Alaska Deep Draft Arctic Port System Feasibility Study

A Subset of the Alaska Regional Ports Study

Economics Appendix B

Nome & Port Clarence, Alaska

January 2015

U.S. Army Corps of Engineers

Alaska District

ALASKA DEEP DRAFT ARCTIC PORT SYSTEM FEASIBILITY STUDY
ECONOMICS APPENDIX B
NOME & PORT CLARENCE, ALASKA

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Common Naming Convention Used in this Report

Arctic Circle –one of the five major circles of latitude, north of the Bering Strait, it is the parallel of latitude that runs 66° 33′ 44″ north of the equator.

Bering Strait – Waterway between the Alaska community of Wales and the Russian shoreline through which all traffic using the Northern Sea Route or the Northwest Passage must traverse.

Bering Straits Native Corporation - Bering Straits Native Corporation (BSNC), owned by Alaska Native shareholders, actively pursues responsible development of our resources and other business opportunities.

Cape Riley – undeveloped land located on the eastern edge of Port Clarence southwest of the community of Teller.

Kawerak - regional non-profit corporation that contracts with the state and federal government to provide services to residents of the Bering Strait.

Northern Sea Route – passage through the Arctic Ocean past Russia's shores.

Northwest Passage – passage through the Arctic Ocean past Canada's shores.

Offshore Oil and Gas leases – for purposes of this report all offshore oil and gas leases are referring to those north of the Bering Strait in the Chukchi and Beaufort Seas.

Point Spencer – the spit of land on the western edge of Port Clarence that is a former Coast Guard Long Range Navigation (LORAN) Station.

Port Clarence – a 10-mile wide body of water northwest of Nome that includes the communities of Teller and Brevig Mission.

Sitnasuak - largest of the 16 village corporations in the Bering Straits Region, serving to protect the land and culture of the native shareholders.

List of Acronyms

ACEP	Alaska Center for Energy and Power
ADCCED	Alaska Department of Commerce Community and Economic Development
ADCRA	Alaska Department of Commerce and Regional Affairs
ADOL&WD	Alaska Department of Labor and Workforce Development
ADOT&PF	Alaska Department of Transportation and Public Facilities
AGC	Alaska Gold Company, LLC
AIS	Automated Identification System
ANSCA	Alaska Native Claims Settlement Act
BOEM	U.S. Bureau of Ocean Energy Management
BSNC	Bering Straits Native Corporation
ETTC	Estimated Total Trip Cargo
FWOP	Future without-project
FWP	Future with-project
IMO	International Maritime Organization
LNG	Liquefied Natural Gas
LORAN	Long Range Navigation
MLLW	Mean Lower Low Water
M&O	Maintenance and Operations
M/V	Motor Vessel
MXAK	Marine Exchange of Alaska
MT	Metric Tons
MTPH	Metric Tons Per Hour
NED	National Economic Development
NOAA	National Oceanic and Atmospheric Administration
NMFS	National Marine Fisheries Service
NSEDC	Norton Sound Economic Development Corporation
NSR	Northern Sea Route
OCS	Outer Continental Shelf
OCT	Opportunity Cost of Time
O&G	Oil and gas

OMB	Office of Management and Budget
OMRR&R	Operations, Maintenance, Repair, Rehabilitation, and Real Estate
OO&G	Offshore oil and gas
PAH	Polycyclic aromatic hydrocarbons
RED	Regional Economic Development
RO/RO	Roll On/Roll Off
SAR	Search and Rescue
TAPS	Trans-Alaska Pipeline System
TPI	Tons Per Inch
TSP	Tentatively Selected Plan
USACE	US Army Corps of Engineers
USCG	US Coast Guard
USCGC	US Coast Guard Cutter
VSU	Vessel Size Unit

I. INTRODUCTION

The Arctic is changing. Diminishing sea ice and expanded natural resource extraction are happening now. From drilling in the Chukchi Sea, dredging for gold in Nome, to ore and gas concentrate tankers going over the top to/from Europe, Alaska is experiencing more and more traffic past its shores. Alaska's western and northern coastline is mostly shallow with very little marine infrastructure. Coast Guard and other support vessels may be many days of ship travel away. Proper planning and responsible development is important to Alaska's future. So, the State of Alaska Department of Transportation and Public Facilities (ADOT&PF) and the US Army Corps of Engineers (USACE) partnered to study locations for an enhanced Alaska Deep Draft Arctic Port System. The USACE and ADOT&PF established the foundation for this study in 2008 and 2010 and built on the good work of others such as the Northern Waters Task Force, the Arctic Marine Shipping Assessment, and workshops with the Institute of the North. This study helps guide deep draft infrastructure development.

The initial step in the Alaska Deep Draft Arctic Port System study was completed in March 2013.[1] That study presented opportunities for development of marine infrastructure in the Arctic by Federal, State, and the local and/or private sector. The study evaluated 14 sites along Alaska's western and northern coasts for enhanced deep draft marine infrastructure. Those 14 sites were evaluated based on their physical suitability in the following categories: port proximity to mission (mining, oil and gas), intermodal connections, upland support, natural water depth, and navigation accessibility. The study recommended that the feasibility study efforts for 2013-2014 should focus on the two highest ranked sites: Nome and Port Clarence.

In April 2013, a planning charette was held at Nome. Participants at the charette included representatives from the cities of Nome, Teller, and Brevig Mission, NOAA, the US Coast Guard, US Fish and Wildlife, the State of Alaska, and the Corps' Alaska District and Pacific Ocean Division. The weeklong charette resulted in the following problem statement to be addressed by this study:

> *Increased vessel traffic coupled with limited marine infrastructure along Alaska's Western and Northern shores poses risks for accidents and incidents, increases response times for Search and Rescue, and requires international coordination.*

The primary planning goal/objective identified during the charette was to "provide navigation improvements to support multiple maritime missions in the Arctic (e.g. search and rescue, oil and gas, security, cargo, resource export, tourism, and oil spill and emergency response)."

The following, using the tools available to the Corps for deep draft navigation evaluations, presents the economic analysis for providing enhanced deep draft marine infrastructure at Nome and Port Clarence.

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[1] http://www.poa.usace.army.mil/Library/ReportsandStudies/AlaskaRegionalPortsStudy.aspx

II. OVERVIEW OF REGION AND COMMUNITIES

This section provides general background information pertaining to the socioeconomic composition of the study area. The information enables planners and report reviewers to understand the area's infrastructure, the level of economic activity, and the potential of the area to support the project under consideration.

A. Physical Location and Description of the Study Area

The study area is part of the Seward Peninsula on the western coast of Alaska and includes the general area of Nome and Port Clarence. The bay of Port Clarence is home to two communities: Teller and Brevig Mission. Figure 1 shows the study area.

Nome was built along the Bering Sea on the south coast of the Seward Peninsula, facing Norton Sound. It lies 539 air miles northwest of Anchorage, 102 miles south of the Arctic Circle and 161 miles east of Russia. Teller is located on a spit 72 miles northwest of Nome on the eastern side of Port Clarence. Brevig Mission is 5 miles northwest of Teller, and 75 miles northwest of Nome. Port Clarence is a 10-mile wide bay located west of Teller and Brevig Mission on the Seward Peninsula. The closed/decommissioned Coast Guard LORAN (LOng RAnge Navigation) station is on the western side of Port Clarence, also known as Point Spencer.

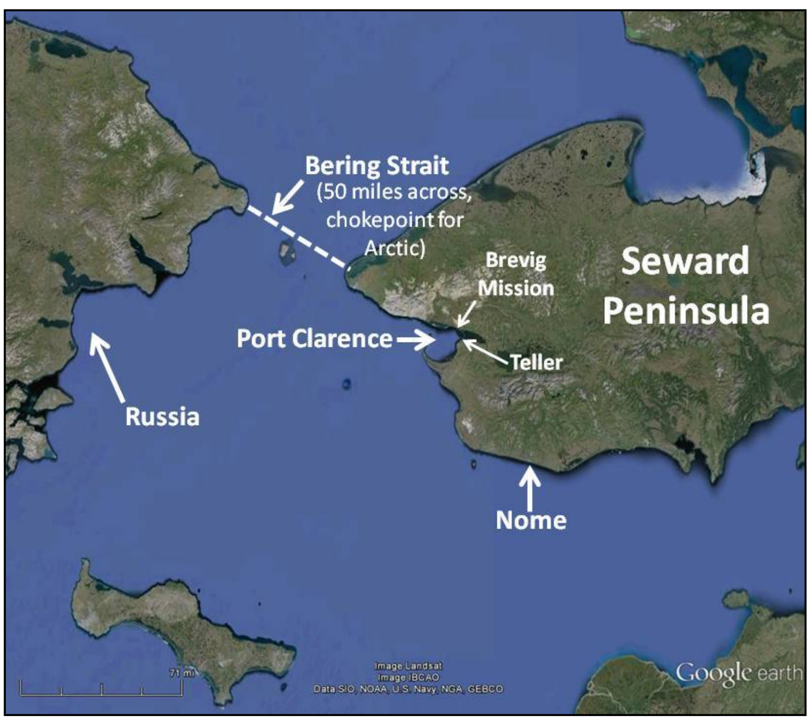

Figure 1. Map of study area

Source: ©Google Earth 2013. Citations added by USACE.

1. Nome

Nome is the supply, service, and transportation center of the Bering Strait region. It serves more than 50 communities along the western shore of Alaska and lies just 125 nautical miles from the Bering Strait.[2] All transportation to the area is by air or sea. Government services provide the majority of employment. In 2011, 40 residents held commercial fishing permits. Retail services, transportation, mining, medical, and other businesses provide year-round income. Several small gold mines and offshore gold dredges continue to provide employment. Subsistence activities contribute to the local diet. Figure 2 shows an aerial view of Nome and the Nome Harbor.

Figure 2. Aerial view of Nome and Nome Harbor

Figure 3 shows the bathymetry near the Port of Nome.

[2] The Port of Nome Strategic Development Plan 2013 lists the following villages served by the Port of Nome: Ambler, Barrow, Wainwright, Point Lay, Point Hope, Kivilina, Noatak, Kotzebue, Noorvik, Kiana, Selawik, Deering, Buckland, Shishmaref, Little Diomede, Wales, Tin City, Brevig Mission, Gambell, Savoonga, Teller, White Mountain, Golovin, Elim, Koyuk, Shaktoolik, Unalakleet, Shungnak, Stebbins, St. Michael, Kotlik, Emmonak, Alakanuk, Nunam Iqua, Mountain Village, St. Marys, Pilot Station, Marshall, Russian Mission, Scammon Bay, Hooper Bay, Chevak, Tununak, Mekoryuk, Toksook Bay, Nightmute, Chefornak, Kipnuk, Kwigillingok, Kongiganak, Quinhagak, Newtok, Mertarvik, Goodnews Bay, and Platinum.

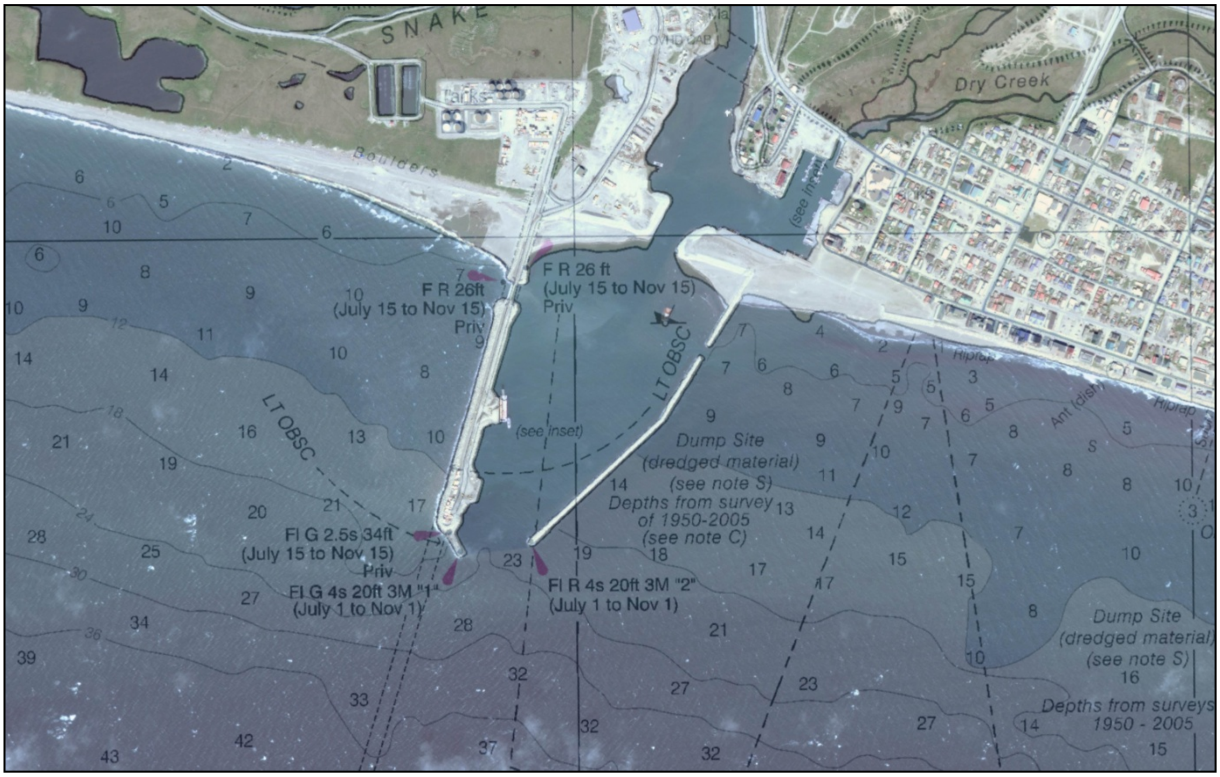

Figure 3. Nome Harbor Bathymetry (feet)

2. Port Clarence

Port Clarence has naturally deep water. NOAA maps show 48-foot depth at the entrance channel to Port Clarence, 40-foot depth off the tip of Point Spencer, and 27-foot depth off the tip of Cape Riley. NOAA has plans to conduct more intensive bathymetric surveys for the entire Port Clarence basin. Figure 4 shows the bathymetry of Port Clarence (in fathoms) as well as the locations of Point Spencer, Cape Riley, Brevig Mission, and Teller.

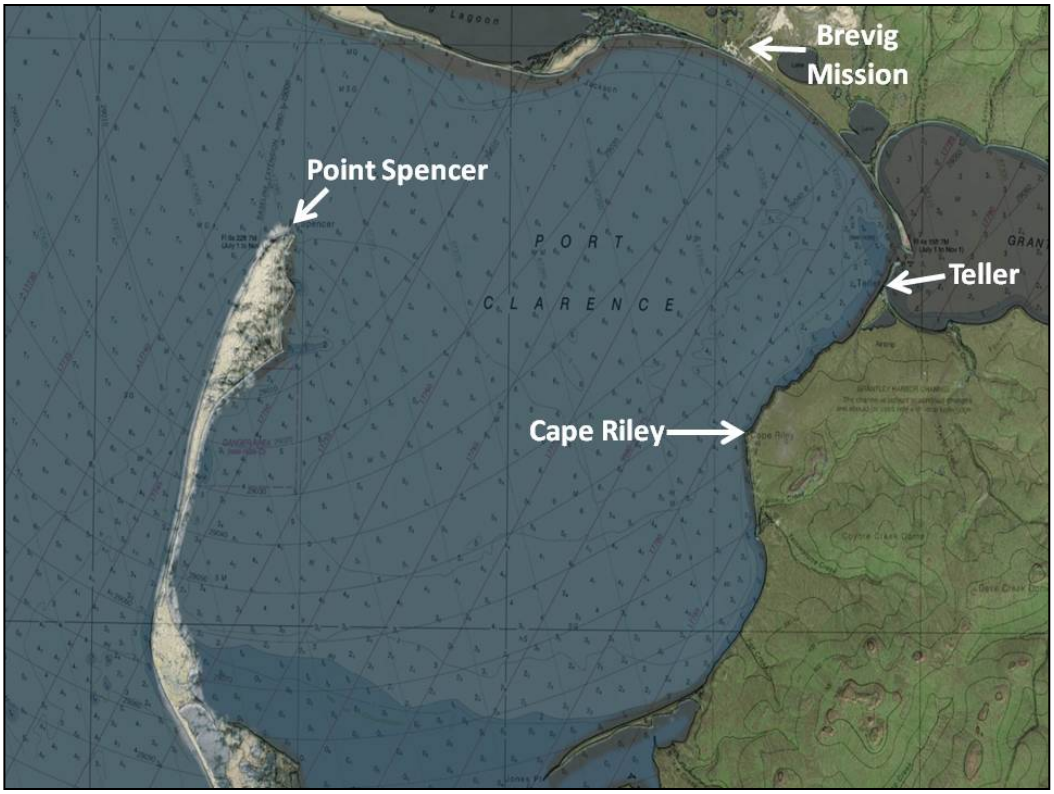

Figure 4. Port Clarence bathymetry, in fathoms (1 fathom = 6 feet)

Source: National Oceanic and Atmospheric Administration. Citations added by USACE.

a. Teller

The Teller economy is based on subsistence activities supplemented by part-time wage earnings. Fish, seal, moose, beluga whale, and reindeer are the primary meat sources. There is a herd of over 1,000 reindeer in the area, and the annual round-up provides meat and a cash product that is sold mainly on the Seward Peninsula. Over one-third of households produce crafts or artwork for sale, and some residents trap fox. Present-day Teller was established in 1900 after the Bluestone Placer Mine discovery 15 miles to the south. During these boom years, Teller had a population of about 5,000 and was a major regional trading center.

b. Brevig Mission

Brevig Mission is located at the mouth of Shelman Creek on Port Clarence, 5 miles northwest of Teller and 75 miles northwest of Nome. Brevig Mission is predominantly Inupiat Eskimo leading a subsistence way of life.

c. Point Spencer

There is no year-round population at Point Spencer. The Coast Guard shut down the LORAN station in 2010.

d. Cape Riley

There is no year-round population at Cape Riley.

B. Climate

The Seward Peninsula has a maritime climate with continental influences when the Bering Sea freezes. Summer temperatures average 44 to 57 °F; winter temperatures average from -9 to 8 °F. Annual precipitation averages 11.5 inches, with 50 inches of snowfall.[3]

C. Demographics

The following demographic information provides relevant characteristics to the local economy.

1. Population Characteristics

The 2012 population of Nome is estimated at 3,759, Teller is 250, Brevig Mission is 417, and Port Clarence (LORAN station of Point Spencer) is zero.[4] Figure 5 and Figure 6 show the populations of Nome, Teller, and Brevig Mission for the years 2000 through 2012.

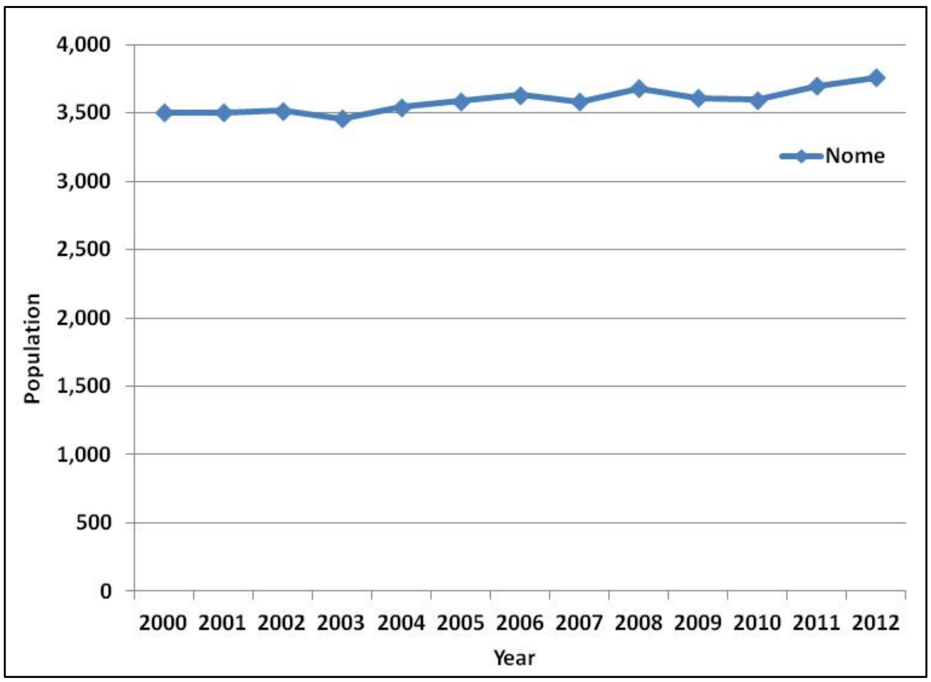

Figure 5. Nome Population, 2000-2012

Source: State of Alaska Department of Labor and Workforce Development, Research and Analysis Section, Demographics Unit, and the US Census 2000 & 2010.

