed. It is believed that the darkness provides protection from predators. This behavior does not occur in

Alaska, where it remains light for nearly 24 hours during the summer. The anadromous stream permit (Title 16 of the Alaska Statutes) administered by the Alaska Department of Fish and Game (ADF&G) for the annual maintenance dredging of the existing harbor states that if a suction dredged is used, work cannot start until June 15. This was placed to protect the outmigrating juvenile salmon. This stipulation would likely apply for the proposed action.

Potential impacts to fish populations can also occur with the loss of pelagic eggs that may be in the zone of operation during water intake (20,000 liters/minute) during the dredging operation. Since the disposal area is upland, any pelagic life forms that become entrained in the dredge will be lost. Very little is known about egg deposition and transport in pelagic forms, or larval and juvenile fish distribution in the area, particularly in the area of the proposed project. The relatively low volume of water would not significantly impact the pelagic fish community in the immediate area.

The chemical analysis of the sediment to be dredged indicates that about 20,000 m^3 is above regulatory levels for cleanup and will require special handling. For the uncontaminated material, the most detrimental water quality aspects occurring during dredging are turbidity and dissolved oxygen. The proposed dredging site is highly mixed due to local winds and storms, and the material to be dredged is uncontaminated. Therefore, if local depressions in dissolved oxygen did occur, they would not persist long enough to pose a problem for fish. The decreased concentrations of dissolved oxygen have been known to produce an avoidance reaction during periods of active dredging.

Numerous laboratory studies have evaluated the effect of increased concentrations of suspended sediments on fish. Potential effects include mortality, physiological disturbances, and abrasive ware on tissues. Several factors decrease the potential impacts on aquatic species due to turbidity. The top layer of dredged material is mainly sand, with only minor amounts of fines. This would decrease the turbidity concentrations. The use of a suction dredge also decreases turbidity since the waterflow is to the pipe, and the turbid water is sucked through the pipe. A bucket dredging operation would cause higher turbidity levels. With either method, the turbidity plume would stay confined to the area between the causeway and the breakwater (if the breakwater was built first). The hardpan would probably be dredged with a special bucket. Although the hardpan can be fine-grained material, it is so cohesive and compacted, individual sediment grains will not be present. Turbidity is expected to be minor.

6.0 ENVIRONMENTAL CONSEQUENCES

6.1 Alternatives

The potential environmental impacts associated with the alternatives evaluated in this EA are discussed in Section 5.0 Alternatives. The alternatives are: no action, rehabilitation of the existing project, recommended plan, curved spending beach, and harbor adjacent to causeway.

6.2 Endangered Species

No resident species in the Nome area are proposed for listing under the Endangered Species Act.

The region contains summer feeding grounds of several endangered whales species, including fin, sei, minke, sperm, and bowhead. The bowhead is the only whale that may come into Norton Sound. Evidence indicates bowhead whales are seasonal feeders who obtain their food primarily on summer range; little (if any) food is obtained during migration. Bowhead whales are unlikely to come near the project area and are seen in the Nome area only sporadically.

Whales would likely avoid the activity occurring in the project area during construction, thus avoiding contact with more concentrated portions of a turbidity plume, if one occurred. Any impact caused by the physical disturbance of sediments would likely be food related and the degree of impact would depend on the area affected. Based on the limited area of heavy activity in relation to the total area of available food and the mobility of whales and their prey, the impact is considered to be minimal.

Threatened spectacled eiders nest in wet tundra near ponds on the Arctic Coast and on the Yukon-Kuskokwin Delta. Breeding grounds for the spectacled eider on the Seward Peninsula are along the Chuckchi Sea and Kotzebue Sound. No breeding grounds are along the Norton Sound side of the peninsula. Major molting and staging areas are located in Norton Sound near Unalakleet. The eiders are not seen in the Nome area, and the project area is not part of their critical habitat nor is it on their known migratory route.

The arctic peregrine falcon was delisted from the Endangered Species List in October 1994. There have been sightings of this bird throughout the Nome area. A pair of peregrines was reported nesting at Cape Nome, in the cliffs formed by the Nome quarry operation. The nest apparently has been abandoned.

The Alaska District coordinated with the USFWS and NMFS to determine if any threatened, endangered, or candidate species inhabit the area. Both agencies concluded there would be no impacts to threatened or endangered species brought about by the proposed project. Refer to the USFWS Coordination Act Report in appendix EA-2 and the NMFS letter in appendix EA-3.

6.4 Special Aquatic Sites

The proposed project would have no effect on special aquatic sites. No new wilderness units were created by the Alaska National Interest Lands Conservation Act. The southern part of Norton Sound from the Yukon Delta easterly to St. Michael is part of the Clarence Rhode National Wildlife Range. Various coastal islands, spires, and rookeries in the Sound are part of the Alaska Maritime National Wildlife Refuge authorized by the Alaska National Interest Lands Conservation Act. These provide habitat for marine mammals and nesting marine birds, but do not extend seaward of the mean high water line.

6.5. Cultural Resources

There are at least 30 regional historic and archaeological sites in Nome. Three sites are near the project area.

The ruins of the wooden launch MV Donaldson has been placed on the National Register of Historic Places. The ruins are located on the opposite shore of the Snake River from the proposed entrance channel. The ruins are not in the project area and would not be impacted by the proposed action.

The Carrie McLain Home is also located above the north bank of the Snake River. Carrie McLain was one of the first settlers and prominent citizen of Nome. She was Nome's foremost historian and the house has been placed on the National Register of Historic Places. This historic landmark is outside the project boundaries and would not be affected by the construction or operation of the proposed project.

The beaches east of Nome and west of the causeway have been placed on the National Register of Historic Places. The gold found in the beaches were the main focus of the 1900 gold rush. The proposed project is on the sand spit, which is not part of the beach landmark. The proposed action would not add any structures to the beach nor would it change the historical significance of the beach landmark.

The Alaska District has coordinated with the State Historic Preservation Officer (SHPO) and the proposed action will not have any negative effects on any sites on or eligible for inclusion in the National Register of Historic Places.

The construction contractor will be notified that if any artifacts, either historical or prehistorical are encountered during construction, the work in that area will immediately cease and the SHPO informed. Work will not start without concurrence with the SHPO.

6.5 Snake River

6.5.1 Wave Driven Circulation.

Water circulation of the inner harbor was tested in the model using existing conditions and with each alternative. The model showed that water exchange was negligible between the harbor and Norton Sound from wave and storm action. Each alternative, with all wave heights and storm conditions, also exhibited little, if any water exchange. The proposed alternative would neither increase nor decrease water exchange from storm-driven wave action.

6.5.2 Density Driven Circulation.

The Alaska District performed a drogue study to determine circulation patterns within the existing entrance channel, turning basin, and moorage area. The study was performed only one time in July 1997. The information gathered is informative only. The study revealed the following:

1. A strong water-density stratification occurs during summer months (given that July 1997 is representative). An 0.5-meter layer of freshwater (0 to 5 parts per thousand) sits on top of a saline (25 to 30 parts per thousand) layer. This layer continued at least 800 meters upstream.

2. The freshwater layer always flows out to Norton Sound, regardless if the tide was flooding or ebbing.

3. A counter clockwise gyre exists in the harbor area generated by the density differences between the fresh and salt water. This gyre is fairly strong and encompasses an area to about the location of the floats (figure EA-2).

4. There is no density driven circulation between the floats and the culverts to Bourbon and Dry Creeks.

Density driven circulation exists with the present condition, and there is no reason to believe the water density stratification would change with any of the alternatives. It appears that this force is one of the only methods for water exchange between the inner harbor and Norton Sound.

6.5.3 Wind and Streamflow Mixing.

Vertical mixing of the water column within the harbor and entrance channel occurs during at least two circumstances. Winds over 80 kilometers per hour (gusts) occur on a regular basis at Nome. These wind forces are probably strong enough to cause vertical mixing. Vertical mixing also occurs during the spring when the streamflow in the Snake River is high. The high spring streamflows are of sufficient volume to totally flush the water within the harbor and entrance channel.

6.6 Sediment Transport and Currents.

Littoral drift moves in both directions along the project site. Sediment movement from the west dominates the deposition pattern. The natural processes allowed the sand to move down the coast and replenish the down-drift beaches. The construction of the causeway has changed the sediment patterns. The causeway is functioning as a groin, impeding longshore sediment transport in both a west and east direction. This is evident with the amount of sand buildup adjacent to both sides of the causeway. It has been assumed that storage of sand on both sides of the causeway has stabilized after 1990. The average annual storage on the east side of the causeway has diminished since 1990, representing a normal east to west system transport. The average annual storage west of the causeway since 1990 represents the net system transport. With those assumptions, the gross east to west transport of sediments is about 45,000 m^3 per year. The gross west to east transport is about 90,000 m^3 per year with a net accumulation of 45,000 m^3 on the west side of the causeway. This material buildup on the west side of the causeway is causing two problems: the beaches down drift are being starved of material and the current patterns caused by the construction of the causeway are sending material off shore, which is accumulating southwest of the tip of the causeway. This material buildup has caused wave defraction, focusing waves around the causeway and to the docks. The increased buildup of this bar will eventually make the docks on the causeway usable only under the calmest wave conditions.

The preferred alternative includes a sand bypass system that would transfer 15,000 to 45,000 m^3 annually to an area east of the proposed breakwater. The sand bypass would re-establish the natural sediment transport, replenish the down-drift beaches, and cease the building of the bar southwest of the end of the causeway.

6.7 Chemical Characteristics

The Nome area has a high mineral soil. This is seen with the high presence of gold and the levels of naturally occurring arsenic. Table EA-2 shows the results of the chemical analysis of the sediment and soil samples taken in December 1997 by Woodward-Clyde for the city of Nome. Copies of their report and analysis are available through the Alaska District upon request. Copies of the report were sent to EPA Region 10 and the Department of Environmental Conservation. Table EA-2 shows the chemical compounds and heavy metals of concern and their screening levels. Alaska has not established screening levels, but the Alaska District, EPA, and the Alaska Department of Environmental Conservation have agreed to use the screening levels established by the State of Washington. Screening levels are concentrations of chemical compounds or heavy metals that have shown adverse effects to aquatic organisms and may adversely affect organisms at the proposed open-water disposal site. These levels are used as a benchmark and do not indicate that the material is not suited for open-water disposal. If the chemical analysis indicates one or more of the compounds of concern are above screening levels, bioassays, as described in the Ocean Dumping Manual, are performed. If the proposed dredged material passes the bioassays, the material can be disposed of in an open- water disposal site no matter what the chemical concentrations. The Alaska District found soils in the harbor turning basin that exceeded screening levels for arsenic (180 mg/kg). Bioassays were performed and the material was deemed not suitable for open-water disposal. The material was placed in a subaqueous disposal site and capped with 1 meter of clean material. Since the concentrations of arsenic are similar (higher) than the concentrations encountered in the turning basin, there is no reason to believe that the material would perform any differently in bioassays.

As explained in the Alternatives Section, the subsurface contaminated material is located on a hardpan layer, where the heavy metal can not migrate any further. The depth of the layer is not known, but the drill logs did not indicate elevated arsenic on the samples above. The Alaska District is taking a conservative approach and estimates a 0.5-meter layer of contaminated material that follows along the top of the hardpan. Drill logs from the causeway encountered the same layer at depths comparable to those encountered by Woodward-Clyde. These areas were mapped and quantities were derived for the channel excavation. The material in the Snake River, where the surface sediment was contaminated, was also included in the estimate. Approximately 25,000 m^3 of material with elevated arsenic would be specially handled for dredging and dredged material disposal.

The chemical analysis also showed levels of mercury above screening levels. The two mercury hits appear to be isolated. These two pockets of contaminated material would also be specially handled for dredged and disposal operations. Both these sites are above mean lower low water and would be easy to handle and dispose of.

The two semivolatile organic compounds benzo(a)pyrene and dibenzo(a,h)anthracene were found in the same samples as the elevated mercury samples. This probably indicates petroleum hydrocarbon contamination. The semivolatiles may dissipate during dredging and disposal, but since they are associated with the mercury contamination, the soils would be specially handled for dredging and disposal.

The existing entrance channel is the proposed disposal site for the contaminated material and the sediments from the Snake River. Since there must be a connection between Norton Sound and the harbor/Snake River, there must always be a channel. The contaminated material would have to be double handled. The material would first be excavated and placed in a lined temporary facility located on the spit. When the new channel was completed through the spit, clean material would be placed at both ends of the existing entrance channel. Geotextile fabric would be placed on the bottom and sides of the channel. The contaminated material would be placed in the lined disposal area and filled with at least 1 meter of clean cover. The area would be platted; no construction activities would be allowed in the area that would compromise the integrity of the cap. The Alaska District and EPA Region 10 will design a monitoring program and a contingency plan.