[4] State of Alaska Department of Labor and Workforce Development, Research and Analysis Section. http://laborstats.alaska.gov/pop/popest.htm

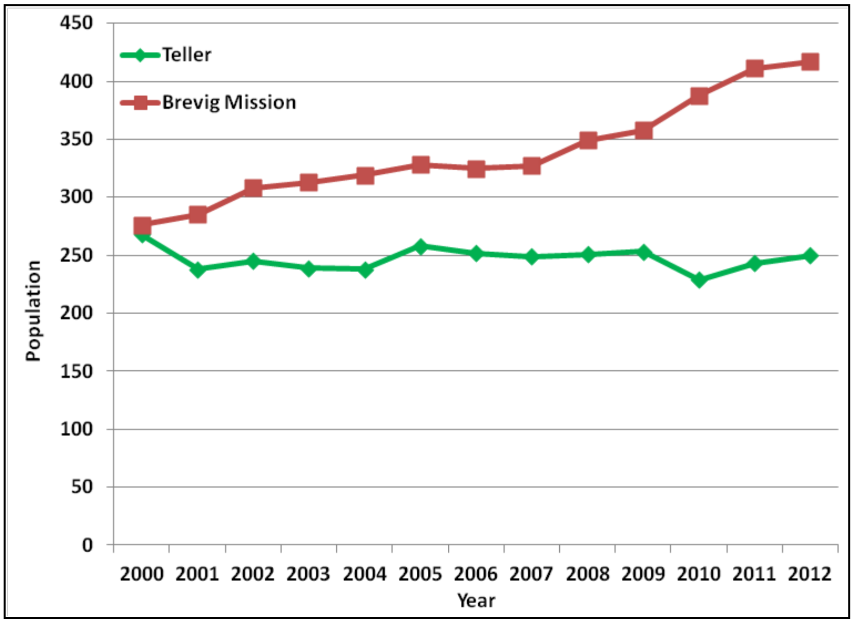

Figure 6. Teller and Brevig Mission Populations, 2000-2012

Source: State of Alaska Department of Labor and Workforce Development, Research and Analysis Section, Demographics Unit, and the US Census 2000 & 2010.

2. Employment and Income

The community of Nome is the terminus for the annual Iditarod sled dog race and in recent years, gold miners have taken a renewed interest in dredging the beaches as the price of gold hit record highs. The community is fairly diversified with commercial fishing activity, tourism, and government sector jobs as a basis. The communities of Teller and Brevig Mission both lead a subsistence way of life harvesting seals, beluga whales, fish, reindeer, and other local resources as needed.

Per capita income of Nome residents is $33,502. Teller and Brevig Mission per capita income are one-third or less of Nome residents' at $11,256 and $8,873 respectively.

Table 1. Nome, Teller, Brevig Mission, and Point Spencer Employment and Income Estimates, 2012

Characteristic	Nome	Teller	Brevig Mission	Point Spencer
Population	3,759	250	417	-
Per capita income	$ 33,502	$ 11,256	$ 8,873	$ -
Median Household Income	$ 69,522	$ 34,107	$30,625	$ -
Persons in Poverty	6.0%	39.3%	49.7%	0.0%

Source: US Census Bureau, 2007-2011 American Community Survey 5-Year Estimates

D. Existing Marine Facilities

1. Nome

The Port of Nome is located at 64 degrees 30 minutes North latitude and 165 degrees 24 minutes West longitude on the southern side of the Seward Peninsula in Norton Sound. The facility is generally ice free by June and frozen over by December or January. The Nome small boat harbor freezes in mid- to late October.[5] Figure 7 shows the Port of Nome and associated infrastructure for the port and small boat harbor.

The Corps of Engineers completed the Nome Navigation Improvements project in the summer of 2006 adding a 3,025-foot breakwater east of the existing causeway and a 270-foot spur on the end of the causeway making it a total of 2,982 feet. These changes significantly reduced the lost weather days from previous years.

The City Dock (south) on the causeway is equipped with marine headers to handle the community's bulk fuel deliveries, and is also the primary dock for unloading the mainline cargo barges. The City Dock is approximately 200 feet in length with a depth of minus 22.5 feet (MLLW).

The West Gold Dock (north) is 190 feet in length with the same depth of minus 22.5 feet (MLLW) and handles nearly all of the exported and imported rock and gravel for this region. It is also the primary location to load or unload heavy equipment. One of the challenges the Port faces is that gravel ramps must be built for roll-on/roll-off (RO/RO) equipment with frequent conflicts occurring due to differing heights of the barge and the fixed height of the dock.

The opening between the new breakwater and the causeway (outer harbor entrance) is approximately 500 feet in width and serves as access to both causeway deep water docks and the new Snake River entrance that leads into the Small Boat Harbor. Buoys outline the minus 12-foot MLLW navigation channel from the outer harbor entrance into the inner harbor. Figure 7 shows an aerial view of the port and harbor facilities at Nome.

[5] Port of Nome Strategic Development Plan – 2013 approved by the Common Council March 27, 2013.

Figure 7. Port of Nome Aerial Image

Source: Port of Nome Strategic Development Plan 2013

The Nome Small Boat Harbor has a depth of minus 10-feet (MLLW) and offers protected mooring for small vessels alongside sheetpile and floating docks. Smaller cargo vessels and landing craft load and unload cargo, equipment and gravel at the inner harbor sheetpile docks and concrete ramp. Diesel, gasoline and AV gas is discharged and loaded at the harbor's east dock for export to surrounding villages.

Norton Sound Economic Development Corporation operates a fish processing facility in Nome, running tenders that bring cod, herring, salmon, crab, and halibut across the Fish Dock in the Small Boat Harbor. The fishing fleet consists of about 22-25 local and regional vessels.

A new addition to the Nome facility in 2005 was a 60-foot wide concrete barge ramp located inside the inner harbor just west of the Snake River entrance. The ramp provides the bulk cargo carriers with a suitable location closer to the causeway and industrial pad to trans-load freight to landing craft and roll-on/roll-off (RO/RO) equipment barges. This location also has approximately two acres of uplands for container, gravel, vessel, and equipment storage.

In the early days, supplies were delivered from ships standing offshore by lighter vessels. Channels were often blasted into the shore fast ice to open deliveries earlier in the season. Then a tramway and wooden dock were built to extend to deeper water. In 1925, the Corps of Engineers built a sheetpile wall jetty into a dredge harbor of the Snake River, but it was often plagued by shoals building at the entrance and limited by the narrow width of the jetty.

The building of a 3,000-foot armor stone breakwater and two open c-cell sheetpile docks in 1989-1991 with a draft of minus 22-feet largely eliminated these limitations on the Port. In 2005, a corresponding 3,000-foot armor stone jetty was built to the east of the existing causeway to provide protection to the dock facilities from storms. At the same time, the old sheetpile jetty channel was filled and a new entrance to the Small Boat Harbor constructed through the Snake River. The barge offloading concrete ramp and lay down area was also constructed in 2005, just inside the harbor entrance, facilitating container-handling and village operations.

2. Port Clarence

a. Point Spencer

Point Spencer on the western edge of Port Clarence is a former USCG LORAN station. In 1976, the Bering Straits Native Corporation (BSNC) selected the Port Clarence lands for conveyance, should the land become available, under the Alaska Native Claims Settlement Act (ANCSA). The station was put into "cold" status in 2012. BSNC has been negotiating with the Coast Guard and the State to transfer the lands. BSNC staff made it a priority to receive title, regardless of the transfer's complexity or legal and regulatory obstacles encountered. [6] BSNC sees this area as a place to develop a facility that would serve as a staging area for oil and gas exploration in the Chukchi and Beaufort Seas. The Coast Guard

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[6] The Bering Straits Native Corporation newsletter The Agluktuk, Summer 2013. http://beringstraits.com/northriver/wb/media/agluktuk/2013/2013%20Summer.pdf

would also like to retain a portion of the land. There is no marine infrastructure at Point Spencer. See Figure 8 for aerial view of Point Spencer.

Figure 8. Point Spencer aerial photograph

b. Teller

There is no marine infrastructure at Teller. Goods are lightered from Nome and offloaded on the beach or transported by land during summer road openings.

c. Brevig Mission

There is no dock or ferry service at Brevig Mission. A cargo ship or tug and barge visits annually and drops supplies on the beach.

d. Cape Riley

Cape Riley is an undeveloped site.

E. Airports

1. Nome

The Nome Airport, owned and operated by the ADOT&PF, has two paved runways; one is 6,001-feet long and 150-feet wide, and the other is 5,576-feet long by 150-feet wide. Scheduled jet flights are available, as well as charter and helicopter services. The city field offers a 1,950-foot long by 110-foot wide gravel general aviation airstrip.

2. Point Spencer

A federally-owned 8,000-foot runway of which 4,497-feet is paved and lighted, with restricted access is owned and operated by the U.S. Coast Guard in Port Clarence. The Port Clarence LORAN tower was demolished in 2010 and the station was disestablished.

3. Teller

There is a state-owned 3,000-foot long by 60-foot wide gravel runway with regular flights from Nome.

4. Brevig Mission

The state-owned 2,990-foot long by 100-foot wide gravel airstrip with a 2,110-foot long by 75-foot wide gravel crosswind strip enables year-round access. Regular air service is available from Nome, and charters are provided from Nome and Teller.

F. Roads

1. Nome

There is a road system within the community and a seasonal connection to Teller via a 72-mile gravel road.

2. Teller

There is a road link to Nome, typically between May and September via a 72-mile gravel road.

3. Brevig Mission

Brevig Mission is not connected to any other community by road. Sea and air travel are the primary forms of transportation and dog sled during the winter months. Teller is five miles away by boat.

4. Cape Riley

Cape Riley is an undeveloped site with no road access.

5. Point Spencer

There is no road connection to Point Spencer. Erosion on the spit and the 33-mile distance from Teller through wetlands and subsistence hunting/gathering areas makes road construction challenging and costly.

G. Government

All of the communities located in the geographic region under consideration are located in the Nome Census Area. This entire region is in the unorganized borough[7] of the State of Alaska. Boroughs and cities with the State of Alaska may choose to levy property tax. The City of Nome is the only one of the three cities evaluated in this report to levy a property tax. The following sections provide a brief description of the taxing authority for each of the cities evaluated and their revenues from 2012 taxes.

1. Nome

Nome is a first class city in the Nome Census Area. The City of Nome levies property taxes, a 5 percent sales tax, and a 6 percent bed tax. Tax revenues to the City of Nome from these three sources were $7.7 million in 2012.[8]

2. Teller

Teller is a second class city in the Nome Census Area. Teller has a 3 percent sales tax, and no property or other taxes. Sales tax revenue to the City of Teller was $38,847 in 2012.[9]

3. Brevig Mission

Brevig Mission is a second class city in the Nome Census Area. Brevig Mission has a 3 percent sales tax, and no property or other taxes. Sales tax revenues to Brevig Mission were $42,017 in 2012.[10]

[7] Boroughs are similar to counties.

[8] http://commerce.alaska.gov/DNN/Portals/4/Repository/Taxable/2012-Full.pdf

[9] Ibid.

[10] Ibid.

III. POTENTIAL DEEP DRAFT PORT USERS

This section details research conducted by the Alaska District regarding vessels which could use enhanced deep draft marine infrastructure in the Arctic. The information presented in this section is intended to serve as a background for readers on the wide array of existing and future traffic in the Arctic. Subsequent sections of this report will address specific vessel calls at Nome, including a description of existing traffic, and projections of the future fleet and calls at Nome.

Proper planning of a system of deep draft Arctic ports is contingent upon knowing which vessels would use the port, how often, and when. The potential users of a deep draft Arctic port system at Nome and Port Clarence are varied. Some of the deep draft vessels expected to use Nome and Port Clarence are in support of natural resource extraction industries – particularly mining and oil and gas exploration. Oil company support vessels used Port Clarence in 2012 as a safe harbor, despite the lack of infrastructure, as it is the nearest sheltered location to offshore oil and gas activity in the Chukchi Sea. Other vessels such as fuel and cargo barges and their associated lightering vessels will continue to serve local areas.

Government vessels from the US Coast Guard, US Navy, and NOAA, also have a presence among the fleet of users. The Navy and Coast Guard have both expressed interest in having adequate marine facilities available to ensure they can carry out their Arctic missions. Neither of these agencies has the funding or desire to construct a port but would welcome a port that would allow easier access for crew changes and resupply.

There is also the potential for large, international shipping or tanker vessels traveling through the Bering Strait to seek safe harbor at a deep draft facility to wait out poor weather conditions or to perform self rescue in the event of vessel incident. However, these instances will be unplanned, incidental usage, so this Federal project is not formulated to meet the needs of these vessels.

While not all vessels listed as potential users are necessarily deep draft vessels, all vessels are competing for space and upland resources at the same limited facilities and would therefore benefit from additional space to accommodate deep draft vessels.

The President's implementation plan for the Arctic calls for preparation for increased activity in the maritime domain. The objective from the plan is to "Establish a framework to guide Federal activities related to the construction, maintenance, and improvements of ports and other infrastructure needed to preserve the mobility and safe navigation of United States military and civilian vessels throughout the Arctic region". [11]

This study takes that first small step toward a system of ports needed on Alaska's Arctic coast. The stretch of shoreline from the Aleutian Chain to the Chukchi and Beaufort Seas is markedly absent of marine infrastructure capable of supporting the fleet. For example, Shell's

[11] *Implementation Plan for The National Strategy for the Arctic Region* – January 2014 as a result of the *National Strategy for the Arctic Region* published May 2013 by The White House.

2012 Chukchi Sea offshore drilling operations were staged in Dutch Harbor, Alaska. This is the closest deepwater port facility to the Chukchi. The 800-mile distance between the Port Clarence and Dutch Harbor is approximately the same distance between Seattle, Washington and Fresno, California or between New York, New York and Jacksonville, Florida, as illustrated in Figure 9. The existing lack of port facilities along these two coasts confirms Alaska's infancy in terms of deep draft marine infrastructure development.

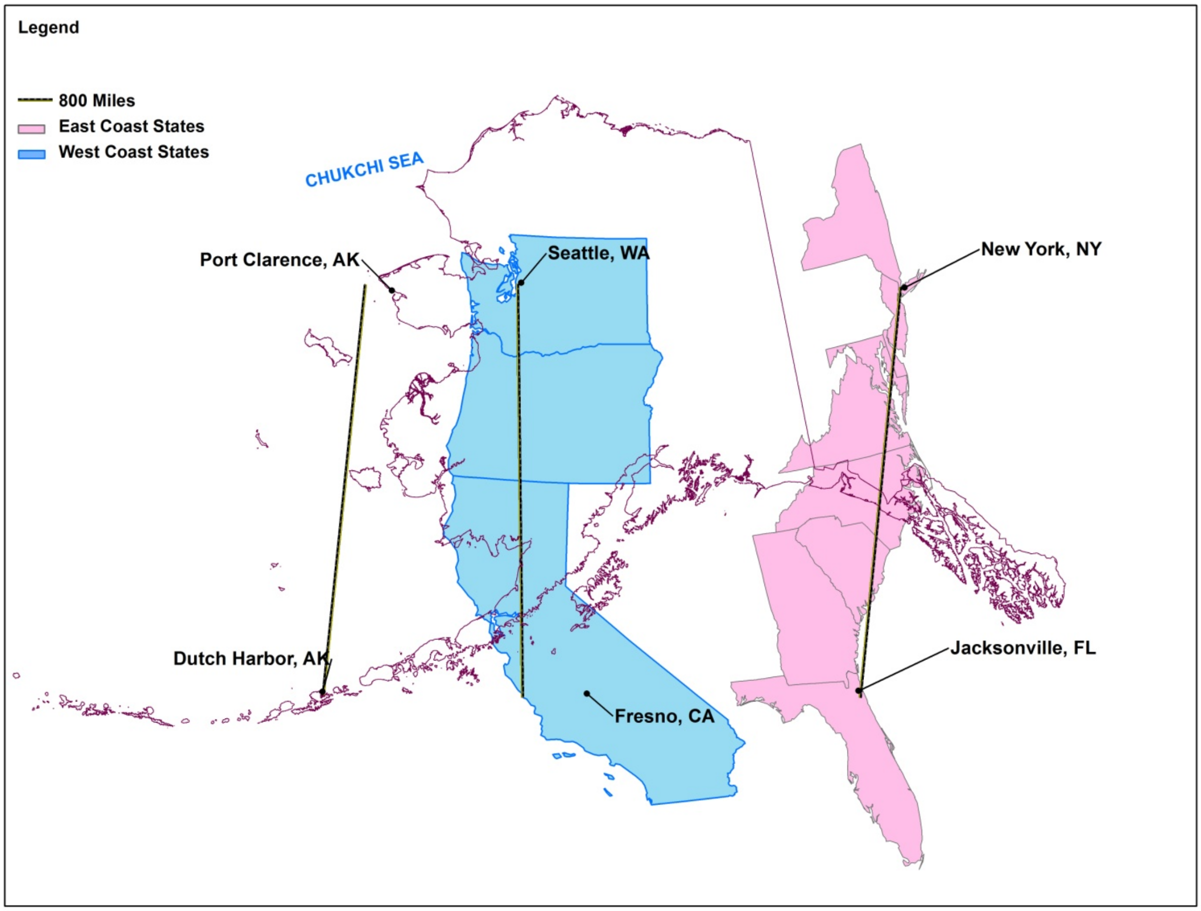

Figure 9. 800-mile comparison

Source: Alaska District Corps of Engineers Geomatics Section.

The following sections provide information on vessels which could use facilities at Nome and Port Clarence, based on current Corps of Engineers research. Also provided is data pertaining to these vessels, their associated industries, and other pertinent background information.

A. Offshore Oil and Gas Activity

Shell conducted an abbreviated drilling season in the Chukchi and Beaufort Seas in the summer of 2012. While this was not a complete drilling season, it is the closest glimpse available to how offshore drilling would operate in Alaska waters and is therefore used as representative of future plans. Shell has announced plans to resume exploration activity in summer of 2015, pending regulatory approval.

The primary component of the oil and gas industry expected to use deep draft facilities at Nome and Port Clarence are support vessels. Large drill rigs may choose to overwinter at Port Clarence, while support vessels could utilize Nome or Port Clarence facilities during the drill season for resupply and crew changes.

Additional information regarding the oil and gas industry and expected vessel fleet will be provided in subsequent sections of this report.

B. Mining

There are at least two mining companies close to being in production in the Nome and Port Clarence area: Graphite One Mine and Lost River Mine. Rock Creek Gold Mine is also located near Nome, but its future plans are uncertain– the mine was recently acquired by the Bering Straits Native Corporation to continue with the reclamation plans. Production plans are unknown.

The Lost River Mine contains fluorspar and tungsten and is expected to be operational in about five years (2019). The location of the mine and discussions with mine developer Ron Sheardown suggest that deep draft facilities at Nome and/or Port Clarence would not benefit mining operations directly. The Graphite One Mine operators have indicated production will begin in 2016 and current plans are to export from Nome but the company has a preference for export from Port Clarence. The company will not be constructing its own port facility but will use publicly available marine infrastructure.

1. Graphite One Mining Operations

The Graphite One Mine is estimated to have a 50-year mine life with mining operations beginning in 2017. Graphite is used in large fuel cell operations, in pebble-bed nuclear reactors, and is listed as a “supply critical mineral” in the US. Transshipment to supply the mine and outbound ore transport will take place by barge. The mine proposes to use 1-ton super sacks to move product to market. The company currently plans to transport product by road to Nome and then on to barges but have indicated a preference to transport to Cape Riley, located in Port Clarence, due to its shorter distance.

C. Barges – Fuel and Freight

Fuel and freight barges frequent the Nome and Port Clarence region. These vessels provide service to Nome, which serves as a transshipment point for fuel and freight distribution to more than 50 rural villages in Western Alaska.

There are several companies which operate barges in the area, including Lynden Transport, Alaska Marine Lines, Bering Marine Corporation, Boyer Towing, Western Towboat, Crowley Maritime Corporation, Delta Western, Northland Services, and Vitus Marine. In the summer of 2013, the Corps of Engineers economics staff interviewed representatives from some of these barge companies. Table 2 lists the vessels that barge companies indicated would use deep draft facilities at Nome and/or Port Clarence. This is only a sample of the projected barge traffic at Nome. Information from barge companies and from the Nome harbormaster staff were combined to calculate more complete traffic projections, which will be discussed in subsequent sections of this analysis.

Table 2. Barge Company Vessels which would Utilize Deep Draft Facilities at Nome and Port Clarence

Company Name	Vessel Name	Type of Vessel	Length (feet)	Beam (feet)	Max Draft (feet)
Lynden Transportation					
	Arctic Bear	Tug	86	25	7.5
	AK Provider	Barge	250	70	13
		Landing Craft	134	33	7
		Tug	108	32	15
	Nenana Provider	Barge	400	100	14
	New Vessel	Landing Craft	180		4
	New Vessel	Landing Craft	180		4
Western Towboat					
	Queen Titan	Tug	120	35	20
	Alaska Mariner	Tug	117	32	16
	Ocean Mariner	Tug	94	27	14.5
	Triumph	Tug	74	25	12
Crowley					
		Line Haul ATB	605	78	27.5
	[30 vessels]	Lighterage Barges	250	76	18
		General cargo or oil spill response	420	105	18
	[10 vessels]	Offshore support to oil and gas	380	80	28
Vitus Marine					
		Tanker	440		32

Source: Corps of Engineers interviews with vessel operators, July 2013.

D. Government Ships

Several government entities have vessels which transit the region. Vessels which would use facilities at Nome and Port Clarence are described in the following sections.