The use of lined and capped disposal sites for contaminated dredged material is not uncommon. The Alaska District performed similar operations with the contaminated dredged material in the turning basin and for the contaminated dredged material from the Wrangell Small Boat Harbor. There are numerous similar sites in the Pacific Northwest and other locations in the lower 48 states.

6.8 Terrestrial Communities

Seward Peninsula and to a lesser extent, the Nome area, supports a variety of seabirds, waterfowl, passerines, and raptors. The project area has minimal bird activity. Shorebirds are common along the margins of Snake River at the project site. Gulls are present throughout the project area and cormorants regularly perch on the jetties. The proposed action would increase the cormorant resting sites; would have no impact, either positive or negative on gulls; and would decrease the amount of shorebird habitat by the width of the entrance channel. These impacts are minor and would not affect either populations or individual birds or species.

The project site is in an area designated as industrial by the city of Nome. There is no regular terrestrial mammal use of the project area.

6.9 Marine Communities

The marine environment at the proposed project site has been altered with the construction of the causeway. A net transport of sand from west to east along the shoreline occurred prior to the construction of the causeway. Bottom sands were constantly being moved; the total transport of material at the project site of 90,000 m^3 to the east and 45,000 m^3 to the west (net transport of 45,000 m^3 to the east). Since the construction of the causeway, about 300,000 m^3 of sand has accumulated adjacent to the causeway. The sediments to the west of the causeway have stabilized somewhat; however, there has been a net loss of material in the past 7 years. The unstable sands probably limited the number and diversity of marine invertebrates present at the site.

The proposed project features would alter the existing substrate to the following:

Feature	Hectares
Main Breakwater	3
Entrance Channel (from 0 MLLW seaward)	10
Dock Approach	2.5
Spur Breakwater	0.5
Sediment Basin	3
TOTAL	19

Construction of the main and the spur breakwaters would change a sandy, flat bottom substrate to a rocky habitat reaching from subtidal to uplands. The breakwaters would provide considerably more surface area for attachment of flora and fauna. Rocky substrate is scarce in the Nome area, with the exception of the causeway that provides similar habitat.

Dredging the entrance channel, sediment basin, and dock approach would not change the sediment type appreciably, but would change the depth. Marine organisms adjusted to living at certain depths may not be able to recolonize the same area. However, the depth changes are relatively minor, and little change in species assemblages are anticipated. There may be a minor loss in overall productivity in the area because of dredging. The sediment management basin would be maintenance dredged annually. For all practical purposes, this 8 acres would be lost to production. Dredging would occur after mid-June because of the no-dredging window for juvenile salmon. Any marine organisms that metamorphose from zooplankton and fall out onto the sediment in the project area would be lost with the dredging.

6.10 Socio-Economic Impacts

Nome is a regional center for trade, health care, and education for 26 outlying communities in the Bering Strait-Norton Sound area. It is also home port to a commercial fishing fleet. In addition, a vital commercial transportation fleet of more than 40 vessels regularly use the harbor and the causeway structure. The proposed navigation improvements at Nome would allow the harbor to accommodate the increasing numbers of fishing vessels and would contribute to the future economic growth of Nome.

On 11 February 1994, Executive Order 12898, Federal Actions to Address Environmental Justice in Minority and Low-Income Populations was issued. The purpose of the order is to avoid the disproportionate placement of Federal actions and policies having adverse environmental, economic, social, or health effects on minority and low-income populations. Based upon an analysis 1990 U.S. Census data, over 50 percent of the population of Nome is Alaska Native.

Construction of the proposed harbor would have both beneficial and detrimental effects on the entire population of Nome, not just on one demographic or economic group. The harbor would not be sited in a low income or minority area of town. It would be in an area designated for industrial development. Contrary to resulting in a disproportionate placement of adverse environmental, economic, social, or health effects on minority and low-income populations, the proposed action would result in economic and social benefits to the local community as a whole.

On 21 April 1997, Executive Order 13045, Protection of Children From Environmental Health Risks and Safety Risks was issued to identify and assess environmental health and safety risks that may disproportionately affect children. The proposed action would affect the community as a whole. No environmental health or safety risks associated with the action would disproportionately affect children.

7.0 ALASKA DISTRICT QUARRY POLICY

The Alaska District policy is to not designate rock quarries for civil works projects. The construction contractor is responsible for providing rock for the project. The rock must meet physical requirements as well as follow environmental criteria. If the construction contractor selects a quarry that is not defined as existing, all environmental analysis must be accomplished prior to any quarry work being started. Since contractor must complete the project within a set period of time, (starting from the award of the contract) any extended delays in quarry and quarry facility authorization cause the project completion date not to be met. Severe penalties (usually monetary) accompany failure to meet project completion dates.
Impacts expected from an existing quarry depend on the characteristics of the surrounding area, the site, the method of operation, the length of time of operation, and many other factors. By assuming the use of an already existing quarry as a rock source, however, a large portion of potential impacts are avoided that could be severe if an undeveloped area were opened for quarry use. Impacts expected from using an existing quarry can be classified into six categories based on activity: blasting, burning, clearing, processing, solid waste disposal, and grading/plowing. Table EA-4 displays the relationship between the operations and the environmental resources of interest. An "X" implies that interaction between the resource of interest and the operation could result in an impact; a "#" indicates that the potential impact is not relevant to that resource category; and a blank space indicates no impact.

7.1 Resources of Concern

The operation and small-scale expansion of a quarry may cause impacts to highly valued habitat types, species, or institutional holdings, which could preclude use of the site. A list of 14 "Resources of Concern" was developed through discussions between the Alaska District and the U.S. Fish and Wildlife Service.

This list was designed to indicate those resources which, if threatened with impact from quarry use or expansion, would remove the quarry site from consideration until a detailed, site-specific environmental review could be accomplished. Table EA-5 lists the "Resources of Concern" which, if present, would require additional environmental review. This list is not meant to be all-inclusive.

Table EA-4. Relationship of Quarry Operations to Selected Natural Resources

RESOURCE	Blasting	Burning	Clearing	Mineral Processing	Solid Waste Disp.	Grading or Plowing
Marine Mammals						
Beluga Whale	X				#	#
Bowhead Whale	X	#	#		#	#
Harbor Seal	X	#	#			
Pacific Walrus	X	#	#			
Polar Bear		#	#		X	#
Ringed Seal	X	#			#	#
Sea Otter	X	#	#		#	#
Steller Sea Lion	X	#	#		X	
Terrestrial Mammals						
Brown Bear	X	X	X		X	X
Black Bear	X	X	X		X	X
Dall Sheep	X		X	X	X	X
Furbearers	X	X	X	X	X	X
Moose	X	X	X			X
Sitka Blacktailed Deer			X	X		X
Birds						
Bald Eagle	X		X	X	X	X
Ducks		X	X	X	X	X
Geese	X			X	X	
Sea Birds	X			X	X	X
Trumpeter Swan				X	X	X
Water Disturbance						
Silt/Sedimentation	X			X	X	
Shock Wave	X					
Water Pollution						
Suspended Sediment				X		
Oil/Fuel Spills				X		
Land Surface Disturbance						
Vegetation Clearing/Destruction		X	X			
Slash/Overburden		X	X			
Overburden Erosion			X			

X = Interaction between the resource and the operation could result in an impact.

= The potential impact is not relevant to this resource category.

Table EA-5. Resources of Concern in Quarry Operations

Anadromous Fish Streams
Areas Meriting Special Attention (as defined by the Coastal Zone Management Act)
Bald Eagle Nests
Critical Habitat (as defined by Alaska Statute Title 16)
Historic and Prehistoric Areas
Marine Mammal Breeding and Haul-Out Areas
Rare or Endangered Species
Sea Bird Rookeries
State or National Parks, Refuges, or Monuments
Wetlands (including inter- and subtidal habitats) and Flood Plains
Wild and Scenic Rivers

Once an area has been committed to a quarry, these methods of operation could aid reclamation:

a. Restore the site to the original or similar condition as quickly as possible.

b. Design working methods to take as little of the most valuable land at one time as possible.

c. Concentrate extraction into large units in areas where conflicts with other land uses are less severe or absent altogether.

7.2 Geology

Quarries are generally accepted as open-cast excavations from which fairly massive and deep deposits of hard or soft rock are extracted. The excavations are fairly deep and tend to work progressively outward and downward. For ease of working they are often on an escarpment or hillside, but they can be on hilltops or in flat land. Each requires a slightly different technique and working sequence. Stone quarries usually have deep pits and little overburden.

7.3 Surface and Ground Water

Runoff from disposal sites and the quarry area can contain significant amounts of sediment, which can enter streams and rivers. Levels of suspended solids in watercourses are categorized in terms of harm to fisheries as follows: 25 milligrams per liter (mg/L) solids - no harm; 26-80 mg/L solids - some harm; 81-400 mg/L solids - extensive; 400+ mg/L solids - severe.

In many pits and quarries, processing water and/or runoff water from operations that contain sediment is passed through settling lagoons before it is recovered or allowed to enter watercourses.

The development of sub-watertable operations in large quarries will mean that large quantities of water may have to be pumped away from the excavation. This water may contain significant levels of sediment. In addition, the quarry may affect the ground-water flow; this is particularly important in limestone aquifers.

An additional source of water pollution from mineral extraction is the contamination of runoff and streams by spillage of fuel oils, lubricants, detergents, etc., from fixed and mobile plants. These are not often a major hazard, however, and can be controlled by careful drainage and containment around likely trouble spots. A fuel spill contingency plan would be a likely requirement at any existing quarry, as would a sewage and wastewater plan.

7.4 Aquatic Environment

The aquatic environment in an existing quarry area could be subject to water pollution effects as stated above. Stream channelization and the construction of roads requiring culverts have the potential to affect aquatic environmental quality.

7.5 Vegetation

Vegetation would be cleared and the top soil stockpiled for future revegetation at most quarry sites. The vegetation would be either removed by machinery or burned. Timber could be harvested and sold. The lack of vegetative cover can increase erosion and greatly increase the sediment runoff. Sidehill excavations are not conducive to revegetation, and quarry sites that are continually active may not be revegetated.

7.6 Wildlife

Quarry operations displace wildlife from the area. The change of habitat, lack of vegetation noise, and land-altering activities are usually too disruptive for wildlife presence within a certain radius of the facility. Adjacent habitat may not be fully utilized because of disturbances caused by noise and the proximity of people.

7.7 Air Quality and Noise

There are no defined nuisance levels for dust and particulates, but emissions can be subject to control limits. Dust deposition, however, can harm vegetation; dust particles block the leaf pores and affect rates of gas exchange in the leaf, which can make the leaves more susceptible to other forms of gaseous pollution. Major sources of dust pollution in quarries and the control measures possible for them are listed in table EA-6.

Table EA-6. Major Sources of Dust Pollution in Pits and Quarry Workings, and Possible Remedial Measures

DUST SOURCE	CONTROL MEASURES
Drilling	1 Collect dust by dry cyclone and filters 2 Suppress dust by water and/or detergent
Blasting	1 Suppress dust by water sprays 2 Consider expected atmospheric conditions before charging and blasting
Loading and Unloading	1 Suppress dust by automatic or manual water sprays (with detergent) 2 Enclose loading or unloading area, where practicable
Mobile Equipment	1 Surface internal roads 2 Direct exhausts upward 3 Suppress dust by water sprays and additives 4 Collect dust by road sweeper 5 Choose a different route 6 Cover loads of fine material
Fixed Plant (crushers, screens, conveyors, etc.)	1 Enclose machinery 2 Suppress dust by water sprays 3 Use collectors (bag, wet or dry centrifugal, electrostatic, etc.)
Dust Blow	1 Enclose stockpiles 2 Revegetate waste dumps 3 Suppress dust by water sprays 4 Collect dust by road sweeper

Noise levels outside the quarry site may become a nuisance to nearby people and to wildlife. Blasting vibration and air and water blast can also constitute a nuisance, and may cause minor damage to buildings and adversely affect wildlife. Banks, barriers, and screens around the quarry, plant, and major vehicle routes will greatly reduce any nuisance from noise and vibration. Careful sitting and shaping are necessary for the noise barrier to be effective. The major sources of noise and their control measures are listed in table EA-7.

7.8 Cultural Resources

Use of an existing quarry site would not affect cultural resources. If an archeological site is uncovered during excavations, an immediate evaluation would be required and measures taken to recover the information or close the quarry.

Table EA-7. Major Sources of Noise and Vibration in Pits and Quarry Workings, and Possible Remedial Measures

SOURCE	REMEDIAL MEASURES
Air Blast	1 Cover detonating fuse with dust, chipping, etc. 2 Use low-energy detonating fuse or eliminate 3 Use drop ball to eliminate secondary blasting 4 Consider expected atmospheric conditions before
charging	and blasting
Blasting Vibrations	1 Restrict maximum instantaneous detonated 2 Optimize blast-hole geometry 3 Alter time and frequency of blasting 4 Consider ripping in softer formations
Mobile Equipment Noise	1 Select vehicle routes carefully 2 Fit efficient silencers and enclose compartments 3 Damp mechanical vibrations 4 Erect bank, screen, or barrier
Fixed Plant Noise	1 Reduce noise at source by damping treatment, etc. 2 Isolate source by enclosure in building, room, etc. 3 Carefully select fixed plant site 4 Erect bank, screen, or barrier close to noise source or receiver

7.9 Visual Resources

The visual intrusion of quarry excavations varies according to the location, type of excavation, and proximity to population centers. Those on hillsides and hilltops may cause severe visual intrusion; those in shallow pits or flat areas may have less of a visual impact. Often, it is spoil mounds, waste disposal areas, and processing plants that cause problems. Shallow pits in flat areas, which either are worked progressively or have little overburden and spoil, do not usually make much visual intrusion into the landscape. At long-established quarries, remedial work is often limited to cosmetic treatment; with new developments, methods of reducing visual intrusion can be considered from the earliest planning stages.

Since spoil and waste areas can present visual intrusion problems, they require careful sitting and landscaping. In many cases, solid wastes can be used to advantage in constructing screening dikes, infilling, reclaiming poor-quality land near the quarry (i.e., improving drainage and ground levels), backfilling excavations, etc. Other problems can include dust-blow contamination of runoff water and sterilization of land.

Table EA-8 summarizes the main causes of visual intrusion from quarry operations and the possible remedial measures.

7.10 Socio-economic

Depending upon the location and size of the quarry operation, local economies can greatly benefit. The quarry employs people from nearby settlements and contributes to the cash flow of the economy. Sometimes the quarry operation provides food and housing for its employees and therefore is less of a boon to the local economy. Quarry products are usually transported by truck or barge. In an urban area, traffic patterns, safety, and nuisance factors like dust and noise are considerations.

7.11 Wilderness

Stone quarries are often located in upland areas important for their scenic or scientific value, creating land use conflicts. A long-term land use commitment to quarry development is assumed to have been made in view of the possible wilderness values in an area. Once the quarry has been depleted, reclamation is possible to return the land to natural processes.

Table EA-8. Main Causes of Visual Intrusion of Quarry Workings, and Possible Remedial Measures

SOURCE OF VISUAL INTRUSION	REMEDIAL MEASURES
Quarry Faces and floor working	1 Selection of site 2 Choice of direction, method, and rate of 3 Screening by banks, trees, etc.
Waste Disposal Areas (banks, infilling, old	1 Choice of dump site 2 Use of waste for amenity purposes quarries, etc.) 3 Landscaping 4 Method of deposition 5 Screening
Stockpiles	1 Selection of location 2 Enclosure 3 Screening
Mobile Equipment	1 Choice of haul routes 2 Screening 3 Camouflage undesirable for safety reasons
Fixed Plant and Buildings	1 Site selection 2 Enclosure and use of unobtrusive colors 3 Low profile 4 Screening
Road and Rail Access Points	1 Site selection 2 Screening 3 Landscaping
Dust Plumes	1 Suppression 2 Collection

8.0 PREPARERS OF THIS DOCUMENT

The environmental assessment was prepared by Mr. John Burns, Environmental Resources Section, Alaska District, Corps of Engineers. Mr. Guy McConnell, biologist, and Ms. Diane Walters, writer-editor contributed to the content and editing of this document. The study manager is Mr. Will Appleton, Project Formulation Section, Alaska District, Corps of Engineers.

9.0 CONCLUSION

Relocating a deeper, wider, and longer entrance channel to the inner harbor; constructing a 3,000 foot-breakwater to provide wave protection to the dock facilities; and establishing a sediment management program would not cause significant impacts to the environment at Nome. The proposed action is consistent with the State of Alaska and the City of Nome Coastal Management programs to the maximum extent practicable. This assessment supports the conclusions that the proposed project does not constitute a major Federal action significantly affecting the quality of the human environment; therefore, a finding of no significant impact will be prepared.

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APPENDIX EA-1

SECTION 404(b)(1) GUIDELINES EVALUATION UNDER THE CLEAN WATER ACT

<u>Section 404(b)(1) Guidelines for the Specification of Disposal Sites for Dredged or Fill Material 40 CFR Part 230</u>

SUBPART A - GENERAL

Dredged or fill material should not be discharged into the aquatic ecosystem unless it can be demonstrated that such a discharge will not have an unacceptable adverse impact, either individually or in combination with known and/or probable impacts of other activities affecting the ecosystems of concern.

The Guidelines were developed by the Administrator for the Environmental Protection Agency (EPA) in conjunction with the Secretary of the Army acting through the Chief of Engineers under Section 404(b)(1) of the Clean Water Act (33 U.S.C. 1344). The Guidelines are applicable to the specification of disposal sites for discharges of dredged or fill material into waters of the United States (U.S.).

In evaluating whether a particular discharge site may be specified, the following steps should generally be followed: (a) review the restriction on discharge, the measures to minimize adverse impacts, and the required factual determinations; (b) examine practicable alternatives to the proposed discharge; (c) delineate the candidate disposal site; (d) evaluate the various physical and chemical components; (e) identify and evaluate any special or critical characteristics of the candidate disposal site and surrounding areas; (f) review factual determinations to determine whether the information is sufficient to provide the required documentation or to perform pre-testing evaluation; (g) evaluate the material to be discharged to determine the possibility of chemical contamination or physical incompatibility; (h) conduct the appropriate tests if there is a reasonable probability of chemical contamination; (i) identify appropriate and practicable changes in the project plan to minimize the impact; and (j) make and document factual determinations and findings of compliance.

SUBPART B - COMPLIANCE WITH THE GUIDELINES

The proposed navigation improvements at Nome would involve discharges of fill material into special aquatic sites and other waters of the U.S. for the placement of the breakwater and the filling of the existing entrance channel into the Snake River harbor. A description of the proposed action and alternatives considered can be found in section 4 of the attached environmental assessment (EA). There are no practicable alternatives to the proposed discharge (preferred alternative) that would accomplish the project's purpose and need and not result in a discharge into a water of the U.S. or have a less adverse impact on the aquatic ecosystem. Therefore, the proposed action is considered the least damaging practicable alternative. The existing channel will be filled because a new channel into the harbor is being constructed at a different location.

As determined in Subparts C through G of this evaluation and as discussed in the EA, the proposed project would not contribute to significant degradation of the waters of the U.S., including adverse effects on human health or welfare, life stages of aquatic life and other wildlife dependent on aquatic ecosystems, aquatic ecosystem diversity, productivity and stability, and recreational, aesthetic, and economic values. In addition, the discharge of fill materials associated with the proposed action complies with the requirements of the guidelines with the inclusion of appropriate and practicable discharge conditions (see Subpart H below) to minimize pollution and adverse effects to the affected aquatic ecosystems.

SUBPART C - POTENTIAL IMPACTS ON PHYSICAL AND CHEMICAL CHARACTERISTICS OF THE AQUATIC ECOSYSTEM

Applicable information about direct, indirect and cumulative environmental impacts of the proposed action and alternatives related to substrate, suspended particulates/turbidity, water, current patterns and water circulation, and normal water fluctuations is contained in sections 5 and 6 of the EA. Adverse impacts to these characteristics are expected to be relatively minor. Work would result in minor increases in turbidity levels during periods of work, and minor changes to existing current patterns in the immediate project area. No appreciable adverse effects are anticipated to occur.

SUBPART D - POTENTIAL IMPACTS ON BIOLOGICAL CHARACTERISTICS OF THE AQUATIC ECOSYSTEM

Pertinent information about direct, indirect, and cumulative impacts of the proposed action and alternatives related to threatened and endangered species, fish, aquatic organisms, and other wildlife is contained in sections 5 and 6 of the EA. Adverse impacts resulting from the discharge of dredged and/or fill materials are expected to relatively minor. Work would result in direct impacts to 19 hectares of marine habitat, and a reduction in the net productivity of the site. Threatened and endangered species would not be affected.

SUBPART E - POTENTIAL IMPACTS ON SPECIAL AQUATIC SITES

The proposed action would adversely affect eelgrass beds, a special aquatic site as defined by 40 CFR 230.43. Discussions about impacts on functions and values associated with the proposed work are found in sections 5 and 6 of the EA.

SUBPART F - POTENTIAL EFFECTS ON HUMAN USE CHARACTERISTICS

Human use characteristics affected by the proposed project include fisheries, aesthetics, and recreation areas. Pertinent information about potential impacts of the proposed work on human use characteristics can be found in sections 5 and 6 of the EA. The proposed harbor facilities would contribute to the future growth of Nome fishery and the increased ability to service the 28 communities who rely on goods and services from Nome. The proposed action would also indirectly have a positive benefit with the filling of the existing entrance channel that has been the location on several drowning deaths. The existing channel is sheet-pile lined with no access to the shore. Several people have fallen into the entrance channel and were unable to get out. The proposed action would increase employment opportunities both during construction and by accommodating a larger fleet, and have minimal adverse affects on human use characteristics.

SUBPART G - EVALUATION AND TESTING

The sediments along the entrance channel have been tested for chemical contamination. A layer of arsenic was found within the area to be dredged. The material appears to be a continuous layer and it appears that it is present along the entire spit. A conservative estimate of 20,000 cubic meters of the contaminated material would be disposed of in a confined disposal site at in the existing entrance channel. A discussion of the handling and disposal of the contaminated material is in section 5 of the EA.

SUBPART H - ACTIONS TO MINIMIZE ADVERSE EFFECTS

The project as proposed, contains all appropriate and practicable mitigation measures to minimize adverse environmental effects. Actions proposed to minimize potential adverse effects for the proposed action are listed below:

- Designing the harbor to maximize the number of vessels that it can safely accommodate, while minimizing the project footprint.

- Conducting in-water work between April 15 and June 15 to help reduce potential adverse impacts to fish..

- Coordinating construction of the harbor with the city of Nome to avoid conflicts with subsistence fishing and commercial activities.

- Development of a quarry development plan that would include limits on construction, disposal of quarry waste, necessary access and traffic routes, quarry rock stockpile area(s) and other stockpile areas for material to be used for quarry restoration. The plan would also include measures to control erosion and minimize adverse impacts from stormwater runoff. A coordinated agency review of the plan would be conducted, thus providing the opportunity for State and Federal agencies to place stipulations on the use of the quarry site.

APPENDIX EA-2

U. S. FISH AND WILDLIFE COORDINATION ACT REPORT

Nome Harbor Navigation Improvement Project
Nome, Alaska

Final
Fish and Wildlife Coordination Act Report

Prepared by: Marcia Heer

U.S. Fish and Wildlife Service
Anchorage Field Office
605 W. 4th Ave., Rm G-62
Anchorage, Alaska 99501

June 1998

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Summary

This report constitutes the U. S. Fish and Wildlife Service's (Service) final Fish and Wildlife Coordination Act Report on the U. S. Army Corps of Engineers' (Corps) Navigation Improvements Study at Nome, Alaska. The purpose of this Report is to provide the Corps of Engineers with planning information to discuss the presence of significant fish and wildlife resources likely to be affected by improvements to the Nome Boat Harbor; define the fish and wildlife resource problems and opportunities that should be addressed by the study; define the potentially significant impacts that could result from meeting other study purposes and objectives; and highlight potentially significant fish and wildlife issues or concerns.

This report is prepared in accordance with the Fiscal Year 1997-98 Scope of Work and the Fish and Wildlife Coordination Act (48 Stat. 401, as amended: 16 U.S.C. 661 et seq.). This document constitutes the final report of the Secretary of the Interior as required by Section 2(b) of the Fish and Wildlife Coordination Act.

The following report is based on information provided by Corps' project biologist John Burns. Biological data and impact assessment are based on a literature review, an assessment of potential impacts known to fish and wildlife resources, coordination with the Corps Environmental Resources Branch, Alaska Department of Fish and Game, National Marine Fisheries Service, Nome residents, and a 1997 field investigation.

The Service believes the harbor navigation improvements can occur in Nome without significantly affecting chum and coho salmon, provided the mitigation measures included in the design plans for Alternative 2 and our recommendations are incorporated into the project to offset impacts and habitat losses.

Introduction

The Alaska District of the U.S. Army Corps of Engineers (Corps) proposes to improve navigation to the boat harbor in Nome, Alaska. The Corps has identified three build alternatives to relocate the channel entrance and one alternative to repair and maintain the existing channel.

Formal project coordination between the Corps and the Service was initiated during the summer of 1997. In September 1997, a Service biologist traveled to Nome to conduct a preliminary site investigation.