1. Coast Guard

a. USCG Polar Star

The US Coast Guard Cutter (USCGC) Polar Star is a USCG heavy icebreaker. Commissioned in 1976, the ship was built by Lockheed Shipbuilding and Construction Company of Seattle, Washington along with her sister ship, Polar Sea. Polar Star is one of the largest ships in the US Coast Guard and one of the world's most powerful non-nuclear ships. The vessel is 399 feet in length with an 83.5-foot beam and drafts 28 feet. The Polar Star is home ported in Seattle, Washington. Polar Star has a variety of missions while operating in polar regions.

b. USCGC Polar Sea

The USCGC Polar Sea is a Polar-class icebreaker Coast Guard cutter, 399 feet long, with an 83.5-foot beam, and 28-foot design draft. Polar-class icebreakers are able to navigate through solid ice up to six feet thick at a constant speed of three knots (3.5 mph), and to break through up to 21 feet of ice by ramming and backing. The ship carries two HH-65C Dolphin helicopters. Its standard crew compliment is 146 and an aviation detachment of nine Coast Guard air personnel. They are sustained by as much as a year's supply of food onboard. In addition, the vessel has accommodations for up to 32 scientific researchers. Potential needs for this vessel are fuel, crew changes, hospital services, and supplies to stay in the area for longer periods. The Polar Sea suffered an unexpected engine casualty in June 2010. The Coast Guard submitted a business case analysis in November 2013 to refurbish the vessel and further extend her life expectancy. At this time the Polar Sea is not operational.

c. USCGC Healy

The USCGC Healy is the Coast Guard's newest (entered service in 2000) and most technologically advanced polar icebreaker – 420 feet long (128 meters), 82-foot beam, and 29.3-foot fully-loaded draft. The Healy is designed to break 4.5 feet of ice continuously at three knots and can operate in temperatures as low as -50 degrees F. It can break 8 feet of ice by backing and ramming. The Healy is designed to conduct a wide range of research activities, providing more than 4,200 square feet of scientific laboratory space, numerous electronic sensor systems, oceanographic winches, and accommodations for up to 50 scientists. As a Coast Guard cutter, Healy is also a capable platform for supporting other potential missions in the polar regions, including logistics, search and rescue, ship escort, environmental protection, and enforcement of laws and treaties.

d. USCGC SPAR

The USCGC Spar is a 225-foot long oceangoing buoy tender homeported in Kodiak, Alaska. The vessel is equipped with a single controllable pitch propeller, bow and stern thrusters which give the cutter the maneuverability it needs to tend buoys offshore and in restricted waters. Spar's operation area includes all the Aleutian Islands, earning her the name "The Aleutian Keeper". Spar is a multi-mission Cutter executing Maritime Homeland Security, Maritime Environmental Protection, Maritime Law Enforcement, Search and Rescue, and Domestic Icebreaking. USCGC Spar's 48 person crew is made up of 8 officers and 40 enlisted members.[12]

[12] US Coast Guard, District 17. http://www.uscg.mil/d17/cgcspar/mission.asp

e. Future Icebreakers

In November 2013, the US Senate delegations from Alaska and Washington State introduced an amendment to the 2014 Defense Authorization Act that would allow the Navy to immediately sign multiyear contracts to procure four new heavy-duty icebreaking vessels. The vessels would be constructed by the US Navy then transferred to the US Coast Guard for their use. If the Defense Authorization Act passes, Congress would then have to appropriate funds to purchase the ships.[13] The request for icebreaker funds comes as a result of the USCG High Latitude Region study[14] which found the following:

- The Coast Guard requires three heavy and three medium icebreakers to fulfill its statutory missions.
- The Coast Guard requires six heavy and four medium icebreakers to fulfill its statutory missions *and* maintain the continuous presence requirements of the Naval Operations Concept.
- Applying non-material alternatives for crewing and homeporting reduces the overall requirements to four heavy and two medium icebreakers.

The existing icebreaker capacity, two inoperative heavy icebreakers and an operational medium icebreaker, does not represent a viable capability to the federal government.[15]

2. Navy

According to vessel traffic information provided by the Nome harbormaster, the USNS Sumner spent two days anchored offshore of the Port of Nome in 2012. The Sumner is an oceanographic survey ship which supports worldwide oceanography programs, including performing acoustical, biological, physical, and geophysical surveys. The vessel is 328.5 feet long, with a 58-foot beam, and 19-foot draft.[16]

The "general" requirements of the expected fleet of future Navy ships which may use facilities at Nome or Port Clarence include: 35-feet draft (necessary harbor depth, not ship depth), either 700-feet or 850-feet in length, and at least 106-feet beam. [17] The purpose for Naval use of an Arctic port would be to get fuel, transship from air cargo, and shelter from storms.[18]

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[13] "Washington, Alaska senators pave way for 4 new icebreakers." The Seattle Times, November 28, 2013, by Kyung M. Song. http://seattletimes.com/html/localnews/2022357413_polaricebreakersxml.html

[14] *United States Coast Guard High Latitude Region Mission Analysis Capstone Summary* prepared for the United States Coast Guard by ABS Consulting – July 2010.

[15] *Changes in the Arctic: Background and Issues for Congress* prepared by Congressional Research Service by Ronald O'Rourke, Coordinator and specialist in Naval Affairs, August 4, 2014.

[16] US Navy's Military Sealift Command, Ship Inventory, Oceanographic Survey Ships. http://www.msc.navy.mil/inventory/ships.asp?ship=161&type=OceanographicSurveyShip

[17] Email from Michael Bosworth, SEA 05TB, Deputy Group Director, Chief Technology Office, April 11, 2013.

[18] Ibid.

3. NOAA

a. NOAA Ship Fairweather

The Fairweather is an ice-strengthened vessel, 231 feet long, with a 42-foot beam, and 15.5-foot draft. The Fairweather is designed and outfitted primarily for conducting hydrographic surveys in support of nautical charting, but it is capable of many other missions in support of NOAA programs. The ship is equipped with the latest in hydrographic survey technology – multi-beam survey systems; high-speed, high-resolution side-scan sonar; position and orientation systems; hydrographic survey launches; and an on-board data-processing server. Increased mission space and deck machinery enable Fairweather to be tasked with anything from buoy operations to fisheries research cruises.

E. Research Vessels

Research vessels also represent a component of Arctic vessel traffic. Table 3 shows the research vessels which made port calls at the Port of Nome in 2012. Data provided by the Marine Exchange of Alaska regarding the research vessels which transited through the Bering Strait in 2011 is shown in Table 4. Decreased Arctic sea ice and increased vessel traffic will lead to more research vessel traffic.

Table 3. Research Vessels which called upon the Port of Nome in 2012

Vessel Name	Length (feet)	Beam (feet)	Draft (feet)	Vessel Flag
Alaska Knight	141	33	13	US
Aquila	164	38	11	US
Bristol Explorer	180	40		US
Geo Arctic	270	49	17	Russia
Norseman II	115	29	13	US
Polar Bear				
Polar Prince	309	72	23	Canada
Professor Khromov	234	43	16	Russia
SW Laurier	272	53	20	Canada
Thunder	69	20		
Westward Wind	160	34	49	US

Source: City of Nome, Harbormaster.

Table 4. Research Vessels which transited through the Bering Strait in 2011

Vessel Name	Length (feet)	Beam (feet)	Draft (feet)	Vessel Flag
Akademik Lavrentyev	246	49	15	Russia
Araon	335	62	24	Korea
Duke	220	46	22	Bahamas
Fairweather	236	43	18	US
Marcus G. Langseth	236	56	21	US
Norseman II	98	33	13	US

Source: Marine Exchange of Alaska

F. Cruise Ships

Tourism in the Arctic has increased in recent years. Cruise ships which called upon the Port of Nome in 2012 include The World, Bremen, Caledonian Sky, and Hanseatic. Table 5 presents the characteristics of these vessels.

Table 5. Cruise Ships which called upon the Port of Nome in 2013

Vessel Name	Length (feet)	Beam (feet)	Draft (feet)	Vessel Flag
The World	644	98	23	Bahamas
Bremen	366	56	22	Bahamas
Caledonian Sky	297	50	14	Bahamas
Hanseatic	404	60	16	Bahamas

Source: City of Nome and Marine Exchange of Alaska

In general, the cruise ships which operate in the Arctic are smaller, specialized cruise ships which hold 500 to 600 passengers, rather than the ships which serve Southeast Alaska and accommodate several thousand passengers. The cruise ship The World is too large to enter the Port of Nome and must anchor offshore and lighter passengers to shore. The Nome harbormaster also reported that in the summer of 2013, a French cruise ship decided to bypass landing at Nome due to size restrictions at the port. This implies that there is unmet cruise ship demand which would utilize the Port of Nome with enhanced marine infrastructure.

G. Other Vessel Types

This category includes vessels which use existing port and harbor facilities, but are not deep draft. These vessels are included in this analysis as they currently utilize the same space as existing deep draft vessels and therefore compete for the same resources – entry to ports, mooring space, and upland facilities such as fuel, airports, restaurants, medical facilities, and hotels.

1. Gold Dredges

Suction gold dredging is a popular form of recovering gold from placer gravels in freshwater streams and in marine sediments. Suction dredging occurs just offshore of the City of Nome. Various sizes of suction dredges are used, varying from those “recreational” models with a small 1 ½ -inch intake hose to large, heavy dredges with 8-inch and 10-inch intake hoses, driven by powerful engines, and capable of processing large amounts of material in a single day. Nome has public mining areas and leased tracts offshore that are managed by the State of Alaska, Department of Natural Resources and the Federal Bureau of Land Management.[19]

High prices for gold have resulted in an influx of gold dredges in the area. The Discovery Channel's reality television show, "Bering Sea Gold" has also contributed to the increase in popularity of gold dredging. In an article published in the Alaska Journal of Commerce in August 2012, Nome harbormaster Joy Baker stated there were 81 ocean-going dredges in the Nome harbor.[20] Conversations with Joy Baker in September 2013 revealed that there were approximately 100 dredges in Nome in 2013 and an additional 17 support vessels for these dredging operations.

These dredges vary in size from modified skiffs or zodiac rafts approximately 20-feet in length to large fabricated dredges nearing 50-feet. These vessels draft, at most, a few feet, and are not potential users of deep draft facilities. However, these dredges do frequently transit through the Port of Nome to access the Nome Small Boat Harbor and can be navigation hazards for the large vessels attempting to access the Port. Also, limited space at the Port of Nome induces overcrowding at the Nome Small Boat Harbor where dredges seek moorage.

2. Commercial Fishing Vessels

Commercial fishing vessels also utilize existing facilities in the Nome and Port Clarence region. Table 6 shows the number of commercial fishing vessels in the study area communities for 2012. The average length of the 20 commercial fishing vessels in Nome is 31.7 feet. These small vessels do not need deep draft port facilities, but could receive ancillary benefits through increased efficiency at existing small boat harbor facilities.

Table 6. Commercial Fishing Vessels, by Community, 2012

Community	Number of Vessels
Nome	20
Teller	2
Brevig Mission	0

Source: State of Alaska Department of Fish and Game, Commercial Fisheries Entry Commission

Also, warming ocean temperatures are moving commercially harvested fish species north which may increase the number of future commercial fishing vessels in the region.

Norton Sound Economic Development Corporation (NSEDC) has a fish processing plant in Nome. This plant processes commercial catch from nearby communities in Western Alaska. Fish are delivered via commercial fishing and tender vessels during the respective fishing seasons.

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[19] State of Alaska, Department of Natural Resources, Nome Dredgers Resource Guide. http://dnr.alaska.gov/mlw/mining/nome/

[20] "High prices and reality TV start another Nome gold rush", by Tyler Rhodes, Alaska Journal of Commerce. August 23, 2012. http://www.alaskajournal.com/Alaska-Journal-of-Commerce/August-Issue-4-2012/High-prices-and-reality-TV-start-another-Nome-gold-rush/

3. Sailboats, Yachts, and Pleasure Boats

In addition to cruise vessels, Arctic tourism has increased pleasure boat traffic in the study area. For example, data provided by Nome harbormaster staff show that 16 pleasure vessels spent a total of 19 days at the Nome harbor in 2011 and 21 vessels spent 61 days in Nome in 2012.

4. Other Vessels

Subsistence, sport fishing, charter, and guided vessels are also active in the study area. Less information is available on the number of these vessels. This is another class of small vessel which does not require deep draft facilities, but could benefit from the efficiencies gained as a result of a deep draft system of ports.

IV. ADDITIONAL ARCTIC BACKGROUND INFORMATION

This section presents additional information pertaining to the Arctic. The intent of this section is to inform readers of additional underlying issues associated with the need for deep draft navigation improvements in the Arctic.

A. Sea Ice

Another key consideration for addressing the need for deep draft port infrastructure development is the changing Arctic. According to NOAA's Office of Response and Restoration:[21]

> *Conditions in the Arctic are changing rapidly. The National Oceanic and Atmospheric Administration (NOAA) estimates that within the next 30 years the Arctic Ocean will be free of multi-year ice in the summer. However, "ice-free" seasonal conditions still present hazards to navigation: unpredictable ice conditions, moving ice floes, unsettled weather, and wave patterns*.

Although winter ice will be present, recent predictions from NOAA and the US Navy suggest that the Arctic may be free of multi-year ice as soon as 2020.[22] And, a recent report from the US Naval Postgraduate School's Department of Oceanography shows that the Arctic could lose its summer ice as early as 2016.[23]

Shipping traffic for deep draft vessels is increasing as ice formation in the Arctic begins later and breaks up earlier in the season. The ice layer is much thinner, making vessel traffic through the Arctic more appealing. Arctic shipping routes, the Northern Sea Route and the Northwest Passage, can save 5,000 miles and up to 20 days off a voyage compared with the traditional Panama and Suez Canal routes. Figure 10 illustrates the Arctic shipping routes compared to their existing alternatives.

[21] National Oceanic and Atmospheric Administration, Office of Response and Restoration, Activities in the Arctic. http://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/activities-arctic.html

[22] "Navy Sees Opportunity, Risk in Thawing Arctic", by Kris Osborn, Military.com news, November 18, 2013. http://www.military.com/daily-news/2013/11/18/navy-sees-opportunity-risk-in-thawing-arctic.html?comp=7000023317843&rank=10

[23] "US Navy predicts summer ice free Arctic by 2016", by Nafeez Ahmed, The Guardian, December 9, 2013. http://www.theguardian.com/environment/earth-insight/2013/dec/09/us-navy-arctic-sea-ice-2016-melt

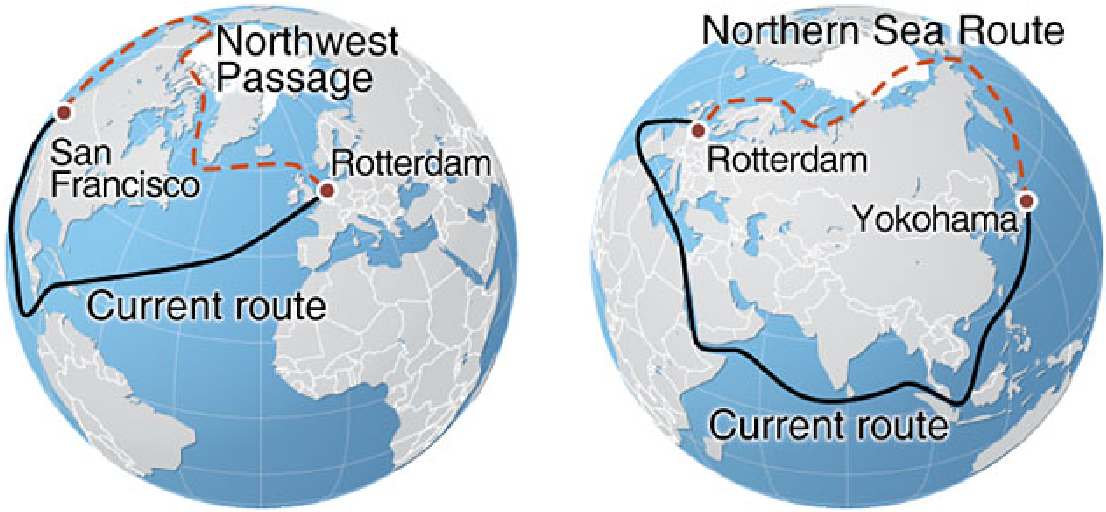

Figure 10. Northwest Passage and Northern Sea Route, in comparison to current shipping routes

Source: Discovering the Arctic

Note: The "current route" under the Northwest Passage is the Panama Canal and under the Northern Sea Route is the Suez Canal.

More vessels are taking advantage of this opening. Deep draft vessel traffic using the Northern Sea Route from 2009 through 2013 rose from 4 vessels, to 11 vessels, to 34 vessels, to 46 vessels, to 71 vessels, respectively.[24] The Russian Federation started issuing permits in 2013 for vessels travelling past its shores; there were 622 permits issued in 2013. Fewer vessels transited through the full length of the Northwest Passage.

In addition to ice conditions, recent violence targeted at ships passing through the Suez Canal may make the Arctic shipping lanes a more attractive option. Political instability in the Middle East has raised concerns about the safety of the Suez Canal.[25]

B. Regional Vessel Traffic

Using data gathered by the Marine Exchange of Alaska (MXAK) through the Automated Identification System (AIS), the Alaska District compiled a list of vessels greater than 100-feet in length overall to demonstrate the traffic currently occurring in the Nome and Port Clarence area. Figure 11 shows large vessel traffic in the Nome and Port Clarence region, both as a number of vessels, and a total number of trips.

[24] Northern Sea Route Information Office. http://www.arctic-lio.com/

[25] "Polar Sea Lane Finds Favor as Suez Security Doubts Grow", Bloomberg, September 11, 2013, by Chris Jasper. http://www.bloomberg.com/news/2013-09-11/sea-levels-may-rise-69-centimeters-until-2100-on-ice-melt.html

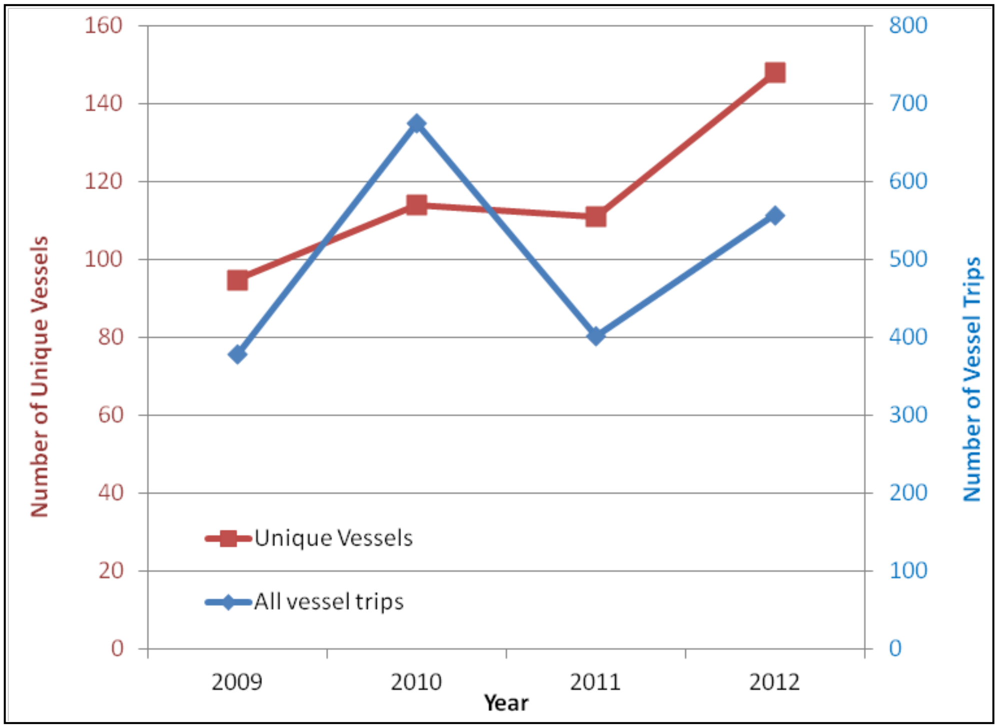

Figure 11. Historic Vessel Traffic in the Nome/Port Clarence Area, by unique vessels and number of vessel trips, per year

Source: Marine Exchange of Alaska database

The four years of data available for the Nome and Port Clarence area show a general trend upward. There was a spike in vessel trips in 2010 due to the NOAA research vessel making repeated trips in the area.

According to MXAK data, most of the large vessel traffic (greater than 100-feet in length) are cargo ships, followed by tankers, “other”, towing, and tug vessels. Table 7 shows the vessels in the Nome and Port Clarence area, by vessel type, between 2009 and 2012. The table presents the data for unique vessels names, not the total number of trips made by each vessel (i.e. if one cargo ship made 60 trips through the region in 2012, its entry would be listed as 1, not 60).

Table 7. Historic Vessel Traffic - Nome/Port Clarence Area, unique vessels, by type of vessel

Ship Type	2009	2010	2011	2012
Cargo	36	34	43	51
Tanker	9	9	18	20
Other	5	0	0	15
Towing	3	5	6	12
Towing long/wide	16	22	16	12
Tug	11	13	10	11
Military	4	2	3	6
N/A	1	0	0	4
Undefined	0	0	0	3
Fishing	0	0	0	3
Passenger	4	5	2	3
Sailing	0	1	1	2
Anchor Handling	0	0	0	2
SAR	1	2	0	2
Research	5	14	7	2
Ice Breaker	0	2	2	0
Law enforcement	0	1	0	0
Pleasure	0	3	2	0
Reserved	0	1	0	0
Drill Ship	0	0	1	0
Total	**95**	**114**	**111**	**148**

Source: Marine Exchange of Alaska

Length, draft, and beam for the 558 vessel trips in the Nome and Port Clarence area in 2012 are displayed in Table 8. Total vessel trips, rather than unique vessels, are presented in the table, as some vessels had different drafts on different transits.