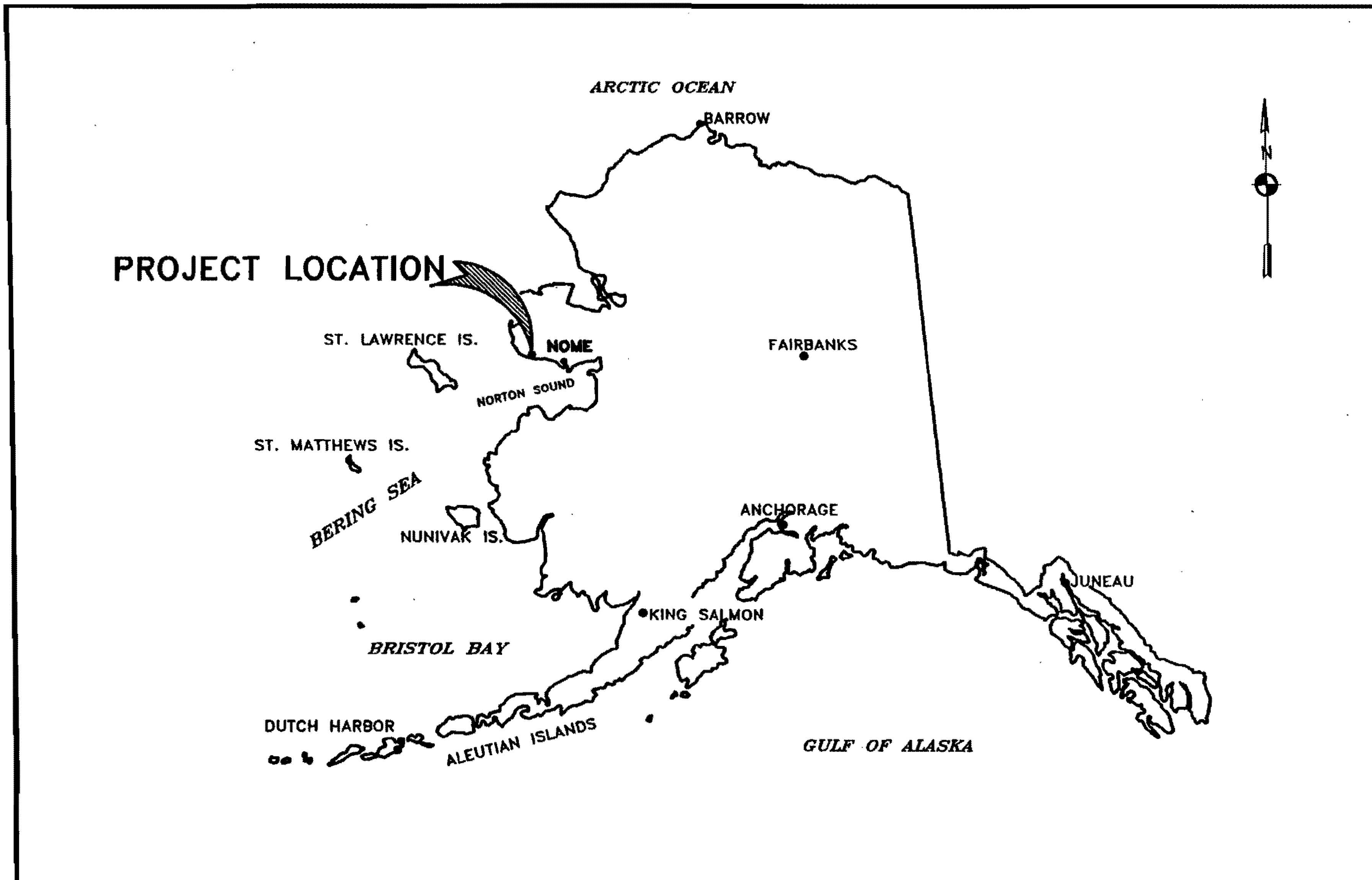
This Fish and Wildlife Coordination Report represents the Service's biological investigation and impact assessment of the four alternatives for improving navigation to the Nome Harbor. This report will discuss fish and wildlife resources in the project area, describe in detail the potential adverse impacts of project alternatives, and recommend measures for mitigating those impacts.

Study Area

Nome, located on the south coast of the Seward Peninsula in northwestern Alaska, is approximately 535 air miles northwest of Anchorage (Figure 1). It is situated on a gently rising plain in the northwestern portion of Norton Sound, an arm of the Bering Sea. The soils of Nome and surrounding areas are of glacial origin that were deposited by early-pleistocene glaciers which overlay older marine deposits of silt and clay (Tetra Tech 1981). Soils in the Nome Harbor consist of silty sands with some gravel at greater depths. Almost all of the Seward Peninsula is underlain by permafrost. Terrain in the vicinity of Nome is poorly drained in many areas.

Nome's climate ranges from a maritime climate in the summer to a continental climate when Norton Sound freezes in the winter. Summer temperatures average 50 degrees F in July and 5 degrees F in January. During the summer, winds generally blow from the southwest and west. During winter months, winds usually arrive from the north and east. Average winds have a speed of 9.6 knots. The average annual precipitation for Nome is 16.44 inches. The most precipitation usually occurs from July-September.

The waters offshore of Nome are quite shallow for substantial distances. A depth of approximately 16 feet below mean lower low water (MLLW) occurs 400 to 600 feet from the shoreline. The water does not reach depths of 80 feet or greater until 25,000 to 28,000 feet from shore (COE 1974). Tides range between -0.5 and +2.5 feet throughout the year. Storm tides within the harbor reach +10 feet or greater. Water levels in this area are more influenced by winds than tidal action.



ALASKA DISTRICT
CORPS OF ENGINEERS
CIVIL WORKS BRANCH

LOCATION AND VICINITY MAP

NAVIGATION IMPROVEMENTS, NOME, ALASKA

FIGURE 1

This project would require dredging a total of approximately 500,000 m^3 of material mainly classified as sand. The dredged material would be disposed of on the sand spit and in the existing entrance channel. If dredged materials exceed available space requirements at the sand spit and existing entrance channel, leftover material will be disposed of at an upland site or at the authorized EPA disposal area located east of the existing entrance channel.

Alternative 3, Curved Channel with Spending Beach

This alternative involves locating the entrance channel in approximately the same area and alignment as the existing channel (Figure 4). A spending beach would be created that would require the removal of approximately 20,000 m^3 of material directly behind the curve of the entrance channel. The spending beach would be built to a 10:1 slope of 10,000 m^3 of rock, ranging from 0.5 kg. to 1,000 kg.

The Channel outside the existing jetties would be excavated to 50 m wide, 225 m long, and to a depth of -4.2 m. Approximately 10,500 m^3 of material would be dredged and placed in the EPA disposal site. Additionally, 1,700 m^3 would be excavated from the nose of the spit to round the channel approach. About 21,000 m^3 of material would be excavated to widen and deepen the channel from the spending beach to the turning basin. The sheet pile would be removed and replaced with new sheet pile except for the areas fronting the spending beach, and the existing jetties would be removed.

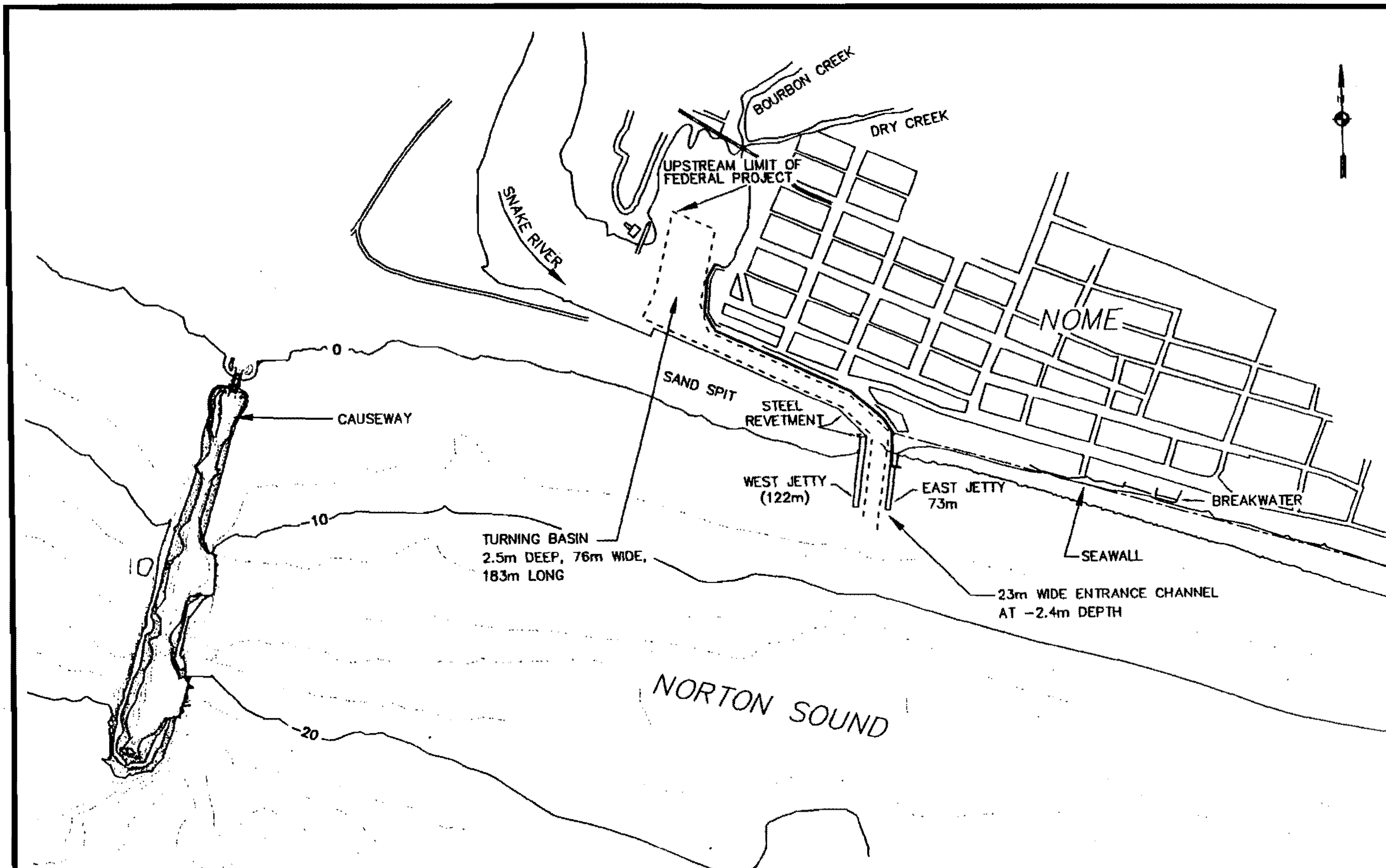
Alternative 4, Harbor Adjacent to Causeway

This alternative involves the development of a harbor on the east side of the existing causeway (Figure 5). The alternative was rule out because of abandonment of existing facilities at the inner harbor, major concerns regarding damage to vessels and the new harbor float that would be caused by long-period swell and ice forces, navigation conflicts between harbor vessels and vessels that use causeway docks, and exposure of vessels to higher energy waves and swells.

Fish and Wildlife Resources

Fish

Snake River supports chum, pink, coho, and occasionally king salmon; arctic char; round whitefish; grayling; burbot; Alaska blackfish; and stickleback (Lean, pers. comm., 1998). The river provides spawning habitat for coho, chum, and pink salmon (ADFG 1993). Dry Creek supports coho and pink salmon, Dolly Varden, Alaska blackfish, and stickleback (Bue, pers. comm., 1997). Rearing habitat in Dry Creek is available for coho salmon and Dolly Varden. Bourbon Creek supports Dolly Varden, Alaska blackfish, and stickleback. Waters within the lower section of Snake River and the inner harbor currently provide juvenile coho salmon with some deeper areas that are used for overwintering habitat. Burbot, grayling, stickleback, saffron cod, and Dolly Varden are also known to overwinter in this area.



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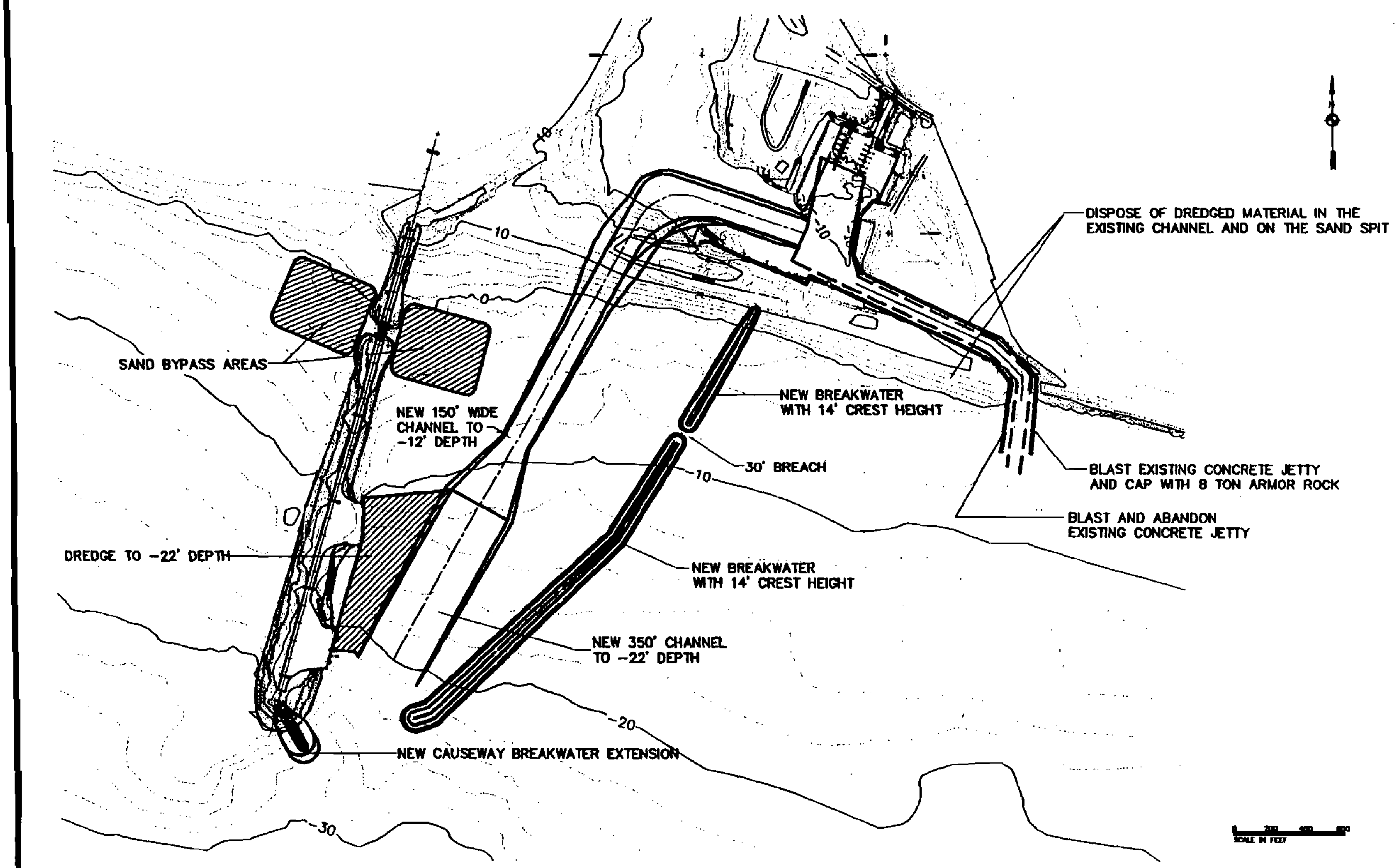
PROJECT AREA MAP
NAVIGATION IMPROVEMENTS, NOME, ALASKA

FIGURE 2



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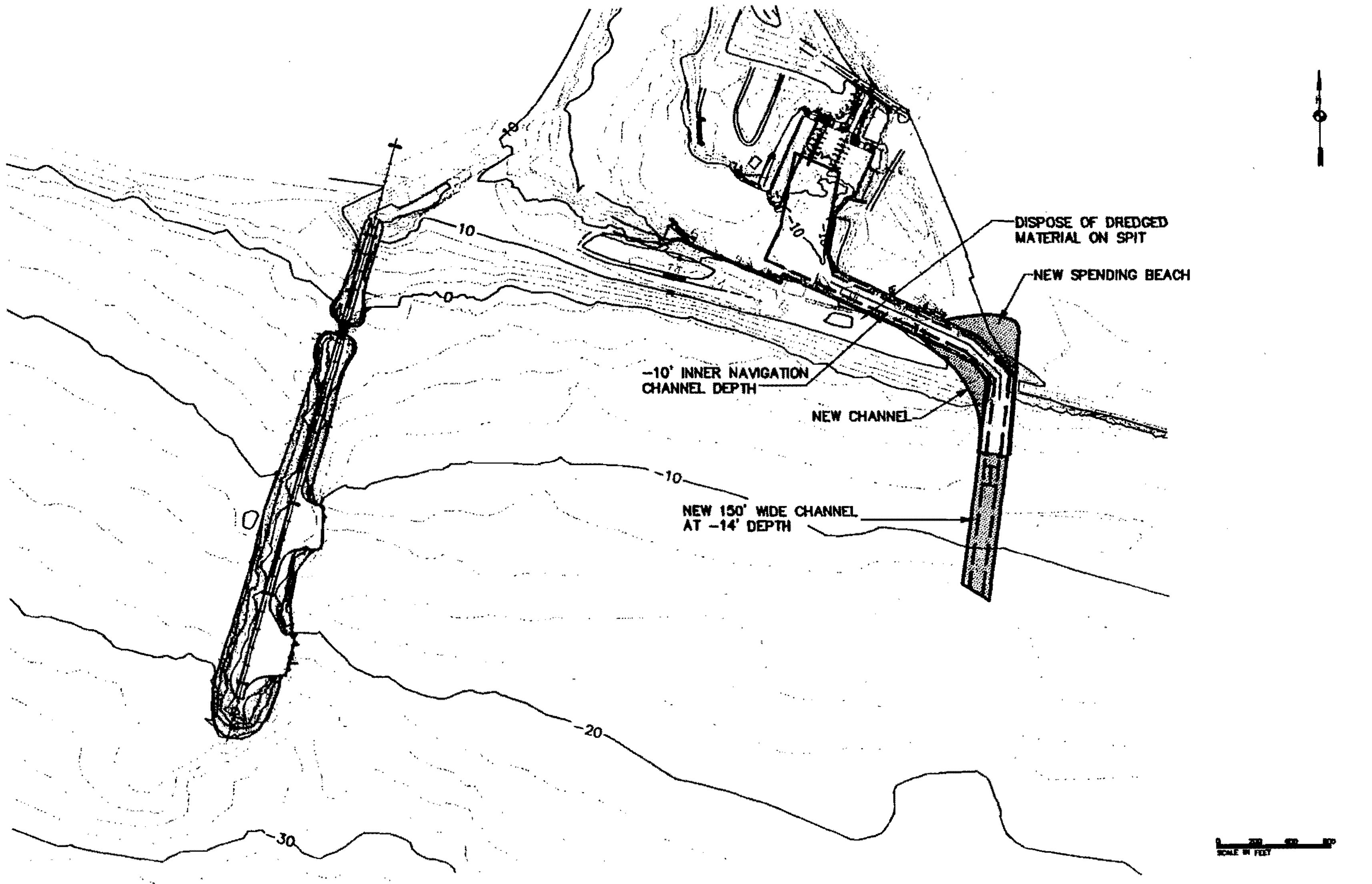
ALTERNATIVE PLAN 2
RECOMMENDED PLAN
NAVIGATION IMPROVEMENTS, NOME, ALASKA

FIGURE 3



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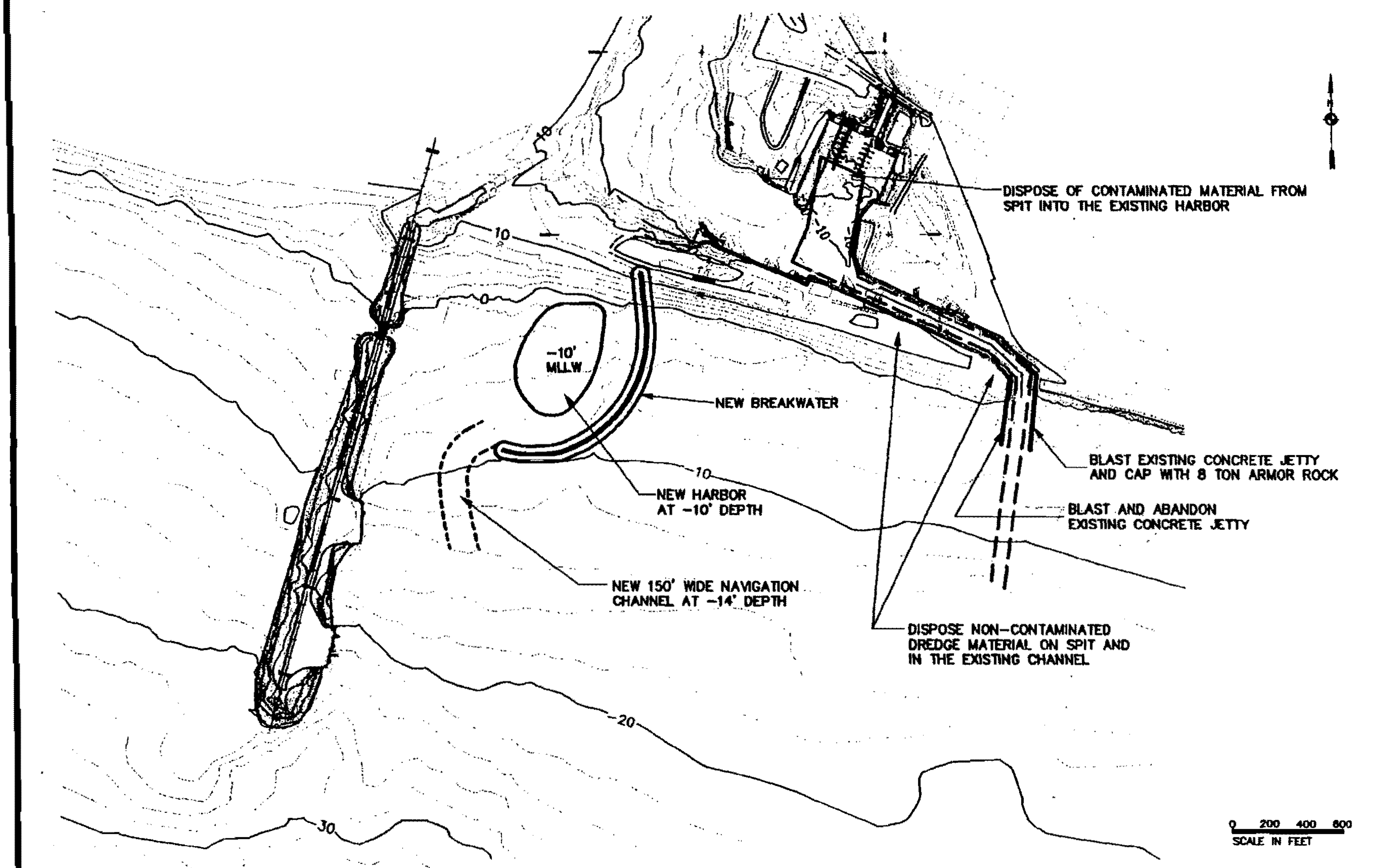
ALTERNATIVE PLAN 3
NEW CHANNEL NEXT TO EXISTING W/SPENDING BEACH
NAVIGATION IMPROVEMENTS, NOME, ALASKA

FIGURE 4



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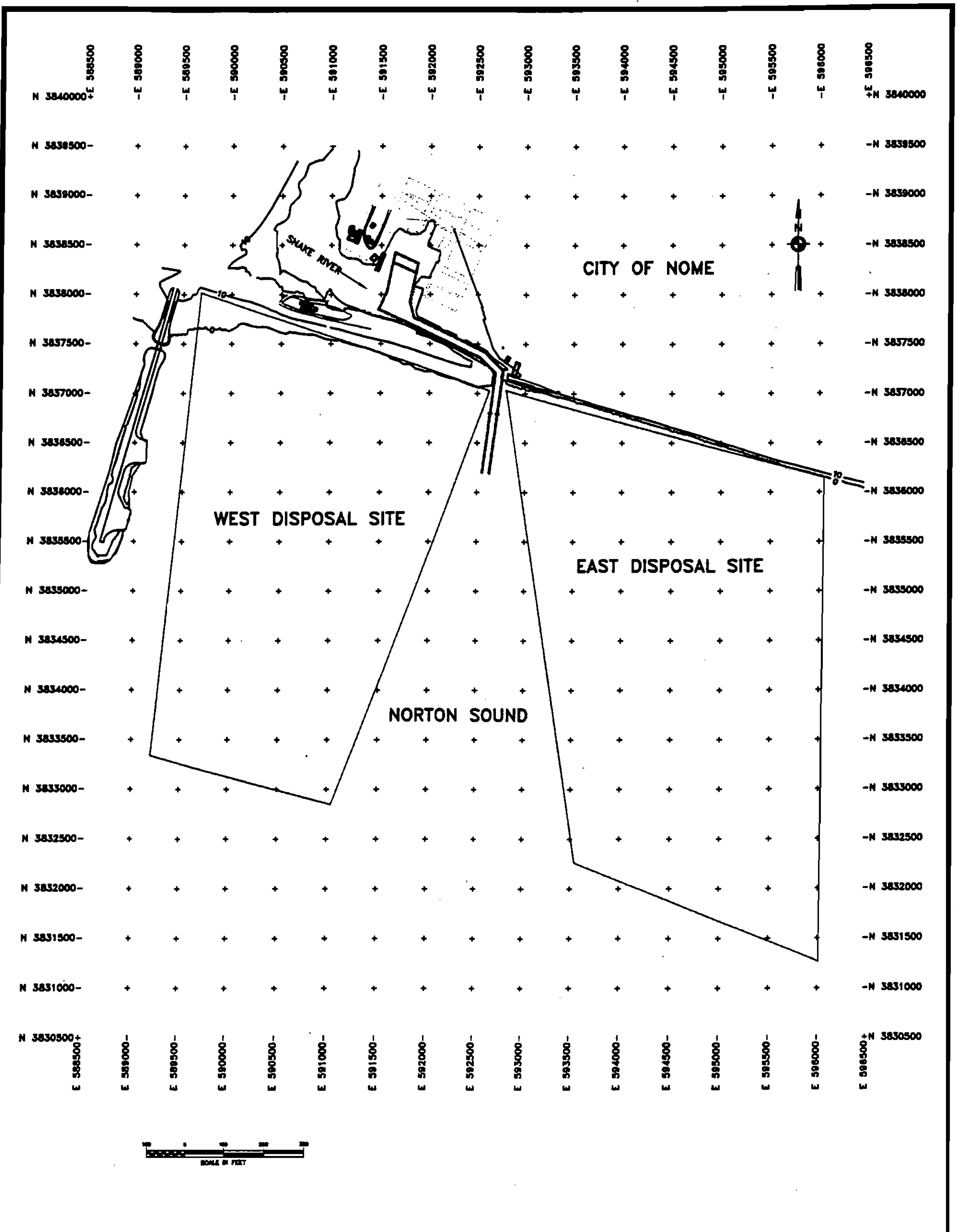
ALTERNATIVE PLAN 4
NEW CHANNEL OFF CAUSEWAY W/BREAKWATER
NAVIGATION IMPROVEMENTS, NOME, ALASKA