Table 8. 2012 Nome/Port Clarence Vessel Characteristics, by all vessel trips

Length	**< 50 meters (164-feet)**	**50 - 100 meters (up to 328-feet)**	**101 - 150 meters (up to 492-feet)**	**151 - 200 meters (up to 656-feet)**	**> 200 meters (>656-feet)**
Number of vessels	187	95	69	67	62
Draft	**< 5 meters (16-feet)**	**5 - 7.5 meters (up to 24.6 feet)**	**7.6 - 10 meters (up to 32.8-feet)**	**10.1 - 12 meters (up to 39-feet)**	**> 12 meters (>39-feet)**
Number of vessels	200	116	67	38	36
Beam	**< 15 meters (49-feet)**	**15-20 meters (up to 65.6-feet)**	**21-25 meters (up to 82-feet)**	**26-30 meters (up to 98-feet)**	**>30 meters (>98-feet)**
Number of vessels	215	110	31	22	102

Source: Marine Exchange of Alaska

Data about recent vessel traffic on the Northern Sea Route also provides a useful perspective of the study area. All vessels using the Northern Sea Route must pass Alaska's shores, most notably at the 50-mile wide Bering Strait. The Russian government requires icebreaker escorts for large vessels passing its shores. The Canadian, Russian, and U.S. Coast Guards have historically kept track of the vessel traffic and in 2013, the Russian Federation began issuing permits to all vessels passing its shores. Depending on the size of the vessel and its ice hardiness, the Russian government is requiring up to two icebreaker escorts for vessels that wish to pass through Russian waters via the Northern Sea Route.

Table 9. Historic Northern Sea Route Traffic

Year	Number of permits	Number of cargo vessels	Tons of cargo
2008		0	
2009		0	
2010		4	111,000
2011		41	820,000
2012		46	1,261,000
2013	622	71	1,356,000

Source: Northern Sea Route Administration – http://www.arctic-lio.com/nsr_nsra.
Final statistics for 2013 issued 22 Nov 2-13.

Reuters reported in May 2013 that Northern Sea Route traffic will increase more than 30-fold in the next eight years.[26] From 2012 to 2013, large vessel traffic on the Northern Sea Route increased by 54 percent (46 vessels to 71) and tons of cargo increased 7 percent (1.26 million to almost 1.4 million). The increase in cargo tonnage from 2011 to 2013 was 65 percent (820,000 to 1.4 million).

Table 9 does not capture the vessel traffic utilizing the Northwest Passage past Canada's shores.

C. Port Governance and Coast Guard Presence

Port and small boat harbor facilities at Nome are managed by a harbormaster and staff, with regulatory oversight of the City of Nome's port commission. Duties include managing and scheduling vessel traffic and moorage, establishing and collecting fees, and planning for future development.

As a naturally protected water body with very limited existing marine infrastructure, Port Clarence has no regulatory structure. The Coast Guard LORAN station at Point Spencer has been decommissioned, and the Bering Straits Native Corporation, the US Coast Guard, and

[26] "Ice Levels, rule changes to boost Arctic northern sea route", Reuters, by Balazs Koranyi, May 29, 2013. http://www.reuters.com/assets/print?aid=USBRE94S0DG20130529

the State of Alaska are negotiating for rights to the land. There are no port or harbor facilities at either Brevig Mission or Teller (the communities located in Port Clarence), and therefore no formal marine governing body. The impacts of large vessels using Port Clarence as a safe harbor are already being felt by local residents. During Corps of Engineers site visits conducted in June 2013, local residents reported finding fruit and paint chips in the water, and that some subsistence fish caught tasted of fuel.

The expected increase in large vessel traffic through the area may lead to an increase in vessels using Port Clarence for safe harbor. The increased traffic and the lack of local governance may negatively affect nearby residents.

The closest major Coast Guard facilities are in Kodiak, Alaska, approximately 1,200 nautical miles from Port Clarence. The Coast Guard maintained a summer forward operating base in the Arctic in 2012 and 2013. Barrow was the base location in 2012, and the Coast Guard used Kotzebue in 2013. Despite the seasonal operating base, the majority of the Coast Guard's response capability which would be used for a major vessel incident, remains based out of Kodiak.

D. Other Conditions and Issues

According to data provided by MXAK, 66 percent of vessel traffic near Nome and Port Clarence in 2012 were non-US flagged vessels. Twenty-one countries, other than the US, had vessels transiting the area. This was an increase from 15 countries in 2011. Issues may arise from having many different foreign-flagged vessels operating in Alaskan waters. According to the International Maritime Organization (IMO), there are currently no mandatory requirements to address safety concerns for ships operating in Arctic waters or transiting the Bering Strait. There are no comprehensive rules for the design, construction, and equipment of vessels, nor are there clearly defined procedures regarding operational, training, search and rescue, and environmental protection matters.[27]

Further, regulatory control of foreign vessels is divided among many entities, including the IMO, flag states, port states, and classification societies. Jurisdictional issues are complex and the legal right of transit and the right of innocent passage limits the intervention measures available to state and federal agencies. The quality of vessel design and construction, crew training and experience, and the management standards of operating companies are inconsistent across the fleet. Classes of vessel are designed for specific commodities and services, leading to a large number of ship types and sizes carrying a wide variety of potentially hazardous substances.[28] One study cites that the assessment of risks associated

[27] "Arctic Economics in the 21st Century: The Benefits and Cost of Cold", Center for Strategic & International Studies, July 30, 2013, by Heather A. Conley. http://csis.org/publications/arctic-economics-21st-century

[28] "Risk of Vessel Accidents and Spills in the Aleutian Islands, Designing a Comprehensive Risk Assessment", Transportation Research Board of the National Academies, 2008.

with maritime safety can be extremely complicated and is based on factors such as the flag of the vessel and related vessel characteristics.[29]

In the summer of 2013, a Russian tanker vessel struck an ice floe off the Russian coast and began taking on water while transiting the Northern Sea Route. There were no fuel leaks or other environmental damages reported. The vessel was allowed to sail the Northern Sea Route only during “light” ice conditions, but the ice conditions at the time of the accident were listed as “medium”. The vessel received assistance and was able to offload its fuel and was then towed to safety. Had this same accident occurred in Alaska waters, the result could have been much more damaging as Alaska does not have the same resources as Russia to address this kind of incident.

Another potential issue related to increased vessel traffic in the Arctic is vessel communications. One study found that reliable communications are vital to safe shipping, and places in Alaska have significant gaps in communication infrastructure. Several recent vessel incidents cite poor communications as a factor contributing to a chain of events leading to serious problems. Vessel monitoring and tracking systems can also enhance safe operations.[30] The increasing use of the vessel Automated Identification System (AIS) has increased vessel tracking capability.

Marine Exchange Alaska (MXAK) continues to add receiver stations and develop their system for more comprehensive coverage. The type of data gathered from the AIS system is self-generated, in that the vessel owner inputs the information.[31] Large vessels that might be in need of a deep draft port typically participate in the AIS system - most are required and others are voluntary. Information could, however, be missing if the vessel identification system or the land-based receiving equipment were down for some reason. The MXAK website states that “(U)nfortunately, the AIS receivers can only see so far offshore, and there will always be portions of Alaska without AIS coverage.” AIS ranges are from 20 to 150 miles depending on obstructions.

In addition, most bathymetric data of the Arctic region is outdated or missing. Some bathymetric data is comprised of lead line data and dates back to Captain Cook’s time of the mid-1700s. Inaccurate depth data is especially problematic for deep draft vessels. NOAA is currently working to update bathymetric data off Alaska’s shores but this is a slow process due to limited budgets and vessel availability.

[29] Ibid.

[30] Ibid.

[31] When participating with the AIS system, the Marine Mobile Ship Identifier (MMSI) is affixed to a vessel, and the course and speed of the vessel is calculated as it travels so these pieces of information gathered by the AIS receiver are reliable. Also reliable are the sizes of the vessels, length and width with draft being variable depending on the load. Less reliable is the vessel type. Vessel owners may report their vessel type depending on the activity they are performing at the time. Cargo and military ships, for instance, will generally be accurate, but towing and/or fishing vessels could be the same vessel performing different activities.

V. EXISTING CONDITIONS

The planning charette identified three sites for detailed consideration: Nome, Point Spencer, and Cape Riley. There is existing marine infrastructure at Nome. Point Spencer and Cape Riley, both located in Port Clarence have limited infrastructure. Additional investigation after the planning charette revealed there are issues associated with Point Spencer and Cape Riley which prevent them from being considered at this time.

At Point Spencer, there are unresolved issues with land ownership and lack of a plan for upland facility development. The analysis for Cape Riley identified only a single user for the site. USACE policy prohibits construction of Federal navigation improvements for the benefits of a single owner.

For these reasons, a detailed benefits analysis was only conducted for one site: Nome. The following sections describe the analysis of Nome. Navigation improvements at Point Spencer and Cape Riley may be examined in the future, potentially after upland development has begun.

A. Facilities and Infrastructure

A detailed description of the existing marine infrastructure at the Port of Nome was presented in the Overview of Region and Communities section.

B. Historical Commerce

The Port of Nome provided data on historical commodity movements, summarized by commodity type. The Port of Nome classifies commodities as dry cargo (cargo), fuel, or gravel. Dry cargo is primarily comprised of household goods, vehicles, non-perishable groceries, project material, and equipment. Fuel in the various fuel types is destined to Nome and transshipped to nearby communities. Gravel is comprised of the rock products produced by the nearby Nome quarry.

Table 10. Historical Commodity Movements at the Port of Nome

Year	Inbound		Outbound		
	Cargo (short tons)	Fuel (gallons)	Cargo (short tons)	Fuel (gallons)	Gravel (short tons)
1988	14,093	6,792,229	12,705	14,127,380	
1989	1,885	5,748,614	9,071	5,219,129	
1990	747		12,233	10,662,402	
1991	4,952	2,045,029	5,855	7,449,230	
1992	6,644	4,913,578	1,876	1,611,954	
1993	11,043	8,700,564	962	5,163,595	12,580
1994	12,832	4,181,015	2,824	3,798,640	7,500
1995	14,203	6,917,950	2,115	4,803,586	7,183
1996	11,451	6,626,002	1,503	3,134,912	2,036
1997	11,036	6,343,388	3,791	2,392,272	
1998	12,978	8,835,159	4,020	2,525,049	29,890
1999	9,984	8,130,570	3,497	2,160,918	78,131
2000	10,823	9,255,109	4,859	2,135,536	47,992
2001	9,802	8,245,287	5,675	2,369,888	9,122
2002	10,444	11,691,455	4,821	2,206,800	84,331
2003	16,646	7,986,904	6,616	1,670,705	73,461
2004	11,532	8,326,929	3,022	1,714,864	57,029
2005	15,916	8,327,589	4,651	5,401,075	41,673
2006	18,304	8,109,833	2,028	4,223,322	19,596
2007	24,420	12,111,791	4,322	3,419,354	16,868
2008	24,143	12,491,656	8,412	5,452,206	21,308
2009	20,118	9,717,925	9,425	5,676,087	90,040
2010	21,382	8,168,838	9,969	4,495,859	169,832
2011	25,302	7,153,305	12,592	1,178,662	69,926
2012	31,897	10,896,371	12,775	2,656,424	57,066
2013	35,732	8,402,438	20,844	3,168,123	34,335

Source: City of Nome harbor receipts

Figure 12 show the historic cargo movements at Nome. Since 2000, about 40 percent of the incoming cargo is redistributed as outgoing cargo to neighboring communities from the harbor dock. Generally speaking, activity at the causeway dock is for incoming cargo and outgoing gravel, while activity at the harbor dock is redistribution of the incoming cargo.

Dry cargo is primarily comprised of household goods utilized by residents of Nome and nearby outlying communities. In addition, the City of Nome reports that the increase in cargo movements in recent years is the result of Federal and State construction projects as well as the movement of contaminated soils through Nome to the Lower 48 for disposal. The equipment and construction materials transported for these projects are classified as dry cargo by the City of Nome.

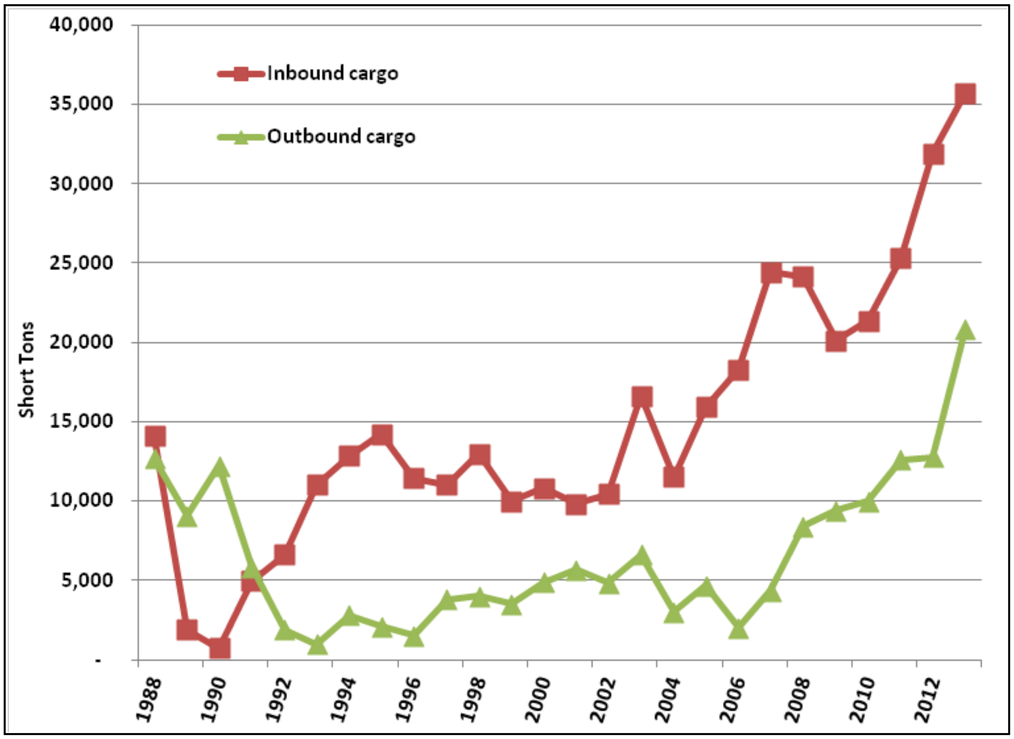

Figure 12. Historical Inbound and Outbound Cargo at the Port of Nome (short tons)

Incoming fuel at Port of Nome has increased in the last 25 years while outgoing fuel has decreased. Incoming fuel was at a low in 1991 with 2 million gallons and a high of 12.5 million gallons in 2008, with obvious year-to-year fluctuations, but an overall upward trend. Outgoing fuel was much higher in the late 1980s and has leveled off in recent years to 1.5 – 3.0 million gallons. Figure 13 displays the historic fuel transfers at the Port of Nome.

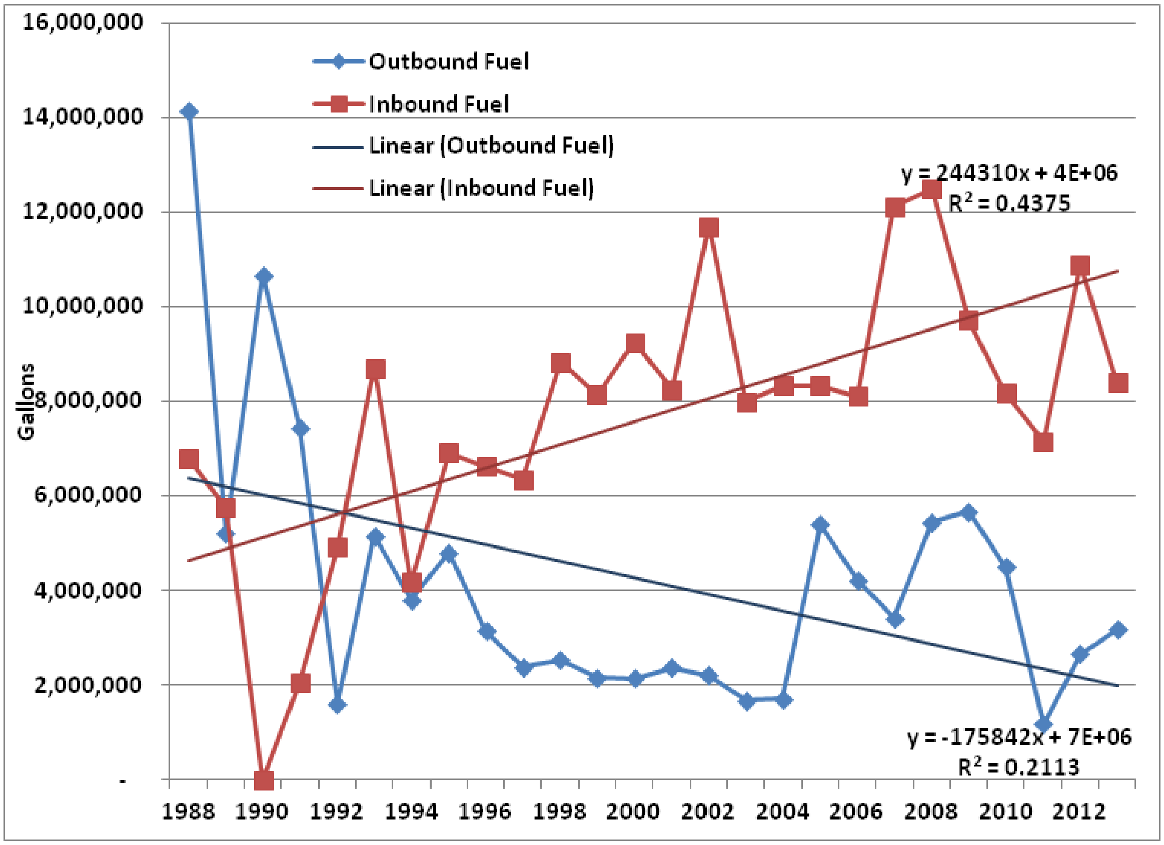

Figure 13. Historical Inbound and Outbound Fuel at the Port of Nome (in gallons)

The Nome Quarry is the regional source for rock and gravel. Figure 14 presents the historic outbound gravel tonnage at the Port of Nome.

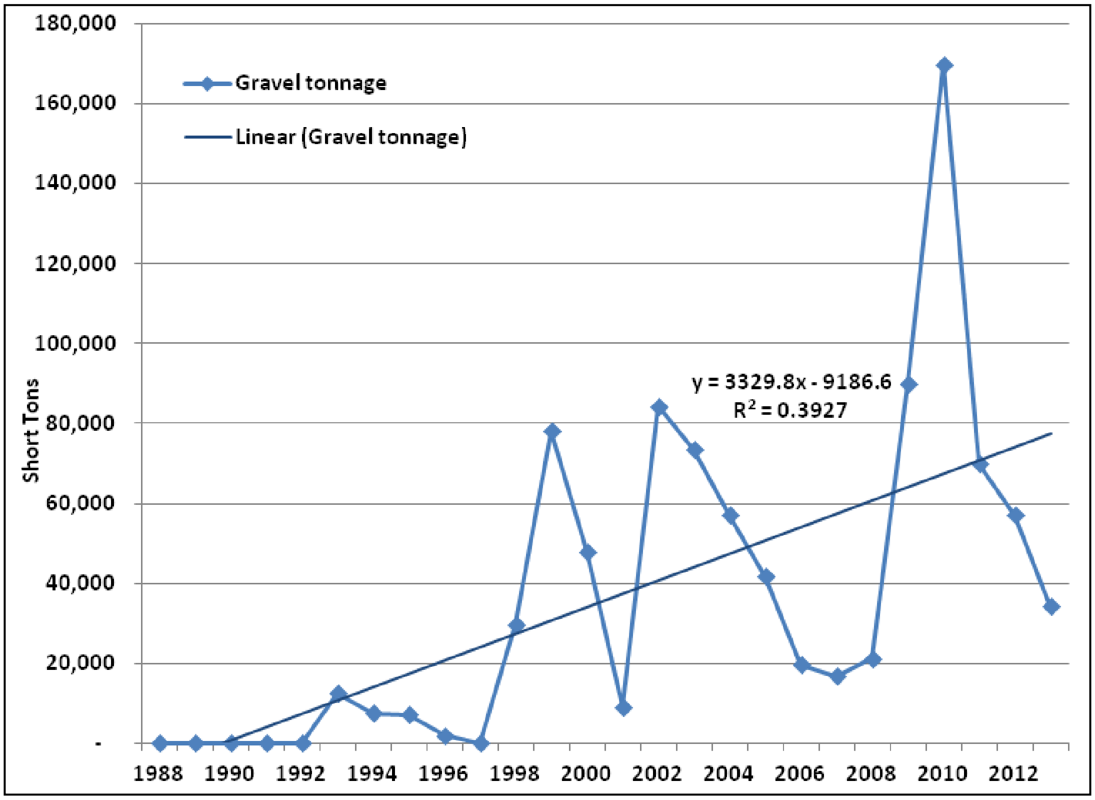

Figure 14. Historical Outbound Gravel at the Port of Nome (in short tons)

Data from the City was provided in this summary form and in respective units: short tons for cargo and gravel and gallons for fuel products. For analysis purposes, all commodity units were converted to metric tons.