FIGURE 5



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EPA APPROVED
DISPOSAL SITES
NAVIGATION IMPROVEMENTS, NOME, ALASKA

FIGURE 6

The Snake River salmon surveys for 1997 (Lean, pers. comm. 1998) counted 6,184 chum, 6,742 pink (odd year count which is about 1/10 the size of an even year count), 12 king, and 1,157 coho (the count was incomplete, about 2/3 of the count was completed). This survey documented that the return of spawning chum, pink, and king salmon occurred between July 8 and August 7. The return of spawning coho salmon occurred between July 30 and August 31. The outmigration of juvenile salmon occurs from approximately mid-May to June 20.

Marine fish found in Norton sound include Arctic and saffron cod; starry flounder; toothed smelt; Pacific herring; Alaska plaice; yellowfin sole; plain, antlered, shorthorn, and arctic staghorn sculpin; slender eelblenny; sturgeon poacher; chinook, coho, sockeye, pink, and chum salmon; and steelhead trout (Wolotira, et. al. 1977). Juvenile Pacific herring and saffron cod are offshore of the Nome Harbor area from mid-May to mid-June.

Birds

Bird use of habitat in the proposed project area is relatively low due to surrounding development and human activity. However, birds documented (Harris, pers. comm., 1997) within or near Nome harbor include red-throated, pacific, and occasionally arctic loon; harlequin duck; king eider; pelagic cormorant; black-legged kittiwake; mew, glaucous, glaucous-winged, slaty-backed, and western gull; common and thick-billed murre; crested and least auklet; rufous-necked stint; western and semi-palmated sandpiper; common raven; McKay's and snow bunting; hoary and common redpoll; and white-wagtail. The birds use the habitat mainly for resting, feeding, and staging purposes; however, a pair of white wagtails use the large rocks at the causeway as habitat for nesting. Other species documented offshore of Nome include horned and tufted puffin, parakeet auklet, and pigeon guillemot (USDOI 1991).

Seabird occurrence in Norton sound is usually the highest from May to September. Migrant waterfowl feeding and staging use of coastal wetlands in the Norton Sound area reaches its peak during May and June and then again in August and September. High use by feeding shorebirds has been documented in some coastal wetlands during the month of May (USDOI 1991).

Mammals

Marine mammals that commonly occur in Norton Sound include the Pacific walrus; ringed, bearded, and spotted seal; and gray and beluga whale (USDOI 1991). Species that occur less frequently in Norton Sound include polar bear; ribbon seal; minke, killer and bowhead whale; and harbor porpoise (Frost, et. al., 1982).

Ringed seals are present in Norton Sound primarily during fall, winter, and spring, and migrate out of Norton Sound with the sea ice during the summer. Habitat conditions are favorable in Norton Sound from late November to late June for the bearded seal. Spotted seals

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occur throughout Norton Sound during the summer, especially in nearshore waters. An important spotted seal summer haulout area close to Nome is located on Safety Sound (Frost, et. al., 1982). During the winter, spotted seal are as close as 1-2 miles offshore on the ice.

Small numbers of migrating or feeding gray and bowhead whales (Burns, et. al., 1993) occur offshore of Nome from May through November and have been documented as close as 1 mile offshore. From late March to May, beluga whales move through Norton Sound. Beluga whales are common offshore of Nome, and throughout the summer, 1000-2000 whales occur in the nearshore waters of Norton Sound (Burns, et. al. 1985). The belugas feed on a variety of anadromous and coastal spawning fish such as salmon, smelt, herring, and saffron cod (Lowry 1984).

The tundra within the Nome area does not support abundant mammal populations; however, mammals that occur on the Seward Peninsula and occasionally have been observed near Nome include moose, brown bear, wolf, wolverine, arctic and red fox, mink, arctic ground squirrel, weasel, muskrat, arctic hare, mice, voles, and lemmings.

Invertebrates

Long term off-shore dredging near Nome has caused invertebrate species to decline in this area. It has been difficult for the benthic habitat to reestablish, because dredging actions have been occurring frequently. Studies indicate that the major invertebrate biomass found in samples offshore Nome include brittlestar (*Amphiodia craterodermata*); segmented worms such as *Haploscoloplos panamensis*, *Teribellides stroemii*, and *Myriochele heeri*; and mollusks such as *Astarte borealis*, *Macoma brota*, *Yoldia hyperborea*, *Turritella sp.*, and *Margarites helicinus* (Hood et.al., 1974). Both red king and tanner crab species occur within this area of Norton Sound. High concentrations of red king crab were documented offshore of Nome in 1976 surveys (Wolotira, et. al. 1977).

Threatened and Endangered Species

Spectacled eider:

Spectacled eiders were listed as a threatened species under the Act on May 10, 1993. Breeding spectacled eiders are most abundant in areas with extensive wetlands. In North America, this species nests on the Yukon-Kuskokwim Delta, possibly on the Seward Peninsula, and across the arctic coastal plain of northern Alaska. Most of the world's population, however, nests in arctic Russia. The population on the Yukon-Kuskokwim Delta in Alaska declined more than 90% since the early 1970's. Causes for this decline are not known but may include lead poisoning, pollution, reduced food supplies, overharvest, and increased predation.

Spectacled eiders migrate in the spring and fall through the Bering, Chukchi, and Beaufort seas and may use coastal habitat during migration. Current data suggests that the entire world population of this species spends the winter in a small portion of the Bering Sea between St.

Lawrence and St. Matthew islands, and that molting areas include Ledyard Bay and Norton Sound. There is no designated critical habitat for spectacled eiders in Alaska.

Site Specific Information on the Spectacled Eider:
Breeding female spectacled eiders (Somateria fischeri) from the Yukon Kuskokwim Delta and their offspring stage and molt in Norton Sound from July to mid-October. During much of this time they are flightless. Concentrations of over 4,000 spectacled eider have been observed in northeastern Norton Sound about 15-35 miles WNW of Besboro Island. Birdwatchers in Nome claim to have observed spectacled eiders just offshore of Nome (Greg Balogh, USFWS, Anchorage pers. comm., 1998).

Arctic Peregrine Falcon:
Nome is within the nesting range of the delisted arctic peregrine falcon (Falco peregrinus tundrius); however, the species is not currently known to nest near the project site. The Arctic peregrine falcon was removed from the list of endangered and threatened species on October 5, 1994. Arctic peregrine falcons nest in the treeless, tundra areas of northern and western Alaska, and migrate south through Canada and the United States. They winter in warmer climates from the southern United States to southern Argentina and Chile. The Service recommends that agencies and applicants avoid impacts to Arctic peregrine falcons as they have recently recovered from threatened status, and could be emergency listed at any time if survey data indicate a declining population trend.

Under Section 7 of the ESA, the action agency must make the initial determination as to whether the project is likely to affect threatened and endangered species. It is the Service's responsibility to either concur or not concur with the action agencies assessment of the impact.

This relates only to threatened and endangered species under our jurisdiction. It does not address species under the jurisdiction of the National Marine Fisheries Service (NMFS). The NMFS has responsibility for all threatened and endangered marine mammals in Alaska. The Corps should contact NMFS to determine if future consultation regarding marine mammals is required for this project.

Under federal statutes, the NMFS, under the Department of Commerce (DOC), has responsibility for managing and protecting all cetaceans and pinnipeds, except walrus. Also the DOC, through NMFS, is responsible for the administration of the Endangered Species Act as it applies to certain cetaceans and pinnipeds in Alaska. These include seven species of whale: fin, right, humpback, blue, sperm, sei, bowhead, and the western stock of the northern Steller sea lion (west of 144 degrees longitude). Additionally, the NMFS is responsible for cetaceans and pinnipeds listed as "depleted" under the Marine Mammal Protection Act (MMPA). A "depleted" status under the MMPA is a population level less than 60% of carrying capacity (i.e., northern fur seal). Additional marine mammals that may be found in Alaskan waters include the killer whale, minke whale, gray whale, beluga whale, harbor porpoise, Dall's porpoise, pacific white-sided dolphin, harbor seal, spotted seal, ringed seal, bearded seal, and northern elephant seal.

mouth of the Snake River. This could potentially increase predation of juvenile salmon by larger, predatory marine fish like saffron cod. The marine fish would be able to remain in the deeper habitat for longer periods of times, thus increasing the opportunities for predation (Lean, pers. comm., 1998). Predation of juvenile fish could also increase if the abutments of the proposed breakwater breach are vertical and constructed of sheet pile or concrete walls since the juvenile fish would be accessible to predators lying in wait in the deeper waters of the breach, and the vertical walls would offer no escape cover such as the spaces between pieces of riprap.

If the existing channel is filled in prior to creation of the new channel, spawning fish could be cut off from gaining entry to Snake River and/or outmigrating fish would be cut off from access to Norton Sound.

This alternative will result in the alteration of 20 hectares of sandy substrate ranging from subtidal to upland habitat. The new channel will cause a loss of some fish rearing and bird foraging habitat at the mouth of Snake River; expanded vessel use will increase disturbance to fish and bird species that use this area. Some aquatic habitat will be lost by filling in the existing channel. The construction of a breakwater will result in a loss of habitat for marine invertebrate infauna species and the destruction of individual sessile organisms through crushing and smothering. This impact is expected to be minimal because invertebrate abundance is low in this area and other species can recolonize the breakwater surface.

Since juvenile coho salmon, burbot, grayling, stickleback, saffron cod, and Dolly Varden are known to overwinter in the harbor area they could be most susceptible to accumulations of petroleum products in the inner harbor.

Impacts - Alternative 3, Curved Channel with Spending Beach

Impacts associated with Alternative 3 would be similar to those described for Alternative 1 and include blasting, dredging, and fill placement. Alternative 3 would require more dredging and fill placement than Alternative 1. Placement of rock material at the spending beach will change the sandy habitat, however the fish and wildlife impacts would be minimal because of existing structures and human activities in this area.

Impacts - Alternative 4, Harbor Adjacent to Causeway

Impacts associated with Alternative 4 include blasting, dredging, and alteration and disturbance of marine habitat. Dredging requirements are more extensive for this alternative compared to Alternatives 1 and 3. The dredging would impact fish, marine mammals, and invertebrates that occur in this area. The project area would extend out into the marine habitat and could have a greater impact on marine mammals, birds, pelagic fish, and invertebrates than the other alternatives. Species that presently use this area would be disturbed and possibly displaced by harbor associated activities.

Mitigation Plan

Under the Fish and Wildlife Coordination Act (48 Stat. 401, as amended: 16 U.S.C. 661 et seq.), the Service is responsible for identifying potential project impacts and recommending actions which would mitigate negative project effects on fish, wildlife, and their habitats.

Based on the Service's Mitigation Policy (FR Vol. 46, No. 15, January 23, 1981) we have selected coho and chum salmon as our evaluation species. The habitat impacted by the project is of high to medium value for the evaluation species and is relatively abundant on a national basis. Our mitigation goal is no net loss of habitat value while minimizing loss of in-kind habitat value.

This mitigation evaluation focuses mainly on Alternative 2, the proposed alternative. If a different alternative is selected, or the Alternative 2 project description changes, we would need to reevaluate the mitigation requirements.

Inwater blasting represents a major potential adverse impact for all the alternatives. The best way to mitigate this potential impact is to conduct the blasting during time periods when fish concentrations are not expected. Fish concentrations in the project area are expected during salmon spawning and juvenile outmigration, approximately from mid-May to August 31. To protect marine mammals from blasting impacts, no blasting that would create overpressures of greater than 10 psi should occur at any time when marine mammals are present. Conducting the blasting operations during the winter, during freeze up, and when fish and marine mammals are less abundant would minimize the impacts. A detailed blasting plan, which incorporates the identified mitigation measures, should be developed and provided for review by the appropriate resource agencies.

To reduce the biological impacts of dredging generated turbidity, suspended sediments, and potential release of mercury and arsenic (Alternative 2 only) on outmigrating juvenile salmon, for Alternatives 1-3, dredging or fill activities should not occur from mid-May to June 20.

Placement of the breach on the breakwater for Alternative 2 should be close enough to shore to prevent outmigrating juvenile salmon from being forced out into deep salt water, yet should not be susceptible to sediment accumulation. Therefore, it should be placed within an area far enough away from anticipated shoreline sedimentation build up. The sedimentation maintenance bypass system should help alleviate sediment build up. Before awareness of the sedimentation maintenance plan to maintain certain breach depths and widths for fish passage, the Alaska Department of Fish and Game recommended that the breach be placed approximately 300 m from the inland end of the breakwater to prevent anticipated build up of shoreline sedimentation from filling in the breach. Since sedimentation maintenance plans described in Alternative 2 will maintain the causeway and proposed breakwater breaches at certain depths for fish passage, it is possible that the breach could be placed about 210-250 m from the inland end of the breakwater, instead of 300 m. To accomodate fish passage, the breakwater breach should be in approximate line with the causeway breach

Depth and width of the breach should be established and maintained at specific levels that accommodate fish passage. The breach should be constructed and maintained at a 10 m width at -2.5 m. The abutments of the breach should be riprap at approximately a 2:1 slope, not vertical with sheetpile or concrete walls. The sloping riprap abutments will provide some protection for juvenile salmon from larger predatory fish.

To facilitate fish migration and avoid trapping, a channel would have to be open during project construction of Alternative 2. The new channel would need to be opened before the existing one is filled in.

To eliminate the abrupt change of water depth where the proposed channel in Alternative 2 crosses the Snake River, the contour of the dredged channel shall gradually slope to the toe of the cut. The gradual slope will afford predatory salt water fish less opportunities to prey on juvenile salmon. The arc will need to be extended upstream from existing design plans where the dredged channel crosses Snake River to allow for the gradual slope.

Recommendations

The following recommendations for Alternative 2, the proposed alternative are made on the basis of design information, the 1997 field investigation, existing literature, the Service's assessment, and information provided by the ADF&G, NMFS, and Corps Civil Works Branch.

1. A detailed inwater blasting plan shall be developed by the Corps, and reviewed by the Service, Alaska Department of Fish and Game, and the National Marine Fisheries Service. At a minimum the plan should include the following:

    a. Specification of the location and size of the charges, and the method of placement.

    b. A map of the anticipated blast-generated overpressure gradient.

    c. Prohibition of inwater blasting from mid-May to August 31.

    d. Blasting shall be scheduled at a time when few fish, birds, or marine mammals are in the vicinity.

    e. Prior to each blast, the area shall be patrolled by boat or on the shore, and devices/techniques authorized by the USFWS and the NMFS shall be used to move birds and marine mammals away from the project area.

    f. Employing either dobying or drill-and-blast technique, the size of individual explosive charges shall be minimized to reduce resultant hydrostatic waves. Maximum allowable shock-wave impulse strengths at specified distances from the blast site shall be employed. An upper limit of 0.69 bar per millisecond (i.e., 10 psi/millisecond) as measured at the mid-water column depth, 100 meters from the charge shall be employed. Each blast shall be closely monitored, the hydrostatic pressures measured and recorded, and the charges adjusted necessary to ensure that "allowable hydrostatic over-pressures are not exceeded.

g. The blasting plan shall prohibit instantaneous pressure changes greater than 2.7 psi in the swim bladder of a fish

h. After each detonation, a visual survey shall be made of the project site within 400 meters of the blast and all dead fish and wildlife removed from the water to prevent attracting foraging fish and wildlife to the area. Animal carcasses shall be disposed of at an upland location and in accordance with any State or Federal requirements.

2. To reduce the biological impacts of dredging generated turbidity, suspended sediments, and potential release of mercury and arsenic on outmigrating juvenile salmon, dredging or fill activities shall not occur from mid-May to June 20th.

3. To facilitate juvenile salmon passage, their acclimation to salt water, and avoidance of predators, the following conditions shall apply to the project:

   a. The breakwater breach shall be placed approximately 210-250 m seaward from the inland end of the breakwater.

   b. The breach shall be constructed and maintained at 10 m wide bottom width by 20 m wide top width with maximum side slopes of 2:1 (effective area 37.5 m^2) and at a depth of - 2.5 m.

   c. The abutments of the breach shall be constructed with riprap and contoured with a side slope of 2:1 on both sides.

4. To prevent blockage of spawning salmon from migration to Snake River or juvenile outmigrants to Norton Sound, the new channel should be open prior to filling in the existing channel.

5. To eliminate the abrupt change of water depth where the proposed channel in Alternative 2 crosses the Snake River, the contour of the dredged channel shall gradually slope to the toe of the cut. The gradual slope will afford predatory marine fish less opportunities to prey on juvenile salmon. The arc shall be extended approximately 30 m upstream from existing design plans, where the dredged channel crosses Snake River, to allow for the gradual slope.

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For more information about the Fish and Wildlife Service in Alaska, call 888-262-6719/TDD or see our web site: http://www.r7.fws.gov

APPENDIX EA-3

CORRESPONDENCE

TONY KNOWLES, GOVERNOR

DEPARTMENT OF FISH AND GAME

Commercial Fisheries Management and Development Division

POUCH 1148
NOME, ALASKA 99762-1148
PHONE: (907) 443-2825
FAX: (907) 443-5893

January 7, 1998

John Burns
Corp. of Engineers
Anchorage, Alaska

Dear Mr. Burns

Thanks for the opportunity to comment on the port design.

As you mentioned I have concerns about the lack of a breach in the new causeway. This is important for several reasons. The primary one is to allow the one-year old salmon a means of surviving their migration to saltwater. These salmon are still adjusting to salt and will run near the surface. If they are forced to round the end of the cause way the transition to salt will be more abrupt and they will have a higher mortality due to predation by fish and birds. Even a few feet of water in the breach allows for salmon fry to avoid the risks off the end of the causeway. The Snake River chum return is very depleted and is currently the focus of fairly intense management to rebuild the stock. There has been no fisheries allowed on the chums for 6 years. Every impact is critical at this point.

I believe the breach in the existing causeway is too near shore. Originally I remember there being six feet of water there. It is nearly dry at times now. I would suggest a breach in at least ten feet of water. It will take longer to silt in and flow would be less affected by the abandoned barge at the six foot isobath.

Those breaches also serve as human access corridors. In the summer small boats might be able to avoid the rough water at the harbor entrance by passing through a breach and in winter the coastal snowmachine trail makes use of the "overpass" in the existing causeway. It is often not practical for snowmachines pass offshore of the causeway because sea ice stacks at the end of the causeway creating impassable conditions. The lack of a breach will require traffic to pass inshore of the causeway or attempt to cross over the causeway which may cause interactions with street traffic.

Are there plans for a boat launch area just west of the dredge channel on the western side of the Snake River? Commercial, recreational, and subsistence users of fish and wildlife would find this a useful addition to the port. The current launching areas are in industrial and residential areas that complicate their use.

Normally, the Habitat Division of the department comments on these projects. I hope you find my comments useful and I have discussed my comments with habitat staff.

Sincerely,

Charles Lean
Area Management Biologist

cc Mac McLean
Rich Cannon

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 21668
Juneau, Alaska 99802-1668

March 11, 1998

Colonel Sheldon L. Jahn
U.S. Army Corps of Engineers, Alaska
ATTN: CEPOA-EN-CW-ER (Burns)
P.O. Box 898
Anchorage, Alaska 99506-0898

ATTN: John Burns

Dear Colonel Jahn:

Thank you for your telephone inquiry regarding Threatened and Endangered species concerns associated with the harbor navigation improvements project for Nome, Alaska. Marine mammals that commonly occur in Norton Sound include the Pacific walrus; ringed, bearded, and spotted seal; and gray and beluga whale. Species that occur less frequently in Norton Sound include ribbon seal; minke, killer and bowhead whale; and harbor porpoise. The endangered bowhead whale may occasionally occur offshore of Nome during open water periods, and has been documented as close as one-mile offshore. However, this species would not be at the project site, and no critical habitat for these listed species has been identified within this area.

We hope this information is useful to you in fulfilling any requirements under Section 7 of the Endangered Species Act. Please direct any questions to Brad Smith in our Anchorage field office at (907) 271-5006.

Sincerely,

Steven Pennoyer
Administrator, Alaska Region

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
222 W. 7th Avenue, #43
Anchorage, Alaska 99513-7577

June 3, 1998

Colonel Sheldon L. Jahn
U.S. Army Corps of Engineers (COE)
CEPOA-EN-CW-ER (Burns)
P.O. Box 898
Anchorage, Alaska 99506-0898

Re: Nome, Alaska
Navigation Improvements
ER 98-18

ATTN: John Burns

Dear Colonel Jahn,

The National Marine Fisheries Service (NMFS) has reviewed the above referenced Civil Works Branch Public Notice and accompanying Environmental Assessment and Finding Of No Significant Impact.

A recent scientific review by NMFS and coordinated with Alaska Department of Fish and Game, highlighted areas of general distributions and known concentrations of fish resources associated to the NMFS Fishery Management Plans. Near shore and marine waters of Norton Sound have been identified as areas known to contain habitats for Red King Crab populations, specifically spawning and egg bearing mature crabs Therefore, we offer the following information for your review to address these populations in the area.

Red King Crab

Egg hatch of larvae is synchronized with the spring phytoplankton bloom in Southeast Alaska suggesting temporal sensitivity in the transition from benthic to planktonic habitat.

Red king crab larvae spend 2 - 3 months in pelagic larval stages before settling to the benthic life stage. Reverse diel migration and feeding patterns of larvae coincide with the distribution of food sources

Early juvenile stage red king crabs are solitary and need high relief habitat or coarse substrate such as boulders, cobble, shell hash, and living substrates such as bryozoans and stalked ascidians. Young-of-the-year crabs occur at depths of 50 m or less.

Late juvenile stage red king crabs of the ages of two and four years exhibit decreasing reliance on habitat and a tendency for the crab to form pods consisting of thousands of crabs. Podding generally continues until four years of age (about 6.5 cm), when the crab move to deeper water and join adults in the spring migration to shallow water for molting and mating.

Mature red king crabs exhibit seasonal migration to shallow waters for reproduction. The remainder of the year red king crabs are found in deep waters. Males grasp females just prior to female molting, after which the eggs (43,000 to 500,000 eggs) are fertilized and extruded on the female's abdomen. The female red king crab carries the eggs for 11 months before they hatch.

This information does not change our position on the project and we believe the anadromous, estuarine, and marine fishery resources in the vicinity of the proposed project can be adequately protected as detailed in the your report. We hope that this information is useful for your project preparation. Please contact Mr. Matthew P. Eagleton at (907) 271-6354 if there are any questions or additional information is needed.

Sincerely,

Jeanne L. Hanson
Acting Supervisor
Western Alaska Field Office
Habitat Conservation Division

cc: ADFG, ADEC, ADGC, EPA, USFWS - Anchorage

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services Anchorage
605 West 4th Avenue, Room 62
Anchorage, Alaska 99501-2249

FAXED 6/3/98

IN REPLY REFER TO:

WAES

JUN 3 1998

Colonel Sheldon L. Jahn
District Engineer, Alaska District
U.S. Army Corps of Engineers
Post Office Box 898
Anchorage, Alaska 99506-0898

Dear Colonel Jahn:

We have reviewed the Environmental Assessment and Finding of No Significant Impact for Navigation Improvements in Nome, Alaska, dated April 1998, and have the following comments.

We support your preferred alternative that includes constructing a 925-meter-breakwater with a breach and the sedimentation management program. Your summary of mitigation measures on page FN-2 does not include the following conditions recommend in our draft Fish and Wildlife Coordination Act (FWCA) report:

1. To reduce the biological impacts of dredging generated turbidity, suspended sediments, and potential release of mercury and arsenic on outmigrating juvenile salmon, dredging or fill activities shall not occur from mid-May to June 20th.

2. To prevent blockage of spawning salmon from migration to Snake River or juvenile outmigrants to Norton Sound, the new channel should be open prior to filling in the existing channel.