To convert fuel volumes to metric tons, this analysis first needed an estimate of fuel deliveries, by type. The City of Nome records indicate total fuel amounts – not a breakdown by type (such as gasoline, heating oil, Av Gas, and etc.). To estimate this breakdown, this analysis utilized commodity data available from the Corps Waterborne Commerce Statistics Center. Data on cargo amounts provided by the Port of Nome is believed to be more representative than the Waterborne Commerce data available. However, the distributions of fuel types presented in Waterborne Commerce data are assumed to be representative. Table 11 presents the total gallons of fuel, by type, reported at Nome. Based on the fuel classifications presented in Waterborne Commerce data, this analysis assumes that Gasoline represents Unleaded Gasoline, Distillate and Residual Fuel Oil are equivalent to Heating Oil, Hydrocarbon and Petrol Gases are equal to Aviation Gas (or Av Gas), and Petroleum Products NEC are Jet Fuel. The equivalent percentages of these fuel types are presented in Table 11.

Table 11. Fuel Type Assumptions using Waterborne Commerce Data

Fuel Type	Percent of Total Gallons (2007-2011 data)	Equivalent Fuel Type
Total Petroleum and Petroleum Products		
2211 Gasoline	59.8%	Unleaded Gasoline
2330 Distillate Fuel Oil	32.2%	Heating Oil
2340 Residual Fuel Oil	0.3%	Heating Oil
2640 Hydrocarbon & Petrol Gases, Liquefied and Gaseous	1.1%	Av Gas
2990 Petro. Products NEC	6.6%	Jet Fuel

Source: Total Fuel Amounts and Types distinctions from USACE Waterborne Commerce Statistics Center, 2007-2011 Publically Available Data. Percent of Total and Equivalent Fuel type classifications based on Alaska District Analysis.

An internet search then revealed conversion factors from gallons to pounds for the various fuel types. Table 12 presents these conversion factors and equivalent weight (in pounds) of the representative fuel mix at Nome. Fuel pounds were then converted to metric tons for use in this analysis.

Table 12. Fuel Conversion, Gallons to Pounds

Fuel Type	Conversion: Gallons to Pounds	Percent Fuel Type	Weighted Fuel Pounds
Heating oil	7.2558	32.5%	2.361
Unleaded gasoline	6.3	59.8%	3.768
AvGas	6.02	1.1%	0.065
Jet Fuel	6.76	6.6%	0.445
Total		**100.0%**	**6.638**

The preceding graphics and tables illustrated all of the existing cargo data provided by the City of Nome, 1988 through 2013. This analysis utilized the 5-year average cargo amounts, to determine the baseline cargo amounts for future forecasts and calculations. Table 13 illustrates the baseline cargo amounts, in metric tons.

Table 13. Total Baseline Commerce amounts, in metric tons, 2009-2013

Year	Fuel	Dry Cargo	Gravel	Total
2009	46,352	26,801	81,683	154,836
2010	38,134	28,441	154,068	220,643
2011	25,088	34,377	63,435	122,901
2012	45,523	57,788	33,058	136,370
2013	30,786	42,217	2,181	75,184
Average	**37,177**	**36,852**	**83,061**	**141,987**

C. Existing Fleet

The Port of Nome provided vessel call information for the 2010-2013 operating seasons. (An important note is that 2013 vessel call data was not available at the time of the initial analysis. Data from 2012 was used as the most recent available at that time.) Data was provided in the form of a calendar which lists vessels calling upon the Port of Nome or anchored offshore for each day. Table 14 summarizes the vessel calls for 2010 through 2013. The vessel types noted in this table are defined by the Port of Nome and may not be consistent with classifications used in future sections of this report.

Table 14. Vessel Calls by vessel type, 2010-2013

Vessel Type	2010	2011	2012	2013
Cruise/Pleasure	2	19	61	25
Dry Cargo	53	106	104	70
Fuel	30	24	36	29
Government	6	2	6	6
Gravel/Construction	65	28	25	36
Misc.	0		7	27
Research	29	7	27	26
Total	**185**	**186**	**266**	**219**

The vessel calendars provide vessel names and their primary purpose: fuel, gravel/construction, dry cargo, cruise ship/pleasure, research, or government. The Port of Nome provided more information about vessels, such as their owner company, length, beam, and design draft as available. Other vessel characteristics were determined through internet research. Vessels were identified using their unique IMO number, if it could be determined through a combination of online research and data provided by the port.

Sailboats, yachts, and other similar recreational vessels were removed from consideration for this analysis. Even though some of these vessels are large vessels and draft deep enough to utilize the outer harbor docks, they are assumed to be lower priority vessels and likely move out of the way of vessels conducting commercial operations. Other, smaller commercial vessels such as commercial fishing vessels and gold dredges primarily utilize small boat harbor facilities at Nome. These vessels must transit through the same channel as deep draft vessels to access the inner harbor facilities, and therefore may contribute to some harbor overcrowding issues and other vessel interactions. However, these vessels are also assumed to stay out of the way of deep draft commercial vessels and were not considered in the existing condition fleet.

With the recent increase in popularity of gold dredging at Nome, the size of the dredge fleet has increased. There are also several larger gold dredges using Nome, which are too deep for the small boat harbor facilities and must use the causeway docks to transfer cargo or conduct vessel repairs. These vessels have not been included in the analysis of the fleet at this time, but may be considered for future phases of study.

1. Vessel Classes

Based on data from the Port of Nome and the assumptions described, there were a total of 224 vessel calls at Nome in 2012. Vessel call data for 2012 forms the baseline for this analysis. At the time when the existing condition vessel call data was gathered, 2012 was the only year for which a full year of detailed information was readily available regarding both vessel calls and commodity transfers by specific vessels.[32]

For this analysis, vessels were divided into seven vessel types and placed into 16 classifications based on vessel type and similarity of their dimensions. The vessel types are: tug and barge, landing craft, tanker, cruise ship, government, research, and tugboat. Table 15 summarizes the number of calls and the dimensions of the largest vessel that called for each class in 2012.

[32] Future versions of analysis could expand the existing condition based on additional years of data.

Table 15. Vessel Calls and Characteristics by Vessel Class

Vessel Type	Vessel Class	2012 Calls	Length (ft)	Beam (ft)	Draft (ft)	Capacity (Metric Tons)
Tug & Barge	Small Tug & Barge	48	299	54	14.0	4,400
	Medium Tug & Barge	32	376	78	18.0	10,653
	Large Tug & Barge	12	511	96	18.0	14,157
Landing Craft	Small Landing Craft	6	78	24	3.5	300
	Large Landing Craft	60	152	50	9.8	500
Tanker	Tanker	6	417	67	28.5	11,611
Cruise Ship	Small Cruise Ship	4	234	42	14.8	620
	Medium Cruise Ship	1	403	59	16.1	1,177
	Large Cruise Ship	1	644	98	23.0	4,558
Government	Cutter	4	225	46	13.0	350
	Buoy Tender	3	329	58	19.7	2,328
	Ice Breaker	2	378	50	17.0	3,250
Research Vessel	Small Research Vessel	21	180	40	15.0	730
	Medium Research Vessel	3	269	56	18.4	2,808
	Large Research Vessel	4	422	85	29.8	4,870
Tugboat	Tugboat	17	129	37	19.0	488

Notes: One Cutter was placed in the Ice Breaker class due to similar dimensions. Lengths for tug and barge class are equal to the sum of the tug and barge.

Vessel capacities are the cargo amounts (in metric tons) which can be carried by each vessel. The primary source for capacity information was internet research of vessel characteristics by specific vessel IMO numbers. For vessel types other than tugs and barges, the deadweight tonnage or displacement of the vessel or a vessel with similar characteristics was utilized as representative of capacity. These simplifying assumptions were made because: 1) the primary purposes of most vessel classes other than tugs and barges is not commodity (cargo/fuel/gravel) transport, and 2) those vessel classes transferring commodities (such as landing craft) are currently not depth-constrained at Nome so any changes of the depth of the port would not affect the amount of commodity moved. For tug and barge combinations, specific capacity information for each vessel was utilized as data was available. For those vessels lacking data, representative capacity information was utilized from McDonough Marine Service Ocean Barges.[33] Capacity information was extrapolated based on vessel characteristics.

Three classes of tug and barge were established based on general groupings of vessel sizes. The length for this class is defined as the length of the tugboat plus the barge. The beam,

[33] Vessel specification for McDonough Marine Service ocean barges provided information on barge size (length, width, beam), loadline, and approximate short ton capacity at freeboard for various drafts. This information was extrapolated using linear regression.

draft, and capacity for this class were defined based on the dimensions of the barge. The distribution of vessel calls by class is presented graphically in Figure 15.

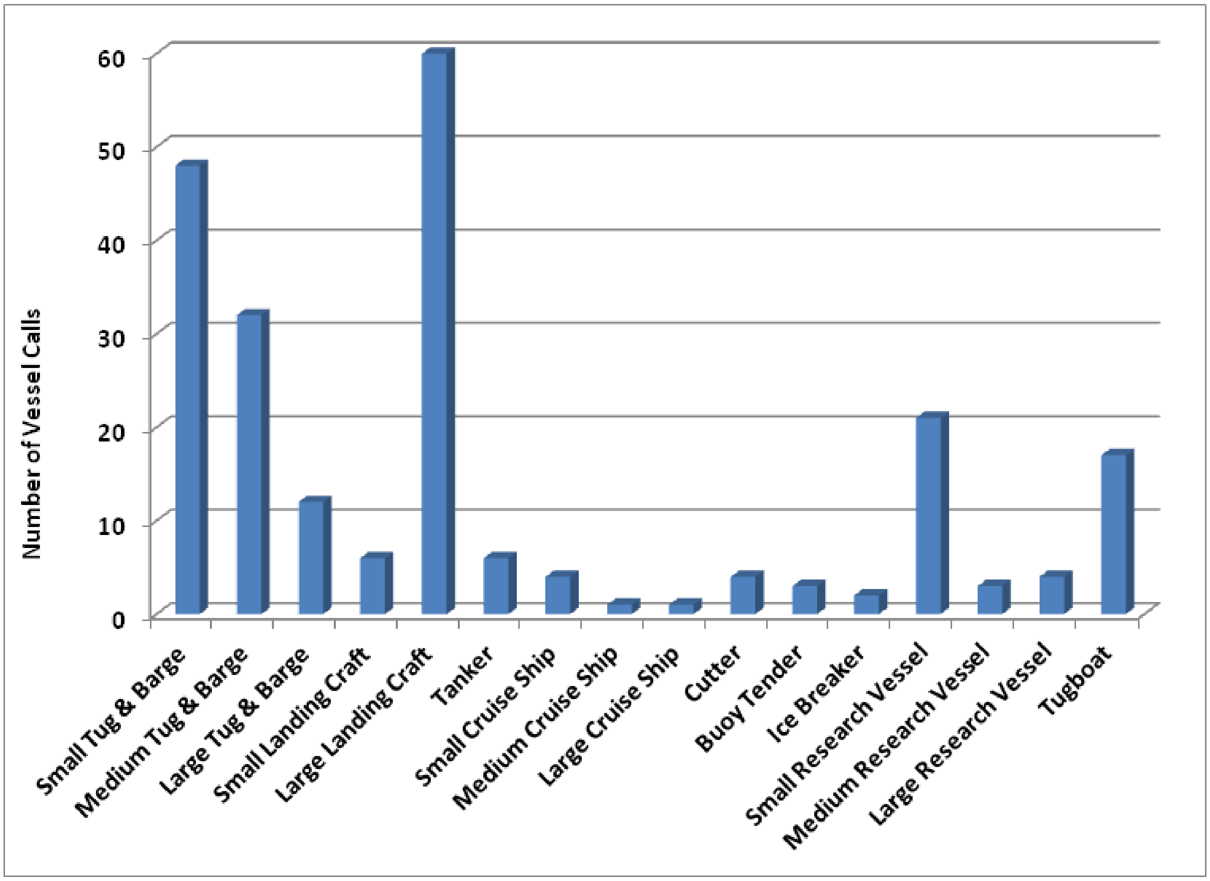

Figure 15. Vessel Calls by Type, 2012

2. Vessel Flags

The vast majority of the vessels that called at Nome in 2012 were sailing under the U.S. flag; however there were thirteen foreign flagged vessels. All of the Tanker and Cruise Ship calls at Nome in that year were vessels sailing under foreign flags. In addition five of the research vessels, two of the government vessels, and one tugboat were foreign flagged. Foreign flagged vessels typically have significantly lower operating costs than U.S. flagged vessels.

D. Shipping Operations

Typical commodity barging operations at the Port of Nome consist of the movement of household goods, vehicles, non-perishable groceries, project material and equipment, gravel and rock products, and a variety of fuels. There are currently two sheet pile docks located at the Port Causeway (City and West Gold Docks) where these items transit, as well as two ramps and four sheet pile docks in the inner small boat harbor area.

All fuels are delivered via pipeline at the City Dock to various tank farms in the port industrial area, or to a privately-owned fuel header and tank farm located at the East Dock in the small boat harbor.

Gravel and rock are typically outbound only, with only a few inbound shipments over the years.

1. Landside Operations

Fuel deliveries occur via fuel headers at the City and East docks and are transferred to or from local tank farms via fuel pipeline. Dry cargo is typically offloaded using forklifts in a "pass-pass" configuration, where a forklift on a barge passes cargo to a forklift on the dock. Some cargo and equipment offloading is roll-on-roll-off, depending on the delivery company and the types of cargo or equipment being loaded.

In general, vessel operators provide their own offloading equipment, either brought on-board the vessel or stored at Nome. The City of Nome does not provide offloading equipment. The City of Nome has no plans to change this configuration and it is consistent with offloading practices in other communities in Alaska. This is particularly true for remote Alaskan communities – many of which have no marine infrastructure, so vessels must provide their own cargo transfer equipment.

Gravel loading typically occurs at the West Gold Dock via a conveyor system that must be set up and then torn down to make room for other vessels in between gravel barge deliveries.

2. Dock Usage

The vessel calendars provided by the Port of Nome do not indicate which docks were utilized for each specific vessel call. The Port of Nome provided additional detail on a vessel-by-vessel basis regarding typical operations of that vessel and which docks are typically used. In terms of general rules, fuel deliveries occur at either the City or East docks, given the location of the fuel headers. Gravel and rock products are transferred almost exclusively at the West Gold Dock.

Considering the information provided by the Port of Nome, the Barge Ramp serves the most vessels, followed by the City Dock. The West Gold Dock and the East Dock have about the same number of calls. The Lightering Area has significantly fewer calls than the other locations; it is primarily used by vessels with sailing drafts in excess of the channel controlling depth and vessels awaiting dock space. Vessels that must lighter their cargos are subject to more difficult wave and weather conditions, which limits the use of larger, more efficient vessels at Nome. Figure 16 displays the dock distribution by vessel call for 2012.

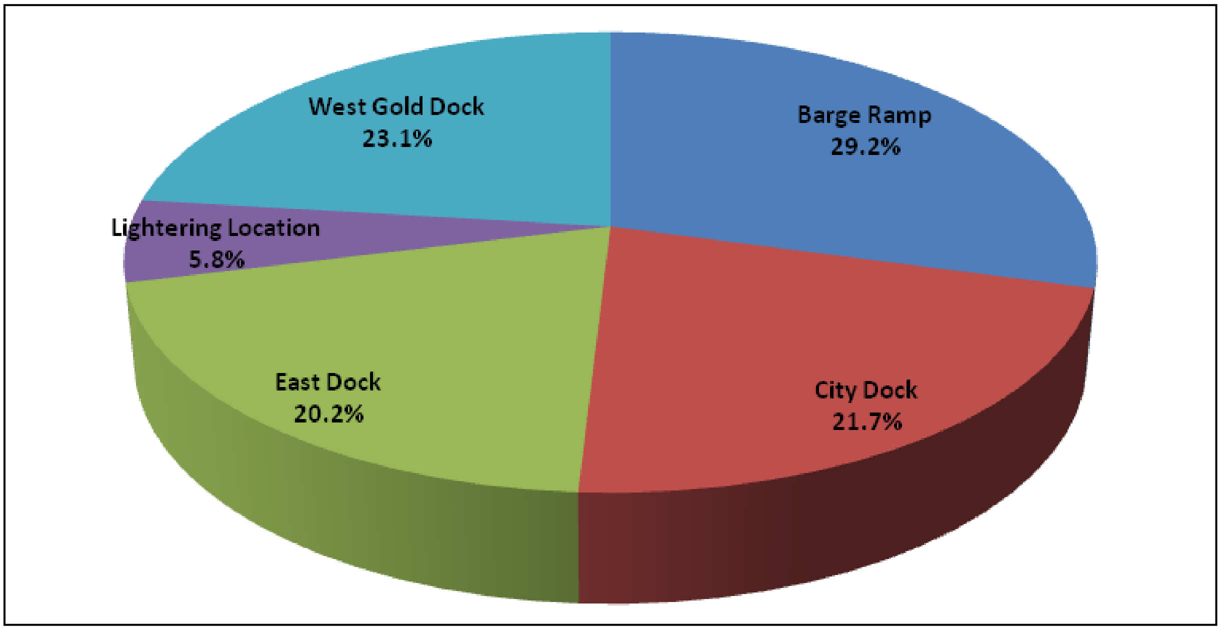

Figure 16. Nome Vessel Calls by Dock, 2012

Table 16 summarizes the number of vessel calls to the Lightering Location by vessels which drafted too deep to enter the Port of Nome. This data is based on the Alaska District analysis of vessel call data provided by the City of Nome, considering only the vessel types and calls which are utilized in HarborSym analysis.

Table 16. Vessel Calls Depth-Constrained at Nome, 2012

Vessel Type	Vessel Class	2012
Tug & Barge	Small Tug & Barge	0
	Medium Tug & Barge	0
	Large Tug & Barge	0
Landing Craft	Small Landing Craft	0
	Large Landing Craft	0
Tanker	Tanker	3
Cruise Ship	Small Cruise Ship	0
	Medium Cruise Ship	0
	Large Cruise Ship	1
Government	Cutter	0
	Buoy Tender	0
	Ice Breaker	0
Research Vessel	Small Research Vessel	0
	Medium Research Vessel	0
	Large Research Vessel	4
Tugboat	Tugboat	0
	Total	**8**

3. Rafting

The dock usage presented in the previous section includes vessel rafting. If a vessel attempts to call at the Port of Nome and the docks are already occupied, the vessel may “raft” or tie up to a vessel already at a dock and load and unload cargo over the vessel at the dock. Figure 17 illustrates typical rafting behavior at Nome.

Figure 17. Typical rafting behavior at Nome

Vessel rafting is not an ideal shipping practice as it introduces inefficiencies and possible safety hazards for vessel docking and loading. However, the Port of Nome reports that vessel rafting occurs to maximize the existing dock space. The Port of Nome provided information on some examples of rafted vessels. These include:

- A 300-foot barge loading gravel with a 73-foot research ship lying outside the barge - bow to bow with the tug. The two captains would work out a safe protocol for the research crew to load groceries/parts around the gravel operation as well as facilitate a crew change.
- Two 225-foot USCG cutter vessels doing a joint shore leave call if they happened to have a day or two overlapped on the dock schedule.
- A 400-foot fuel linehaul barge with a 150- or 180-foot barge lying outside the linehaul barge, with both tugs bow to bow outside the smaller barge. The linehaul would be discharging to the dock header while loading the smaller barge for a village or inner harbor header delivery.
- A 350-foot cargo mainline barge with one or two 150-foot landing crafts lying bow to bow outside the bigger barge, loading cargo for village delivery.
- A 417-foot tanker with a 300 foot ATB (articulating tug/barge - with the tug permanently in the push configuration connected in a stern slot) laying outside with tanker discharging to shore and ATB loading for delivery.
- A 308-foot Canadian research vessel with a 270-foot Russian research vessel lying on the outside for 5 days in the fall of 2012 when the congestion started relaxing.

These scenarios represent examples of configurations, not an exhaustive list of all vessel rafting. With that in mind, this information is intended to show that rafting occurs among many vessel and cargo types at Nome.

4. Commodity Transfers

Commodity transfer data was collected from the Port of Nome and other sources for the years 1997 through 2013. The year 2012 was used to calibrate the existing condition HarborSym model and served as the basis for the commodity and fleet forecasts.[34]

During that year a total of 130,334 metric tons[35] of commodities moved through the Port of Nome. This included 84,925 tons inbound and 45,279 tons outbound. Dry cargo amounted to 48,395 tons, of which 39,089 tons were inbound and 9,307 tons were outbound. Fuel totaled 46,667 tons, of which 42,160 were inbound and 4,507 tons were outbound. Gravel amounted to 31,995 tons, all of which were outbound. Equipment amounted to 1,219 tons, of which 571 were inbound and 641 tons were outbound. Figure 18 displays the total commodity transfers for 2012.

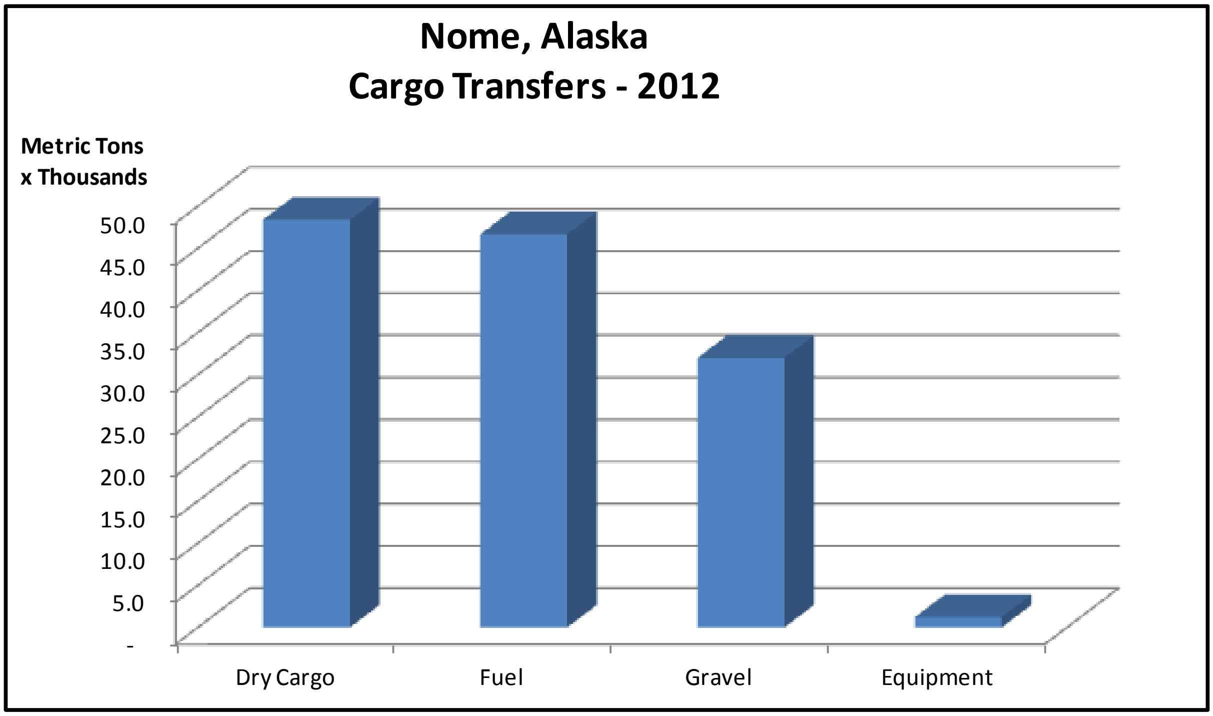

Figure 18. Commodity Transfers by Type

In terms of commodity transfers, about one half of the Dry Cargo was transferred at the City Dock in 2012, with the remainder distributed among the other three docks. Over three quarters of the fuel moved through the City Dock in 2012, while the remainder shipped

[34] Cargo data from the Port of Nome was provided as a summary of vessel invoices. In some cases, the amount of cargo reported on the invoice data was not denoted to a particular vessel or call date. Professional judgment was utilized to assign some cargo movements to vessels.

[35] All tonnages are state in metric tons unless otherwise stated.

through the East Dock. Nearly all the gravel moved through the West Gold Dock. Shipments of Equipment moved through the City Dock and the West Gold Dock in about equal shares, while a smaller amount was handled at the Barge Ramp. Because Equipment represents such a small amount of cargo, it was combined with Dry Cargo for evaluation of future "without" and "with" project conditions. Figure 19 displays the percent of cargo transferred by dock in 2012.

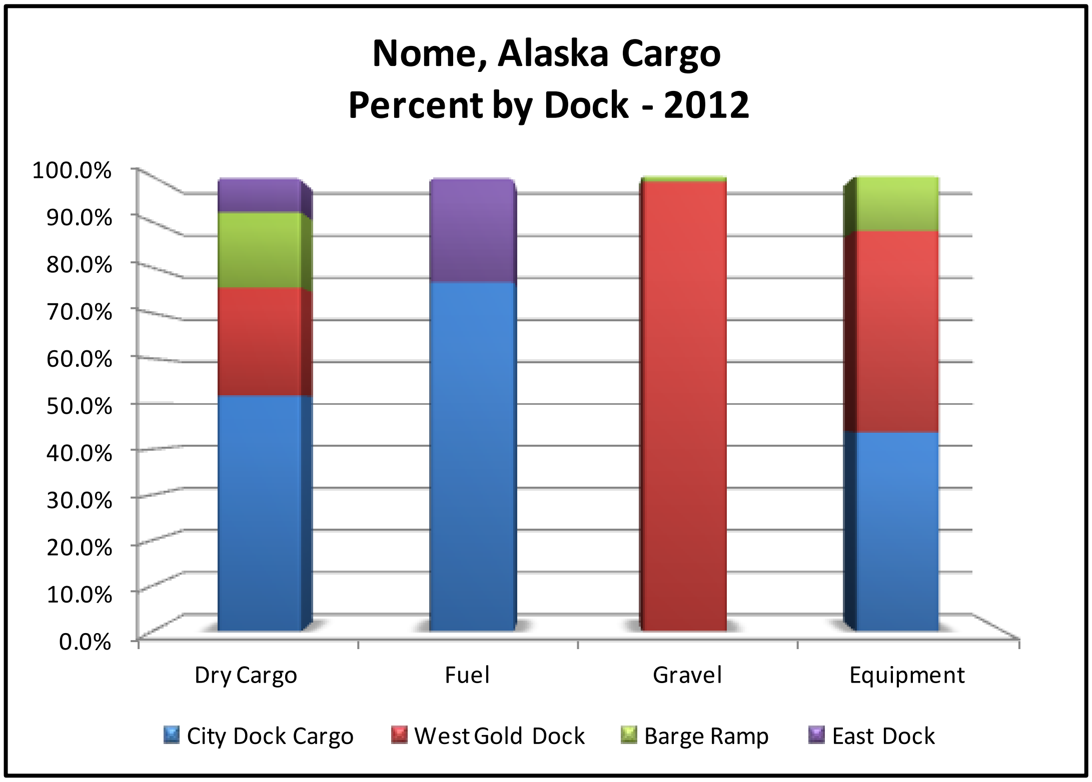

Figure 19. Commodity Percent by Dock

VI. HARBORSYM MODELING – EXISTING CONDITION BASE CASE

A. Use of HarborSym Model

The HarborSym model is a computer simulation model designed to conduct economic analysis of U.S. Army Corps of Engineers deep draft navigation planning studies. It is certified for use by Corps Headquarters. The HarborSym model for Nome, Alaska is based on empirical data provided by the Port of Nome, the Corps Navigation Data Center, and the Alaska District. Additional information and documentation on the HarborSym model can be found at http://www.corpsnets.us/harborsym/.

This section describes the specific sailing practices of vessels at Nome and other information which serves as inputs to HarborSym modeling. The inputs in this section refer to modeling of the existing condition in the "base case" – looking only at traffic which called at Nome in 2012. Future scenarios will be examined in subsequent sections.

B. Facilities

Figure 20 is an aerial photograph of the Port of Nome, Alaska. The Port is located at 64.49 degrees north latitude and 165.45 degrees west longitude. It typically operates from 1 June through 31 October depending on weather conditions. The UTC[36] offset is -9 hours.

[36] UTC stands for Coordinated Universal Time and represents an adjustment from Greenwich Mean Time or GMT.

Figure 20. Port of Nome, Alaska

1. Link/Node Network

The existing condition HarborSym model for Nome, Alaska is defined using a link/node network which describes a total of ten reaches. The link/node network is displayed in Figure 20. For most port studies the link/node network would begin at the sea buoy located outside the entrance to the harbor. However, Nome has no sea buoy because it would not survive the ice that develops in the Bering Sea/Norton Sound area during the winter. Therefore, for this study the link/node network begins at a point approximately 1,500 feet from the entrance to the harbor, which is defined as the Entry/Exit point in HarborSym.

The second node is defined as a Lightering Area, which, for modeling purposes, is located approximately 500 feet outside the harbor. The third node is a turning area which supports the City Dock and is approximately 1,000 feet from the Lightering Area. A short link connects the first turning basin area with the City Dock. The City Dock is approximately 200 feet long and has a depth alongside of 22 feet; it has the capacity to service vessels over 400 feet long. The first turning area is linked to a second turning area which supports the West

Gold Dock. This dock is also about 200 feet long, with a depth of 22 feet, and can service vessels up to about 375 feet long.

Beyond the West Gold Dock the channel narrows to pass into the Inner Harbor with a controlling depth of 10 feet. A turning basin is defined in the model just north of the entrance to the Inner Harbor. It services a Barge Ramp to the West and the East Dock area, which includes the South Dock and a small boat basin. The Inner Harbor serves primarily small barges, landing craft, and tugboats. In addition the Inner Harbor serves fishing vessels, gold dredges, and recreation craft. These vessels are using the same entrance channel as the large commercial vessels but for purposes of the HarborSym model are assumed to be able to function without interference.

2. Dock Definitions

For the HarborSym model, the Nome docks were divided into four areas; the City Dock, which is located in the Outer Harbor close to the harbor entrance. The West Gold Dock which is located just north of the City Dock in the Outer Harbor, the Barge Ramp, which is located on the West side of the Inner Harbor and the East Dock, which is on the east side of the Inner Harbor. To simplify the modeling, the East Dock and the South Dock are combined in the model. This does not impact the results. There is also an anchorage area which is used to lighter large vessels and is defined as the Lightering Location in HarborSym. It is located outside the Port area in Norton Sound, outside the entrance to the Nome harbor.

3. Port Operating Restrictions

Certain types of vessels using the Port of Nome are restricted to entering the harbor to times when onshore staff or facilities are available. For example, vessels making fuel deliveries to the City Dock can only enter the port or tie up to the dock between 5:00AM and 10:00PM. These vessels are considered regulated vessels by the Coast Guard and need security personnel and line handlers to facilitate docking and loading/unloading; these personnel are only available during this time frame. Fuel vessels can undock and leave the port at any time as personnel are not needed for oversight. Similarly, vessels delivering dry cargo can only enter the port and dock between 6:00AM and 10:00PM because Nome harbor staff is needed to direct traffic and ensure vessels are tied up properly. Foreign-flagged research and cruise vessels using a dock at Nome can only enter the harbor or access a dock between 6:00AM and 10:00PM because US Customs officials must be present and are only available during this time.

If vessels arrive outside these timeframes, they must wait offshore. There are no timing restrictions on vessels delivering gravel, vessels using the lightering area, vessels not transferring a commodity (other than those otherwise mentioned), government vessels, or tugboats not towing a barge.

These operational restrictions have been documented with the City of Nome harbormaster.

HarborSym randomizes vessel arrival times within a +/- 12-hour window of the user-assigned vessel call date, except for vessels noted as “priority” vessels. The Priority vessels are those with restricted hours to enter the harbor. Priority vessels are simulated first in HarborSym and are allowed to access a dock at a specific time. To incorporate the vessel timing restrictions, “Priority” vessel classes were created for the affected vessel types. These priority vessel types are essentially clones of the same non-priority vessel types. Then, the specific vessels subject to port restrictions were classified as the priority type of vessel in the call list. Vessel arrival times were randomized considering the port restrictions for these vessel types.

4. Tidal Impacts

Nome, Alaska is impacted by both astronomical and meteorological tidal fluctuations. The HarborSym model has the capability to incorporate astronomical tides. The published tide data for Nome, Alaska (in feet) is as follows:

Highest Observed Water Level (10/19/04)…………….. +9.80
Mean Higher High Water (MHHW) .... +1.52
Mean High Water (MHW).. +1.33
Mean Low Water (MLW).. +0.30
Mean Lower Low Water (MLLW)................................ 0.0 (datum)
Lowest Observed Water Level (11/11/05).................. -6.69

Although there is a tide station at Nome, the HarborSym model does not contain tidal information for Nome specifically; however information is available for Carolyn Island, Golovnin Bay, which is the closest available station to Nome available within the HarborSym model.

The predicted tide data (in feet) for Carolyn Island, Golovnin Bay is as follows:

Mean Higher High Water (MHHW) .... +1.80
Mean Tide Level (MTL)... +0.90
Mean Lower Low Water (MLLW).................................... 0.0 (datum)

Based on this information, the tide range is slightly higher at Golovnin Bay by less than three tenths of a foot compared to Nome. For purposes of the HarborSym modeling, the Golovnin Bay data are considered representative of Nome, based on input from Alaska District engineering, and are adopted for use in this study.[37]

The atmospheric pressure, wind setup, and storm surge effects have a much greater impact on water levels in the Nome area than astronomical tide. For example, storm surges during southerly wind conditions in the summer/fall can raise water levels for several days. Once the storm passes and winds die down and pressure increases, water levels come back down. During strong northerly winds and high pressure, set-downs can occur for several days also,

[37] In HarborSym, “synthetic” tide stations can be developed and utilized to address missing tidal information from the study area. This type of analysis was not conducted to reach the Tentatively Selected Plan milestone, but will be undertaken for future phases of study.

usually in the fall, typically for a few days in duration. These set up or set down events may have an impact on the limited shipping season at Nome.

The HarborSym model is not able to model these types of meteorological effects. This means that the delays captured in the HarborSym model are a conservative estimate as the model does not capture all weather conditions which affect use of the Port. For future phases of study, a spreadsheet model will be utilized to quantify vessel delays associated with the meteorological effects.[38]

5. Docking/Undocking Times

Vessel docking and undocking times were estimated for each vessel type and confirmed with the Port Harbormaster as being representative. Generally the larger, more complex vessels experience greater docking times. The extensive amount of rafting that occurs at Nome causes higher docking and undocking times than would otherwise be expected.

The Port of Nome provided examples of vessel rafting behavior at Nome. This information suggested that essentially every type of vessel which calls at the Port of Nome has engaged in rafting in the past, or can be expected to raft to other vessels in the future. As a generalizing assumption, this analysis assumes that all vessel types stand to benefit from efficiencies associated with reduced rafting. This is not meant to imply that every vessel which has called at Nome has actually engaged in rafting – one barge company stated it is against their safety regulations.

Typically undocking takes less time than docking and this is reflected in the values. HarborSym uses these values to develop uniform distributions and selects a distinct docking and undocking time for each vessel call in each iteration of the model. Docking and undocking times are provided in Table 17.

[38] Any future spreadsheet models will undergo the appropriate USACE review and approval processes.

Table 17: Existing Condition Docking Times

Vessel Class	Docking Time		Undocking Time	
	Minimum	Maximum	Minimum	Maximum
Small Tug and Barge	15	30	12	24
Medium Tug and Barge	30	60	15	45
Large Tug and Barge	30	60	15	45
Small Landing Craft	6	12	6	12
Large Landing Craft	15	30	12	24
Tanker	30	60	15	45
Small Cruise Ship	15	30	12	24
Medium Cruise Ship	30	60	15	45
Large Cruise Ship	30	60	15	45
Cutter	30	60	15	45
Buoy Tender	30	60	15	45
Ice Breaker	30	60	15	45
Small Research Vessel	15	30	12	24
Medium Research Vessel	30	60	15	45
Large Research Vessel	30	60	15	45
Tugboat	15	30	12	24

6. Sailing Drafts

Typical sailing draft assumptions were determined based on detailed data from Waterborne Commerce of the United States for the years 2010, 2011 and 2012. A total of approximately 1,200 records were inspected. This data was used to inform the sailing draft assumptions for the vessel call lists. The data clearly indicated that the vast majority of vessels calling at Nome sail at, or in some cases, slightly above their design drafts on load-carrying legs. It is believed this practice is at least partly due to the potential for rough weather and the need to adequately ballast vessels that operate in the region. The drafts of the largest vessels that utilized the Nome dock facilities were limited by channel constraints. For example, Tankers calling at the dock were limited to 17 feet and Large Tug & Barge combinations were limited to 18 feet.

7. Underkeel Clearance

Based on Waterborne Commerce data, the minimum underkeel clearance for most vessel classes is 2 feet. The medium research, cruise and government vessel classes were assigned a minimum underkeel clearance of 2.5 feet, while the large research, cruise and government vessel classes were assigned a minimum underkeel clearance of 3 feet. Large Tug & Barge combinations were assigned a minimum underkeel clearance of 4 feet and Tankers were assigned a minimum underkeel clearance of 5 feet. These assumptions are based on the sample of data available from Waterborne Commerce and were reviewed for accuracy by a representative from the Port of Nome.

8. Vessel Speeds

The HarborSym model uses vessel speeds to estimate travel time and cost at sea and within reaches of the harbor. Typical vessel speeds were estimated for vessel operations at sea and within the various reaches of the Port of Nome. Vessel speeds at sea were estimated based on sample Automated Identification System (AIS) data for each vessel type where available, and input from vessel operators. Vessel speeds at sea are displayed in Table 18.

Table 18: Vessel Speeds at Sea, by vessel class

Vessel Class	Vessel Speeds at Sea (knots)		
	Minimum	Most Likely	Maximum
Small Tug & Barge	7	8	9
Medium Tug & Barge	7	8	9
Large Tug & Barge	7	8	9
Small Landing Craft	10	12	15
Large Landing Craft	10	12	15
Tanker	16	17	18
Small Cruise Ship	10	12	14
Medium Cruise Ship	10	12	15
Large Cruise Ship	10	12	17
Cutter	12	15	20
Buoy Tender	12	15	20
Ice Breaker	12	15	20
Small Research Vessel	10	12	15
Medium Research Vessel	10	12	15
Large Research Vessel	10	12	15
Tugboat	8	10	12

Vessel speeds while operating within the various channel reaches at the Port of Nome were estimated by vessel operators and port officials. While vessel speeds were estimated for each vessel class in each reach, it is highly unlikely that the larger vessels would operate in the inner harbor, beyond reach 6, and the largest vessels are limited to the lightering area due to channel depth constraints.

9. Vessel Turning Times

HarborSym requires minimum, most likely, and maximum vessel turning times for each vessel class and for each turning basin in the model. At Nome, vessels are assumed to turn at the dock, so the default turning basin usage is set to "No Turn" in HarborSym. Vessel turning time inputs are still needed for modeling. Table 19 summarizes the assumed vessel turning times by vessel type. Turning times for each vessel class are equal for all turning basins.

These times are estimated based on professional judgment and were reviewed for accuracy by the Port of Nome. Vessel turning times are not expected to change in future project conditions and are therefore not a critical input for HarborSym modeling.

Table 19. Vessel Turning Times, by vessel type, for all turning basins

Vessel Type	Vessel Turning Times		
	Min	ML	Max
Tug & Barge	0.25	0.5	0.75
Research	0.25	0.5	0.75
Cruise Ship	0.25	0.5	0.75
Landing Craft	0.1	0.2	0.3
Tanker	0.25	0.5	0.75
Government	0.25	0.5	0.75
Tugboat	0.1	0.2	0.3

Note: Min is minimum, ML is most likely, and Max is maximum.

10. Vessel Capacities

The primary source for vessel capacity information was internet searches of vessel characteristics by specific vessel IMO numbers.[39] For vessel types other than tugs and barges, the deadweight tonnage or displacement of the vessel or a vessel with similar characteristics was utilized as representative. These simplifying assumptions were made because: 1) the primary purposes of vessel classes other than tugs and barges are not commodity (cargo/fuel/gravel) transport, and 2) those vessel classes transferring commodities (such as landing craft) are currently not depth-constrained at Nome. So changes of depth at the port do not affect the amount of commodity moved for vessels other than tugs and barges.

For tug and barge combinations, specific capacity information for each vessel was utilized as data was available. For those vessels lacking data, representative capacity information was utilized from McDonough Marine Service Ocean Barges.[40] Capacity information was extrapolated based on similar vessel characteristics.

11. Vessel TPI Factors

Tons per Inch (TPI) factors for tug and barge combinations were estimated using an extrapolation of the vessel characteristics of McDonough Marine Service ocean barges.

TPI Factors for other vessel types were estimated using the U.S. Army Corps of Engineers Institute for Water Resources (IWR) vessel operating cost database. This information is not

[39] The IMO ship identification number is made of the three letters "IMO" followed by the seven-digit number assigned to all ships by IHS Fairplay (formerly known as Lloyd's Register-Fairplay) when constructed. This is a unique seven digit number that is assigned to propelled, sea-going merchant ships of 100 GT and above. www.imo.org.

[40] Vessel specification for McDonough Marine Service ocean barges provided information on barge size (length, width, beam), loadline, and approximate short ton capacity at freeboard for various drafts. This information was extrapolated using linear regression.

critical to the analysis as other vessel types are either not calling upon Nome for the purpose of cargo shipments or are not depth-constrained at Nome under existing conditions.

12. Vessel Operating Costs

HarborSym requires vessel minimum, most likely, and maximum vessel operating costs at sea and in port for each vessel class. IWR determines deep draft vessel operating costs (VOCs) for many of the most common vessel types, and these costs are issued as guidance by HQUSACE. They were last issued in 2011.[41]

Information for Tanker and Cruise Ship vessel classes are included in the IWR costs. However, the tankers and cruise ships which call upon Nome are smaller than those listed by IWR so tankers and cruise ships at Nome are based upon extrapolation of the IWR VOCs.

Tugboat operating costs at sea are based on rate information provided by the Port of Nome and vessel operators.

Vessels costs for the other vessel classes are estimated based on available data, either by extrapolating costs for vessels that are similar, or apportioning costs for vessels where some type of relationship can be determined. Where data is unavailable, operating costs in port are assumed to be 67 percent of operating costs at sea. Maximum and minimum costs are defined as plus or minus 10 percent of the most likely value for this study. Operating costs for foreign-flagged vessels are set at 50 percent of domestic vessel VOCs, if no other data is available.

Most likely Tug & Barge and Landing Craft operating costs at sea and in port are extrapolated from the vessel operating costs for General Cargo vessels with similar deadweight tonnage contained in the Deep Draft Vessel Operating Cost guidance issues by the Corps.

Vessel operating costs for government and research vessels are based upon the US Coast Guard's published Reimbursable Standard Rates, as coordinated through IWR. Rates for Coast Guard vessels are assumed representative of research vessels given their similar vessel characteristics and missions.

[41] Updated vessel operating costs are expected to be released in the near future. This analysis will be revised to include these updated VOCs as appropriate. Per HQUSACE and the DDNPCX, these operating costs cannot be updated to current dollar levels using an available index. Therefore, the 2011 VOCs, as presented, are assumed representative of current price levels until updated values are published by HQUSACE.