3. To eliminate the abrupt change of water depth where the proposed channel in Alternative 2 crosses the Snake River, the contour of the dredged channel shall gradually slope to the toe of the cut. The gradual slope will afford predatory marine fish less opportunities to prey on juvenile salmon. The arc shall be extended approximately 30 m upstream from existing design plans, where the dredged channel crosses Snake River, to allow for the gradual slope.

4. The abutments of the breach shall be constructed with riprap and contoured with a slope of about 2:1 on both sides.

RECEIVED

JUN 10 1998

REGULATORY BRANCH
Alaska District, Corps of Engineers

In addition we agree with Alaska Department of Fish and Game's recommendation (March 24, 1998, letter in response to our draft FWCA report) that the breach should have a 10 m wide bottom width by 20 m wide top width with maximum side slopes of 2:1 (effective area 37.5 m^2).

To mitigate for project impacts to fish and wildlife we would like the above mitigation measures to be included as part of the project. Please contact Marcia Heer at 271-2440 to discuss these recommendations further. We appreciate the opportunity to review the Environmental Assessment.

Sincerely,

Robert J. Willis, Acting

Ann G. Rappoport
Field Supervisor

cc: ADF&G (Fairbanks), NMFS

STATE OF ALASKA

TONY KNOWLES, GOVERNOR

DEPT. OF ENVIRONMENTAL CONSERVATION
Division of Air and Water Quality
Watershed Management
610 University Avenue
Fairbanks, AK 99709-3643

Director's Office: (907) 465-5260
Fairbanks Office: (907) 451-2360
Fax: (907) 451-2187
File: COE # ER 98-18
Navigation Improvements, Nome

June 25, 1998

Mr. John Burns
Alaska District Corps of Engineers
P.O. Box 898
Anchorage, AK 99506-0809

Re: Certificate of Reasonable Assurance, Navigation Improvements, Nome, ER 98-18

Dear Mr. Burns:

In accordance with Section 401 of the federal Clean Water Act and provisions of the Alaska Water Quality Standards, the Department of Environmental Conservation has issued the enclosed Certificate of Reasonable Assurance for the referenced project.

The project is to construct a 925-meter-long breakwater parallel to the causeway; excavate a new entrance channel through the sand spit and into the existing harbor in the Snake River; and, implement a sand-bypass management program. Approximately 140,000 cubic meters of rock will be required to construct the breakwater; approximately 360,000 cubic meters of dredged material would be excavated to build the entrance channel and turning basin and another 120,000 cubic meters will be dredged to form a sediment bypass management basin.

Dredged material will be placed in three locations: the existing sand spit; the approved EPA disposal site; and, the existing channel. Approximately 20,000 cubic meters of material contaminated with arsenic will be disposed of in lined disposal site in the existing channel. This channel will be blocked at both ends and a geotextile fabric that retains the fines and allows the water to pass, will be placed on the bottom and sides of the blocked channel. At least one meter of clean material will cap the contaminated material. The area will be platted with the city of Nome to ensure the integrity of the cap is maintained.

All appropriate and practicable mitigation measures have been incorporated into the project and include (a) designing the navigation improvements to maximize the safe use of the causeway and provide access to the existing small boat harbor, while minimizing the project footprint; (b) constructing the breakwater prior to dredging the basin to help contain any sediment plume; using a silt curtain for in-water work between April 15 and June 15; (c) coordinating construction of the harbor with the city of Nome to avoid conflicts with subsistence fisheries and commercial activities; (d) developing a quarry development plan to be reviewed by State and Federal resource agencies; (e) and design a sediment management program that will ensure that both the fisheries breaches at the causeway and breakwater are always at their designed dimensions.

The purpose of the project is to expand navigation system for Nome Harbor in Nome, Alaska. to satisfy additional moorage needs and to protect vessels currently using the Nome causeway.

Construction of the navigation improvements will contribute to the future growth of Nome and will provide more timely and less expensive service to the 26 outlying villages that depend on Nome as transportation hub.

The project is located at the harbor in Nome, Alaska.

Department of Environmental Conservation regulations provide that any person who disagrees with any portion of this action may request an adjudicatory hearing in accordance with 18 AAC 15.200-920. The hearing request should be mailed or delivered to the Commissioner of the Department of Environmental Conservation, 410 Willoughby Avenue, Suite 105, Juneau, AK 99801-1795, with a copy to the undersigned. Failure to submit a hearing request within thirty days of receipt of this letter constitutes a waiver of the right to judicial review of this action.

By copy of this letter and certification, we are advising the Division of Governmental Coordination of this action. Please contact me if you have any questions concerning this certification.

Sincerely,

Joyce Beelman

Joyce Beelman
Environmental Specialist

Enclosures: Certificate of Reasonable Assurance
Invoice ($500)

cc: DGC/Anchorage
USFWS/Fairbanks
ADNR/Fairbanks
US EPA/Anchorage
ADF&G/Fairbanks

STATE OF ALASKA
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
CERTIFICATE OF REASONABLE ASSURANCE

Navigation Improvements Nome, Alaska **COE # ER 98-18**

This Certificate of Reasonable Assurance, in accordance with Section 401 of the federal Clean Water Act and the Alaska Water Quality Standards, is issued to Alaska District Corps of Engineers, P.O. Box 898, Anchorage, AK 99506-0898, for the proposed project.

The project is to construct a 925-meter-long breakwater parallel to the causeway; excavate a new entrance channel through the sand spit and into the existing harbor in the Snake River; and, implement a sand-bypass management program. Approximately 140,000 cubic meters of rock will be required to construct the breakwater; approximately 360,000 cubic meters of dredged material would be excavated to build the entrance channel and turning basin and another 120,000 cubic meters will be dredged to form a sediment bypass management basin.

Dredged material will be placed in three locations: the existing sand spit; the approved EPA disposal site; and, the existing channel. Approximately 20,000 cubic meters of material contaminated with arsenic will be disposed of in lined disposal site in the existing channel. This channel will be blocked at both ends and a geotextile fabric that retains the fines and allows the water to pass, will be placed on the bottom and sides of the blocked channel. At least one meter of clean material will cap the contaminated material. The area will be platted with the city of Nome to ensure the integrity of the cap is maintained.

All appropriate and practicable mitigation measures have been incorporated into the project and include (a) designing the navigation improvements to maximize the safe use of the causeway and provide access to the existing small boat harbor, while minimizing the project footprint; (b) constructing the breakwater prior to dredging the basin to help contain any sediment plume; using a silt curtain for in-water work between April 15 and June 15; (c) coordinating construction of the harbor with the city of Nome to avoid conflicts with subsistence fisheries and commercial activities; (d) developing a quarry development plan to be reviewed by State and Federal resource agencies; (e) and design a sediment management program that will ensure that both the fisheries breaches at the causeway and breakwater are always at their designed dimensions.

The purpose of the project is to expand navigation system for Nome Harbor in Nome, Alaska, to satisfy additional moorage needs and to protect vessels currently using the Nome causeway.

Construction of the navigation improvements will contribute to the future growth of Nome and will provide more timely and less expensive service to the 26 outlying villages that depend on Nome as transportation hub.

The project is located at the harbor in Nome, Alaska.

Water Quality Certification is required under Section 401 because the proposed activity will be authorized by a U.S. Army Corps of Engineers Section 404 permit identified as Navigation Improvements Nome, Alaska, COE # ER 98-18, and a discharge to navigable waters might result.

Public notice of the application for this certification was given as required by 18 AAC 15.180.

Having reviewed the application and comments received in response to the public notice, the Alaska Department of Environmental Conservation certifies that there is reasonable assurance that the proposed activity, as well as any discharge that might result, will comply with applicable provisions of Section 401 of the federal Clean Water Act, and with the Alaska Water Quality Standards, 18 AAC 70.

6-25-98
Date

Joyce Beelman
Joyce Beelman
Environmental Specialist

STATE OF ALASKA

TONY KNOWLES, GOVERNOR

OFFICE OF THE GOVERNOR

OFFICE OF MANAGEMENT AND BUDGET
DIVISION OF GOVERNMENTAL COORDINATION

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June 25, 1998

Mr. John Burns
Alaska District Corps of Engineers
ATTN: CEPOA-EN-CW-ER
P.O. Box 898
Anchorage, Alaska 99506-0898

Dear Mr. Burns:

SUBJECT: FINAL CONSISTENCY RESPONSE
Navigation Improvements, Nome
STATE I.D. NO. AK 9805-03AA

The Division of Governmental Coordination (DGC) has completed the review of your project for consistency with the Alaska Coastal Management Program (ACMP). This consistency determination applies to the federal consistency determination required for the project per 15 CFR 930 Subpart C. On June 18, 1998, you were issued a proposed consistency response for your project. This is the State's final consistency response.

The project is to construct a 925-meter-long breakwater parallel to the causeway; excavate a new entrance channel through the sand spit and into the existing harbor in the Snake River; and, implement a sand-bypass management program. Approximately 140,000 cubic meters of rock will be required to construct the breakwater; approximately 360,000 cubic meters of dredged material would be excavated to build the entrance channel and turning basin and another 120,000 cubic meters will be dredged to form a sediment bypass management basin.

Dredged material will be placed in three locations: the existing sand spit; the approved EPA disposal site; and, the existing channel. Approximately 20,000 cubic meters of material contaminated with arsenic will be disposed of in a lined disposal site in the existing channel. This channel will be blocked at both ends and a geotextile fabric that retains the fines and allows the water to pass, will be placed on the bottom and sides of the blocked channel. At least one meter of clean

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actual use differs from the approved use contained in the project description, the State may amend the State approvals listed in this consistency determination.

Should cultural or paleontological resources be discovered as a result of this activity, we request that work which would disturb such resources be stopped, and that the State Historic Preservation Office (269-8715) and the U.S. Army Corps of Engineers (COE) (753-2712) be contacted immediately so that consultation per section 106 of the National Historic Preservation Act may proceed.

This final consistency determination is a final administrative decision for purposes of Alaska Appellate Rules 601-612. Any appeal from this decision to the superior court must be made within 30 days of the date of this determination.

By copy of this letter, we are informing the U.S. Army Corps of Engineers of our final finding.

If you have questions regarding this process, please contact me at 269-7473 or e-mail maureen_mccrea@gov.state.ak.us.

Sincerely,

Maureen McCrea

Maureen McCrea
Senior Project Review Coordinator

cc: Tim Smith, DNR/SHPO, Anchorage
Joyce Beelman, DEC, Fairbanks
Roselynn Smith, DNR/DOL, Fairbanks
Al Ott, DFG/DHR, Fairbanks,
Chuck Degnan, BSCRSA, Unalakleet
Randy Romenesko, City Manager, Nome

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Rationale: This measure is necessary to protect fish resources by preventing blockage of migrating fish per 6 AAC 80.130(B)(2).

5. The contour of the dredged channel shall gradually slope to the toe of the cut where the proposed channel crosses the Snake. River. The area shall be extended approximately 30 meters upstream of the existing design plan to allow for the gradual slope.

Rationale: This measure is necessary to protect fish resources by affording predatory marine fish less opportunity to prey on outmigrant juvenile salmon per 6 AAC 80.130(B)(2).

6. Inwater instantaneous blasting pressure shall not exceed 2.7 pounds per square inch. Larger blasts may be accommodated if each blast is separated by an eight millisecond or longer delay.

Rationale: This measure is necessary to protect fish resources by preventing excessive pressure per 6 AAC 80.130(B)(2).

A copy of the pertinent ACMP standard was enclosed with the proposed finding.

The following federal and State permits also are needed for the project:

Alaska Department of Environmental Conservation (DEC)
Section 401
Certificate of Reasonable Assurance

Alaska Department of Fish and Game (DFG)
Fish Habitat Permit

Other Concerns/Advisories

Please be advised that although the State has found the project consistent with the ACMP, based on your project description and any modifications contained herein, you are still required to meet all applicable State and federal laws and regulations. Your consistency determination may include reference to specific laws and regulations, but this in no way precludes your responsibility to comply with other applicable laws and regulations.

If changes to the approved project are proposed prior to or during its siting, construction, or operation, you are required to contact this office immediately to determine if further review and approval of the revised project is necessary. If the actual use differs from the approved use contained in the project description, the State may amend the State approvals listed in this consistency determination.

Should cultural or paleontological resources be discovered as a result of this activity, we request that work which would disturb such resources be stopped, and that the State Historic Preservation Office (269-8715) and the U.S. Army Corps of Engineers (COE) (753-2712) be contacted immediately so that consultation per section 106 of the National Historic Preservation Act may proceed.

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If you have questions regarding this process, please contact me at 269-7473 or e-mail maureen_mccrea@gov.state.ak.us.

Sincerely,

Maureen M^cCrea

Maureen McCrea
Senior Project Review Coordinator

cc: Tim Smith, DNR/SHPO, Anchorage
Joyce Beelman, DEC, Fairbanks
Roselynn Smith, DNR/DOL, Fairbanks
Al Ott, DFG/DHR, Fairbanks,
Chuck Degnan, BSCRSA, Unalakleet
Randy Romenesko, City Manager, Nome

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