A complete list of estimated vessel operating costs is provided in Table 20.

Table 20: Estimated Vessel Operating Costs

Vessel Class	Flag	Vessel Operating Costs at Sea			Vessel Operating Costs in Port		
		Min	ML	Max	Min	ML	Max
Small Tug & Barge	US	$590	$630	$670	$408	$433	$457
Medium Tug & Barge	US	$636	$795	$954	$436	$534	$631
Large Tug & Barge	US	$954	$1,082	$1,210	$631	$710	$788
Small Landing Craft	US	$495	$550	$605	$345	$384	$422
Large Landing Craft	US	$526	$584	$643	$364	$405	$445
Tanker	Foreign	$726	$806	$887	$412	$458	$503
Small Cruise Ship	Foreign	$1,800	$2,000	$2,200	$900	$1,000	$1,100
Medium Cruise Ship	Foreign	$3,500	$4,000	$4,500	$2,000	$2,200	$2,400
Large Cruise Ship	Foreign	$6,500	$7,000	$7,500	$5,500	$6,000	$6,500
Cutter	US	$3,591	$3,990	$4,389	$2,406	$2,673	$2,941
Buoy Tender	US	$9,283	$10,314	$11,345	$6,219	$6,910	$7,601
Ice Breaker	US	$11,189	$12,432	$13,675	$7,496	$8,329	$9,162
Small Research Vessel	US	$3,591	$3,990	$4,389	$2,406	$2,673	$2,941
Medium Research Vessel	US	$9,283	$10,314	$11,345	$6,219	$6,910	$7,601
Medium Research Vessel	Foreign	$4,641	$5,157	$5,673	$3,110	$3,455	$3,801
Large Research Vessel	Foreign	$5,594	$6,216	$6,838	$3,748	$4,165	$4,581
Tugboat	US	$500	$600	$700	$400	$425	$450

Note: Min is minimum, ML is most likely, and Max is maximum.

C. Route Groups

A route group is a set of typical port itineraries that are applicable to a particular class or classes of vessels. Route groups are defined to include the minimum, most likely, and maximum travel distances for the previous port of call, the next port of call, and the remaining voyage distance. HarborSym develops triangular distributions from this data and selects a distinct distance for each voyage segment of each call and model iteration. For this study a set of six route groups were defined. These route groups and their associated distances are shown in Table 21.

Each route groups is associated with particular sets of vessels as follows: the Large and Medium Tug & Barge class and the Tankers were associated with a West Coast United States – Nome (WCUS-Nome) service area. Ninety percent of the small Tug & Barge class calls were associated with the Nome Service Area and 10 percent were with the Nome-Lightering service area. The Tugboat class was associated with the Nome Service Area. Research Vessels were associated with a Bering Sea Research service area, Government Vessels were associated with a Bering Sea Patrol service area and Cruise Ships were associated with a Bering Sea Cruise Ship service area. Small Landing Craft were associated with the Nome

Service Area while Large Landing Craft were associated 90 percent with the Nome Service Area and 10 percent with the Nome-Lightering service area.

The basis for the distances defined in each route group is explained in the following sections.

Table 21: Route Group Definitions

Route Group	Distance to Previous Port		
	Minimum	Most Likely	Maximum
West Coast US - Nome	620	634	659
Nome Service Area	74	238	566
Nome Lightering	0.4	0.8	1.2
Bering Sea Patrol	100	250	1,000
Bering Sea Research	337	1,010	2,878
Bering Sea Cruise	225	225	470

Route Group	Distance to Next Port		
	Minimum	Most Likely	Maximum
West Coast US - Nome	280	832	2,290
Nome Service Area	74	238	566
Nome Lightering	0.4	0.8	1.2
Bering Sea Patrol	100	250	1,000
Bering Sea Research	337	1,010	2,878
Bering Sea Cruise	225	348	1,700

Route Group	Additional Sea Distance		
	Minimum	Most Likely	Maximum
West Coast US - Nome	-	1,944	2,570
Nome Service Area	74	238	566
Nome Lightering	-	-	-
Bering Sea Patrol	2,000	3,500	5,000
Bering Sea Research	337	1,010	2,878
Bering Sea Cruise	1,000	3,587	4,510

1. West Coast US – Nome

The West Coast US – Nome route group sailing distances are based upon available sailing schedules for the "mainline" barges and tankers serving Nome. Sailing schedules were obtained from the vessel companies which serve Nome: Alaska Logistics, Northland Services, Crowley Maritime, and Boyer Towing. These mainline barge services typically originate in the Pacific Northwest (Seattle or Tacoma area) and stop in several Alaskan communities before or after arriving at Nome. Alaska Logistics sailing schedules include stops in Bethel, Naknek, Kotzebue, and Dillingham. Northland services voyages include these same communities with stops in Dutch Harbor for some trips. An example of a sailing schedule for these companies is Seattle, Seward, Bethel, Nome, Kotzebue, Naknek, Dillingham, Seattle. Boyer Towing's sailing schedules often originate in Seattle, with stops in Southeast Alaska (such as Ketchikan) en route to Nome.

Crowley Maritime reports that their large tugs and barges are either filled from an offshore tanker (which originates in Asia) or from the fuel plant in Nikiski.

The distances for the West Coast US route group are equal to the averages of the distances between these ports and Nome, based on available sailing schedules. Averages of these distances are believed representative given a lack of data available on exact sailing routes for each vessel call in 2012. Similarly, future vessel trips may take different routes, so average values address some of the uncertainty.

2. Nome Service Area

The Nome Service Area route group represents the rural communities near Nome which receive transshipment services from Nome. More specifically, a mainline tug and barge (or tanker) will deliver cargo or fuel to Nome. At Nome, these commodities will be transferred to a smaller vessel for delivery to rural communities. Gravel products from the Nome quarry are also shipped to rural communities for construction projects.

Data provided by the Port of Nome lists 50 communities in western Alaska which have been served from the Port of Nome. These communities range from as far south as Platinum (507 nautical miles south of Nome) to as far north as Barrow (566 nautical miles from Nome). Distances between Nome and these 50 communities are based on NOAA's Distances Between United States Ports, as available, with further estimates conducted using Google Earth. Again, average values of the distances between Nome and these outlying communities were utilized to address the uncertainty in the exact origin and destination of each vessel call.

3. Nome Lightering

The Nome Lightering route group represents the distances which must be traveled to conduct lightering operations to the Port of Nome from a vessel anchored offshore. The exact location of vessels anchored offshore of Nome is dependent upon weather conditions and the preferences of the captains, so the values utilized in HarborSym provide reasonable estimates of lightering distances.

4. Bering Sea Patrol

The Bering Sea Patrol route group is based upon available sailing information for government vessels. In the case of US Coast Guard vessels, data on vessel homeports was utilized. The USCG Hickory is based in Homer, the Sycamore is based in Cordova, and the Munro and Alex Haley are based in Kodiak.

Two Canadian Coast Guard vessels called at Nome during 2012: the Polar Prince and the Sir Wilfred Laurier. AIS tracking data from the Marine Exchange of Alaska listed destination information for some of the sailings of these two vessels. According to MXAK data, these vessels sailed to Barrow, Nome, the Chukchi Sea, Herschel Island, Dutch Harbor and St. John's during 2012.

Average values of all of these ports were utilized to form the distribution of possible sailing distances for government vessels.

5. Bering Sea Research

Available data on the sailing schedules of research vessels calling at Nome in 2012 were used to estimate the Bering Sea research route group distances. In some cases, specific research vessels maintain websites which list their schedules and ports of call. In other cases, MXAK data provides some information on destination ports. Research vessels traveled from as far as Incheon, South Korea (approximately 3,700 nautical miles from Nome) to as near as Port Clarence, Alaska (approximately 119 nautical miles from Nome).

For this category, the ports of call of research vessels were placed into three distance categories, and the average of each category is set equal to the minimum, most likely, and maximum route group distances for HarborSym.

6. Bering Sea Cruise

The route group for cruise ships is based upon the available sailing schedules of the two cruise ships which called upon Nome in 2012: the Hanseatic and The World. The website for the cruise ship Hanseatic listed four sailing schedules with stops primarily in the Russian, Alaskan, Canadian, and Scandinavian Arctic.

The voyage for The World in 2012 in the vicinity of Nome included stops in Vancouver, Ketchikan, Wrangell, Petersburg, Haines, Kodiak, Dutch Harbor, St. Paul Island, Provideniya, Nome, and St. Anthony, Canada. The World is essentially a floating condominium complex where the on-board passengers/owners decide at which ports to stop each year. Therefore, the routes will vary each year.

The distances for the Bering Sea Cruise route group is based on taking the average values of the ports of call listed for these cruise ships.

D. Commodity Transfers

1. Commodity Transfer Rates

The Port of Nome provided information on the arrival and departure dates for each vessel as well as the amount of commerce transferred at each dock. This information was used to determine minimum, most likely, and maximum cargo transfer rates for each dock and commodity. The port does not maintain records for the number of hours each vessel spends at a dock, only the number of days. In some cases, cargo amounts which arrive at Nome for transshipment are only listed on the arrival invoice and not on the subsequent departure. To accurately account for the total cargo transfer, some cargo amounts were assigned to specific vessels using professional judgment. Cargo assignments were based on consideration of the vessels belonging to specific companies and comparison of cargo amounts typically aboard each vessel. These factors add uncertainty to the transfer rates. All assumptions made for the cargo transfer rates were reviewed by the Port for accuracy.

As the intent in HarborSym is to keep the vessel at the dock the correct amount of time, the transfer rates are gross rates that include other dock related activities such as bunkering, inspections, repairs, and similar activities. Much of the dry cargo is handled by forklift, and occasionally barge crane, the petroleum products are pumped via pipeline and the gravel is transferred by conveyor. Cargo transfer times are impacted by the need to raft vessels, which can make cargo transfers more difficult. Cargo transfer rates are displayed in Table 22 and are stated in metric tons per hour (MTPH).

Table 22: Cargo Transfer Rates

Dock	Commodity	Vessel Class	Minimum (MTPH)	Most Likely (MTPH)	Maximum (MTPH)
Barge Ramp	Gravel	Landing Craft	11.8	11.8	11.8
Barge Ramp	Dry Cargo	Landing Craft	3.8	11.8	26.2
Barge Ramp	Equipment	Landing Craft	0.2	2.5	4.7
Barge Ramp	Dry Cargo	Tug and Barge	1.5	3.1	4.7
City Dock	Dry Cargo	Cruise Ship	0.1	0.2	0.2
City Dock	Fuel	Cruise Ship	12.5	12.5	12.5
City Dock	Dry Cargo	Landing Craft	4.3	4.3	4.3
City Dock	Dry Cargo	Research	0.2	0.2	0.2
City Dock	Fuel	Tanker	61.6	122.6	198.7
City Dock	Fuel	Tug	7.7	7.7	7.7
City Dock	Dry Cargo	Tug and Barge	5.8	46.3	113.7
City Dock	Equipment	Tug and Barge	1.4	1.6	1.7
City Dock	Fuel	Tug and Barge	9.9	78.5	211.3
East Dock	Dry Cargo	Landing Craft	1.9	8.5	17.5
East Dock	Fuel	Tug	7.7	7.7	7.7
East Dock	Dry Cargo	Tug and Barge	0.1	0.1	0.1
East Dock	Fuel	Tug and Barge	4.0	13.1	34.8
West Gold	Dry Cargo	Cruise Ship	0.1	0.1	0.1
West Gold	Dry Cargo	Research	0.1	0.1	0.1
West Gold	Gravel	Tug and Barge	28.5	49.8	110.8
West Gold	Dry Cargo	Tug and Barge	8.1	24.6	91.2
West Gold	Equipment	Tug and Barge	0.7	2.0	3.6

2. Layberth

Some vessels that transit the Port at Nome do not transfer cargo. They enter the port to escape bad weather, change or rest crews, effect repairs and/or provision their vessel. For this study these vessels are defined as Layberth vessels. It is important that the HarborSym model properly accounts for Layberth vessel operations, including the time they spend occupying dock space. For this purpose a Layberth "commodity" is defined in the model. One unit of this Layberth "commodity" is intended to keep a Layberthed vessel at the dock for 2.4 hours; thus ten units equals one day. The loading / unloading rate for this "commodity" is defined as 0.4167 units per hour (10 units/24 hours).

3. Estimated Total Trip Cargo

Estimated Total Trip Cargo (ETTC) amounts are used in combination with the amount of cargo transferred per vessel call to apportion transportation costs to a specific port. For example, if only a portion of a vessel's total cargo is transferred at the subject port, only that portion of transportation costs (and by extension cost savings) will be allocated to the port. For the base case, ETTC values were estimated based on the total vessel capacity, considering the assumed vessel arrival draft at Nome and the Tons per Inch (TPI) factor. Therefore, the ETTC amounts are subject to the uncertainty described for vessel capacities, sailing drafts, and TPI factors. ETTC values for vessels not transferring cargo at Nome are equal to vessel capacity.

E. Dock Constraints

The HarborSym model determines capacity constraints at docks based on user provided information of the maximum number of vessels, cargo transfer rates and vessel size units (VSUs). The cargo transfer rate is a gross rate that encompasses not only the movement of cargo, but also other activities that occur while the vessel is in dock, such as inspections, bunkering, crew changes, repairs, resupply, etc. The VSU is an abstract concept that allows the user to provide a multi-dimensional accounting for vessel dimensions. For this study the VSUs of each vessel class are based on the length multiplied by the beam divided by 1,000 of the largest vessel in that class.

1. Defining Dock VSU Capacity

There is a considerable amount of rafting behavior at the Port of Nome. Therefore VSU capacities for the City Dock and the West Gold Dock were determined based on typical rafting scenarios for large vessels. The following seven scenarios were provided by Port personnel who are familiar with harbor operations.

Scenario One: The Port has had a 300' barge loading gravel with a 73-foot research ship lying outside the barge - bow to bow with the tug. The two captains would work out a safe protocol for the research crew to load groceries/parts around the gravel operation as well as facilitate a crew change.

In the model this would be a Small Research Vessel at 7.2 VSUs plus a Medium Tug & Barge at 31.1 VSUs. The total would be 38.3 VSUs and would apply to the West Gold Dock since the commodity is gravel.

Scenario Two: The Port has had a pair of 225-foot USCG cutter vessels doing a joint shore leave call if they happened to have a day or two overlapped on the dock schedule.

This would be two Cutters at 14.2 VSUs each. The total would be 28.4 VSUs. This would apply to the City Dock.

Scenario Three: The Port has had a 400-foot fuel linehaul barge with a 150- or 180-foot barge lying outside the linehaul barge, with both tugs bow to bow outside the smaller barge. The linehaul would be discharging to the dock header while loading the smaller barge for a village or inner harbor header delivery.

This would be a Large Tug & Barge at 52.8 VSUs plus a Small Tug & Barge at 16.1 VSUs. The total would be 68.9 VSUs. This would apply to the City Dock since the commodity is fuel.

Scenario Four: The Port has seen a 350-foot cargo mainline barge with one or two 150-foot landing crafts lying bow to bow outside the bigger barge, loading cargo for village delivery.

This would be a Large Tug & Barge at 52.8 VSUs plus two Large Landing Craft at 4.4 VSUs each. The total would be 61.6 VSUs. This would apply to both the City Dock and the West Gold Dock.

Scenario Five: The Port has had a 417-foot tanker with a 300 foot ATB (articulating tug/barge - with the tug permanently in the push configuration connected in a stern slot) laying outside with tanker discharging to shore and ATB loading for delivery.

This would be a Tanker at 29.8 VSUs plus a Medium Tug & Barge at 31.1 VSUs. The total would be 60.9 VSUs. This would apply to the City Dock since the commodity is fuel.

Scenario Six: The Port has had a 308-foot Canadian research vessel with a 270-foot Russian research vessel lying on the outside for 5 days in the fall of 2012 when the congestion started relaxing.

This would be a Large Research Vessel at 29.3 VSUs plus a Medium Research Vessel at 16.2 VSUs. The total would be 45.5 VSUs. This applies to both the City Dock and the West Gold Dock.

Scenario Seven: The largest cruise ship that has been served at the Port is 403 feet, but the cruise ship limitations are based more on depth than vessel length.

This would be a Medium Cruise Ship at 37.4 VSUs. This applies to the City Dock.

2. Dock Capacity Summary

The City Dock and the West Gold Dock have similar capacities in terms of vessel sizes, although they handle different commodities and vessel types. The largest VSU in this analysis is 68.9 VSUs, which would apply to the City Dock. The largest VSU value for the West Gold Dock is 61.6. Because it is possible for each of these docks to accommodate two Large Tug & Barge combinations at a time, and because this vessel type has a VSU value of

49.1, a VSU value of 100 was applied to the City Dock and the West Gold Dock. It was assumed that each dock could handle a maximum of three vessels at one time.[42]

It was assumed that the Barge Ramp could serve a maximum of two vessels at a time and that these would typically include a mixture of landing craft and small tug & barge combinations. A VSU value of 40 was assigned for the Barge Ramp.

The East Dock is a compilation of docks that includes the East Dock, plus the South Dock and a Small Boat Basin. It was assumed that this area could serve a maximum of five commercial vessels[43] and a VSU value of 60 was assigned. This dock also serves primarily landing craft and small tug & barge combinations.

F. Existing Condition Model Outputs

HarborSym was run using 2012 existing conditions to calibrate the model. The existing condition model was run for 10 iterations, beginning on 1 June 2012 and ending on 31 October 2012. Season dates are based on the typical operations of the Port of Nome. There were a total of 225 vessel calls, and on average there was less than one deleted vessel per iteration, with a maximum of one. The overall cost of vessel operations amounted to an average of approximately $95.3 million, with an average of $14.3 million total allocated cost to the port. An average of 126,028 metric tons of cargo was transferred, out of a possible total of 128,269 metric tons. Total time in the system averaged 6,649 hours, with a maximum of 6,941 hours and a minimum of 6,311 hours. Total wait time in the system averaged 213 hours, which included 17.2 hours at the dock and 195.9 hours at the channel entrance. Existing condition wait times were primarily related to channel and dock availability. Docking time averaged 92.1 hours and undocking time averaged 70.5 hours. Cargo transfer time, including time spent in Layberth, amounted to over 6,102 hours and some of this time is associated with the burdensome requirement to raft vessels at the City and West Gold docks. As traffic increases at the port, delay times and cargo transfer times can be expected to increase significantly.

[42] A tug & barge combination counts as a single vessel in the HarborSym model.

[43] Small recreation vessels, gold dredges and commercial fishing are not considered in the model.

VII. FUTURE WITHOUT PROJECT CONDITION – BASE CASE SCENARIO

The future without project condition was evaluated over a 50-year planning horizon, from 2020 to 2070. Conducting this analysis provides a basis for comparison for the future with project condition. The year 2020 was selected for the base year as this would be the first year of operation provided all funding were in place and all construction completed in the estimated timeframe. The base case considered three points in time for HarborSym analysis; the base year of 2020, and the years 2030, and 2040. Values were interpolated for the intervening years. To address the uncertainty in forecasting, all values are held constant after 2040. This base case scenario is the future projection of traffic and commodities using historical activity at the Port of Nome.

A “No Growth” scenario was also evaluated using only the base year 2020 information.

The discussion of the future without-project condition will mirror the existing conditions discussion by addressing the facilities, commodities, fleet, shipping operations, and model outputs noting any differences from the existing conditions.

A. Facilities

The future without project condition must take into account any known or relatively certain marine infrastructure enhancements. An additional dock, referred to as the Middle Dock, was included in the without project models, because this dock is in the advanced planning stages and is considered part of the most likely future without-project condition. In addition, the capacity of the Barge Ramp was increased from two vessels to three vessels based on ongoing port development plans. The Middle Dock is considered to have a similar capacity to the City Dock and is assigned 100 vessel size units. The improved Barge Ramp was assigned 60 vessel size units in recognition of the planned increase to its capacity.

Initial testing of the future condition HarborSym models found that some vessels were showing delay times at the Lightering Location. This does not accurately represent real conditions. The Lightering Location “dock” defined in HarborSym simply represents locations at which vessels anchor offshore at Nome. Since this is an offshore area, there should be no limits on the number of vessels which can access it and no delays associated with using it. To address this issue, the capacity of the Lightering Location was increased to 100,000 vessel size units and 50 vessels. These constraints are intentionally large to eliminate the possibility of vessels facing delays at the Lightering Location. Similarly, the controlling depth of the Lightering Location was increased to 40 feet to ensure all vessels were able to access the area in HarborSym.

B. Commodity Forecast

Three commodity categories were employed in the base case future conditions analysis; fuel, dry cargo, and gravel. Equipment, which was considered separately in the existing condition analysis, was subsumed into the dry cargo category for the future conditions analysis because it represents less than one percent of total shipments. The forecast is based on historic trends.

1. Fuel

Deliveries to the Port of Nome include gasoline, heating oil, jet and marine fuel. According to the U.S. Waterborne Commerce Statistics Data Center, from 2007 to 2011, almost 60 percent of all fuel deliveries to Nome were unleaded gasoline. This is followed by 32 percent classified as distillate fuel oil, less than 1 percent residual fuel oil, and 1 percent Hydrocarbons & Petrol Gases. Almost 7 percent of the fuel deliveries were Petro Products not elsewhere classified. Nome is not connected by road or rail to other communities so all fuel deliveries must enter the City through the Port of Nome. In addition, Nome is the hub community serving about 50 smaller villages along Alaska's western and northern coastline. So some of the fuel entering the Port of Nome is then transferred to smaller vessels for delivery to the outlying villages. Figure 21 displays the inbound and outbound fuel at the Port of Nome from 1997 through 2013. Year to year fluctuations are seen in the data set while the overall trend is upwards. About 84 percent of the total fuel moved across the dock is used in the vicinity of the City of Nome while about 16 percent of the fuel is transferred to smaller vessels for delivery to the outlying communities.

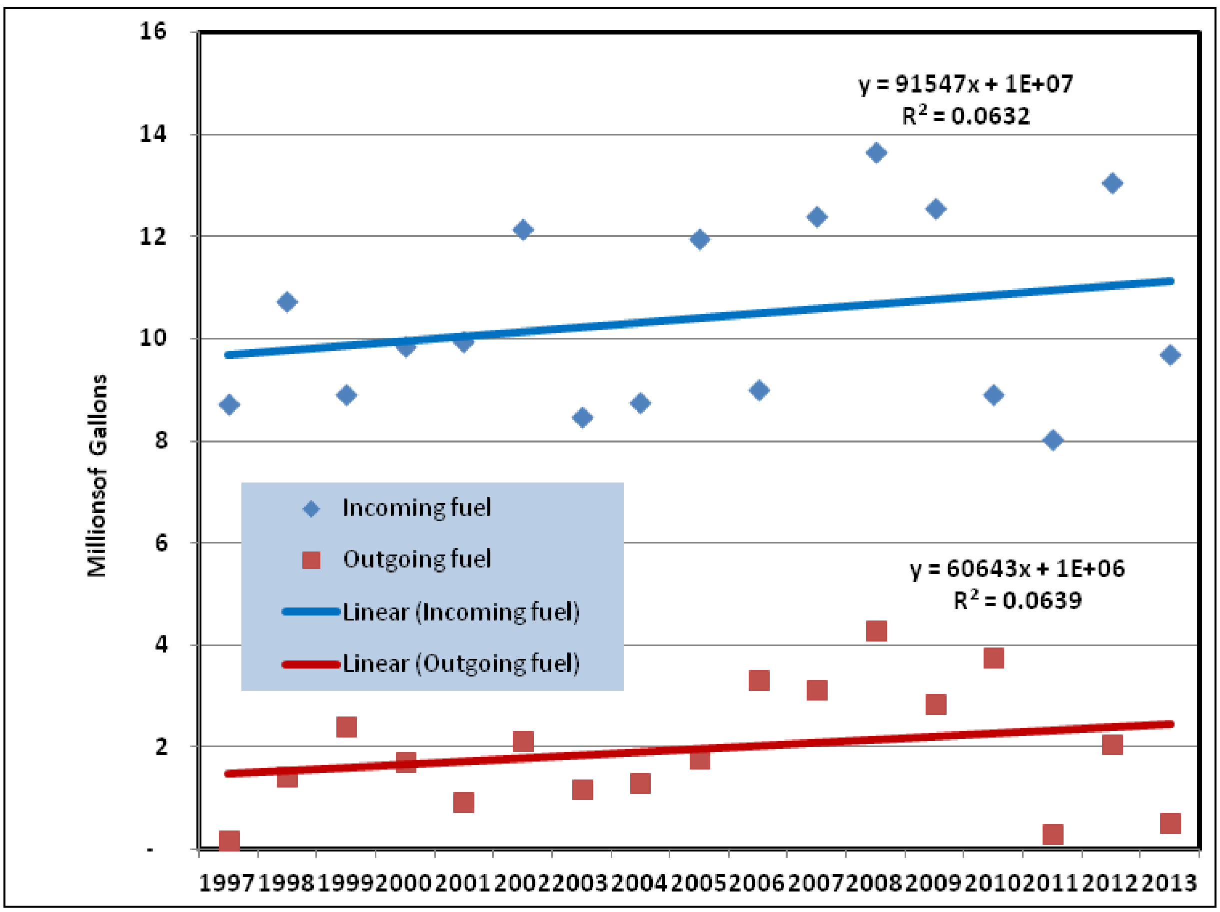

Figure 21. Historic Inbound and Outbound Fuel

Source: Port of Nome revenue summaries, 1997-2013

The commodity forecast for fuel deliveries at Nome is based on a linear regression of the historical amounts. First, the total fuel amount (both inbound and outbound) was forecast. The future amounts of inbound and outbound fuel are equal to the total expected fuel amount multiplied by the historical average percentage of inbound and outbound fuel. Table 23 summarizes the fuel forecast for the selected analysis years.

Table 23. Fuel Commodity Forecast Summary

Year	Fuel (metric tons)		
	Total	Inbound	Outbound
2020	44,075	37,098	6,978
2030	48,658	40,955	7,703
2040	53,240	44,812	8,429

2. Dry Cargo

The Port of Nome saw significant increases in transfers of dry cargo in the recent past. This includes groceries, furniture, vehicles such as cars, trucks, snow machines, and all-terrain vehicles, office supplies, repair parts, equipment, and everything else that a person might find in their local retail establishments. If the cargo is non-perishable and not time-sensitive in the delivery, it is more economical to send the supplies by barge than it is to fly the goods to town – the only other option for getting dry cargo. As with fuel, dry cargo moving through the Port of Nome is sometimes reloaded onto smaller vessels for delivery to the outlying villages. Figure 22 shows the historic movement of inbound and outbound dry cargo at Nome. Again, there are annual fluctuations while the overall trend is upward even more significantly than fuel. Since the open water season has historically been short, the window of opportunity to receive dry cargo at the Port runs from about the beginning of June through the middle of October. There has been shoulder season lengthening in recent years, but most of the population relies on the 4-month season to receive a year's worth of supplies. About 64 percent of the total dry cargo moved across the dock is used in the vicinity of the City of Nome while about 36 percent of the dry cargo is transferred to smaller vessels for delivery to the outlying communities.

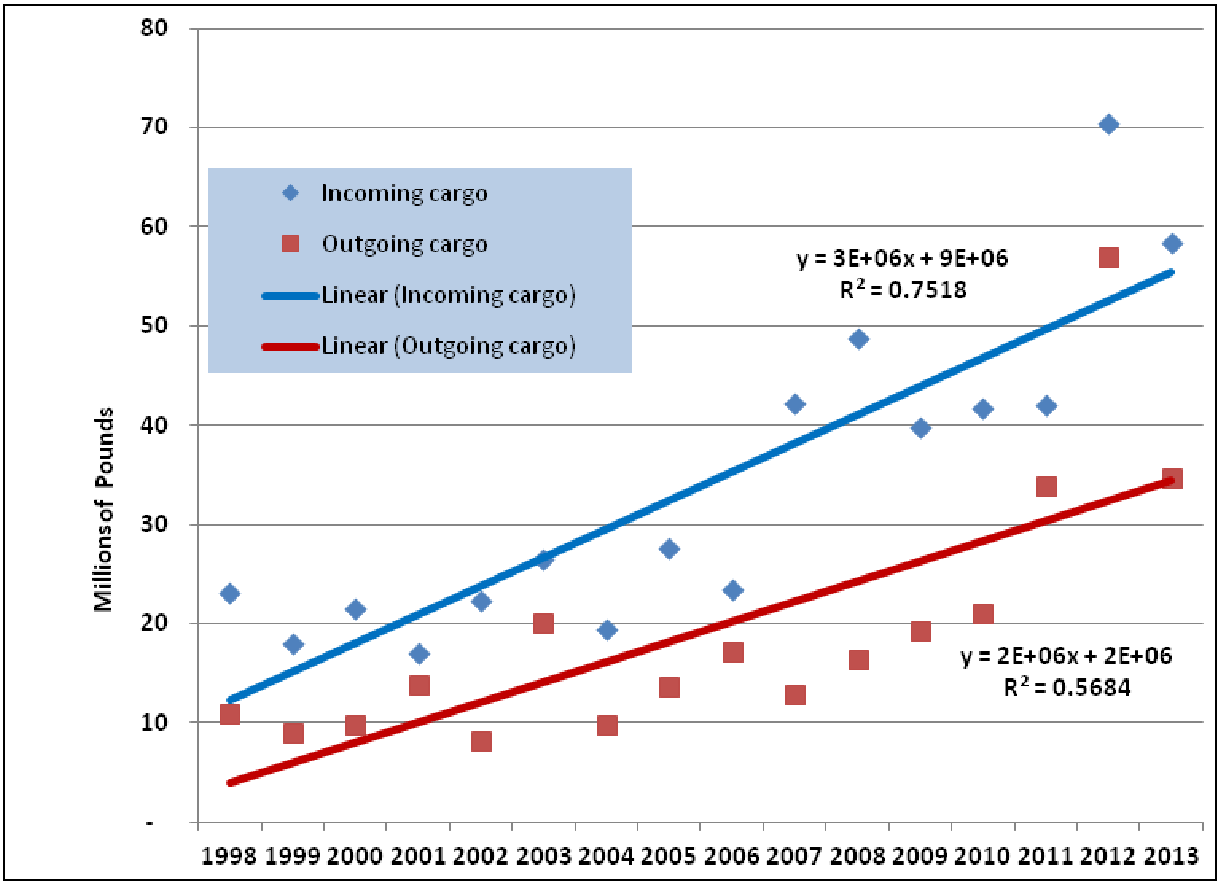

Figure 22. Historic Inbound and Outbound Dry Cargo

Source: Port of Nome revenue summaries, 1998-2013

The forecast for the amount of dry cargo moving through the Port of Nome is again based on linear regression of historical data. First, the total dry cargo is forecast, and the amounts inbound and outbound are based on the average historical percentages. Table 24 summarizes the commodity forecast for dry cargo.

Table 24. Dry Cargo Commodity Forecast Summary

Year	Dry Cargo (metric tons)		
	Total	Inbound	Outbound
2020	56,349	35,964	20,385
2030	78,603	50,167	28,436
2040	100,858	64,371	36,487

3. Gravel

Gravel and rock originating from the Cape Nome quarry and local town gravel pits is outbound from the Port of Nome to locations all along Alaska's western and northern coastline. Cape Nome Quarry, located 12 miles east of Nome, is a source of industrial grade armor stone and rip rap commonly used in seawalls, causeways, and breakwaters. The quarry opened in 1985 and through 2013, the quarry has produced 2.6 million tons. The quarry has an estimated resource remaining of 150 million tons. Since 1994, the quarry has produced 780,000 tons of product. The quarry is operated by a subsidiary of the Bering Straits Native Corporation. Historic demand for rock and gravel from the Cape Nome Quarry suggests that the remaining mine life is many hundreds of years.

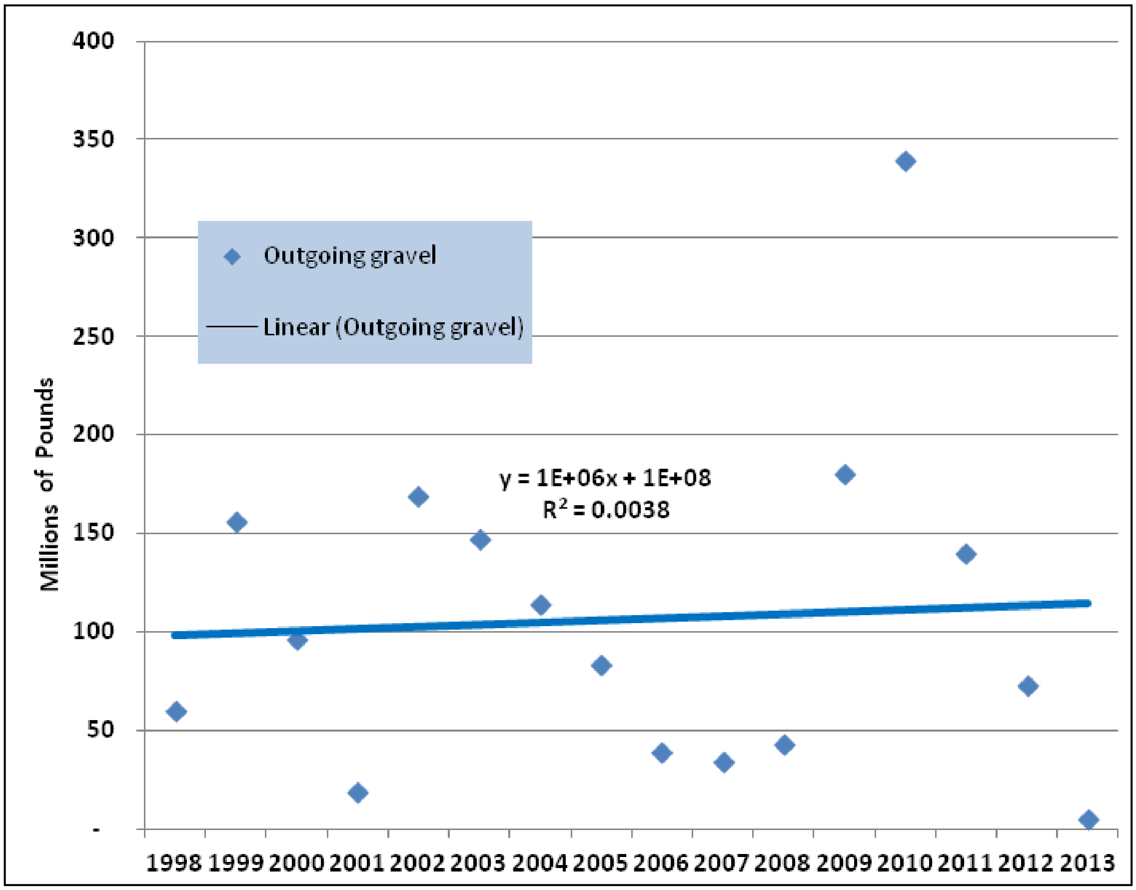

Figure 23. Historic Outbound Gravel at the Port of Nome

Source: Port of Nome revenue summaries, 1998-2013

Gravel is only expected to move outbound from the Port of Nome in the future. The forecast of gravel movements at Nome is based upon linear regression of the historical data. The regression equation and R-square values are presented in Figure 23. Table 25 summarizes the expected outbound gravel at Nome for selected years of analysis.

Table 25. Gravel Commodity Forecast Summary

Year	Gravel Outbound
2020	55,241
2030	60,177
2040	65,114

4. Commodity Forecast Summary

Table 26 provides a summary of the commodity forecast. The existing commodity forecast listed in the table is equal to the five-year average commodity amounts and provides an example of the baseline commodity movements. The forecasted values are based on a linear regression using the values from 1997 through 2013. In addition, the commodity amounts utilized for cargo transfers in the existing condition HarborSym data are based on a different data set[44] provided by the Port of Nome and may not exactly equal the baseline values presented here.

Table 26. Nome Base Case Commodity Forecast Summary

Year	Fuel	Dry Cargo	Gravel	Totals
Existing	37,177	37,925	66,885	141,987
2020	44,075	56,349	55,241	155,665
2030	48,658	78,603	60,177	187,438
2040	53,240	100,858	65,114	219,212

Notes: Existing commodity based on the 5-year average from 2009 - 2013.
All values are stated in metric tons.

C. Fleet Forecast

For vessels transferring cargo at Nome, the number of vessels that would call in the future was estimated employing the base case commodity forecast and assuming that loading behavior for each vessel type and dock would be consistent with historic experience, as outlined in the existing conditions section. For layberthed vessels (i.e. vessels calling at the port, but not transferring cargo) future calls were estimated using historic growth rates for similar vessels that transferred cargo. For tugboats the overall growth rate of tugs & barges that transferred cargo was used. For the base case, no growth was assumed for layberthed government, research, and cruise vessels. It is noted that a few of the research and cruise vessels transferred small amounts of cargo, and some growth in these vessels was forecast, based on the types of commodities being transferred (typically fuel and/or dry cargo). All estimates are rounded to the nearest whole vessel. The fleet forecast for each of the model points in time is provided in Table 27.

[44] Commodity transfers for existing condition HarborSym modeling are based on detailed Port invoices, only available for the year 2012 at the time of this analysis. Commodity forecasts for the future conditions base case are based upon summary revenue files provided by the Port of Nome. Due to different classification and computer systems, there are disparities between the detailed invoices and the summary revenue files, so values may not exactly match.

Table 27: Nome, Alaska Fleet Forecast

Vessel Type	Vessel Class	Existing	2020	2030	2040
Tug & Barge	Small Tug & Barge	48	58	74	89
	Medium Tug & Barge	32	48	57	79
	Large Tug & Barge	12	12	20	24
Landing Craft	Small Landing Craft	6	8	10	12
	Large Landing Craft	60	77	109	147
Tanker	Tanker	6	7	7	7
Cruise Ship	Small Cruise Ship	4	5	7	7
	Medium Cruise Ship	1	2	3	3
	Large Cruise Ship	1	1	1	1
Government	Cutter	4	6	7	7
	Buoy Tender	3	2	2	2
	Ice Breaker	2	2	2	2
Research Vessel	Small Research Vessel	21	26	28	29
	Medium Research Vessel	3	3	3	3
	Large Research Vessel	4	4	4	4
Tugboat	Tugboat	17	23	30	46
	Total	**224**	**284**	**364**	**462**

1. Dock Usage

In the future condition base case, vessels were assigned to docks based on their historic use, considering the commodity being transferred. For example, vessels delivering fuel were assigned to either the City or East Docks and gravel to the West Gold Dock. As with the existing condition, there are some vessels which draft too deep to access the docks at the Port of Nome and use the Lightering Location. Table 28 summarizes these vessel calls.

Table 28. Vessel Calls depth-constrained at Nome, Future Without Project Condition Base Case

Vessel Type	Vessel Class	2020	2030	2040
Tug & Barge	Small Tug & Barge	0	0	0
	Medium Tug & Barge	1	2	2
	Large Tug & Barge	1	1	1
Landing Craft	Small Landing Craft	0	0	0
	Large Landing Craft	0	0	0
Tanker	Tanker	2	2	2
Cruise Ship	Small Cruise Ship	0	0	0
	Medium Cruise Ship	0	0	0
	Large Cruise Ship	1	1	1
Government	Cutter	0	0	0
	Buoy Tender	1	1	1
	Ice Breaker	0	0	0
Research Vessel	Small Research Vessel	0	0	0
	Medium Research Vessel	2	2	2
	Large Research Vessel	4	4	4
Tugboat	Tugboat	0	0	0
	Total	**12**	**13**	**13**

2. Vessel Call Dates

Information on vessel call data from the Port of Nome shows that vessels tend to call at Nome most in the months of July and August. Based on the average of 2010-2013 vessel data, 29 percent of calls occur in both July and August, followed by 23 percent in September, 10 percent in October, and 8 percent in June. The existing condition call list is based on actual vessel calls at the Port of Nome and represents this date distribution.

These baseline dates were then used to develop the distribution of vessel calls in the future conditions for 2020.

As vessel traffic increases at Nome in 2030 and 2040, it is predicted that vessels will be more likely to use the port at less crowded times and calls will be more evenly distributed. Further, overall sea ice levels are expected to decrease over the period of analysis which will make the Port of Nome more accessible to vessels during the shoulder season months of June and October.

The vessel call distribution for 2040 assumes that calls will be evenly distributed over the 5-month operation season: 20 percent of calls will occur in each month. The vessel call distribution for 2030 is the average of the distributions of 2020 and 2040 to represent the shift between more even distributions. Calls for 2030 are equal to 14, 24, 25, 22, and 15 percent respectively for the months June through October.

D. Other Changes to Future Conditions, Shipping Operations

There is a large variance in some of the variables associated with the existing condition HarborSym modeling (including large ranges in vessel route groups and speeds). Much of this data is contained in a triangular distribution for Monte Carlo analysis in HarborSym. Combining this data with a limited number of vessels in many vessel classes results in significant variations in the results of the modeling (particularly vessel costs at sea). These variations could be reduced by increasing the number of iterations per simulation to 500 or 1,000. This was not deemed appropriate for this analysis given the relatively small level of traffic at Nome. A better path forward to reduce this variation was to take the average value of some of the variables which affect vessel costs at sea for vessel classes with small number of vessels. This method is appropriate given that vessel operations at sea are not expected to change between the future without and future with project scenarios and no benefits are derived from these operations.

1. Vessel Speeds at Sea

Table 29 presents the number of vessels, by class for the future without project condition analysis year 2020. This analysis reduced some of the variation in vessel "at sea" operations by using the average vessel speed at sea for classes with small numbers of vessels. These classes, in general, were those with less than 20 vessels as that presented a natural breaking point amongst vessel classes. The exception to that rule is Small Tug & Barge_P and Large Tug & Barge. When these two classes are combined with their respective priority or non-priority counterpart, the total classes have more than 20 vessels. Table 29 also presents the revised vessel speeds at sea for each vessel class. The speeds at sea, by vessel class are carried through for each analysis year, and in both the future without and with project conditions.

Table 29. Number of Vessels and Speed at Sea, by vessel class, FWOP 2020

Vessel Class	Number of vessels	Vessel Speed at Sea		
		Min	Most Likely	Max
Small Landing Craft	8	12	12	12
Large Landing Craft	116	10	12	15
Small Cruise Ship	0	12	12	12
Medium Cruise Ship	0	12	12	12
Large Cruise Ship	1	13	13	13
Small Tug & Barge	73	7	8	9
Medium Tug & Barge	21	7	8	9
Large Tug & Barge	0	7	8	9
Small Research Vessel	26	10	12	15
Medium Research Vessel	2	12	12	12
Large Research Vessel	4	12	12	12
Tanker	2	17	17	17
Cutter	7	16	16	16
Buoy Tender	2	16	16	16
Ice Breaker	2	16	16	16
Tugboat	23	8	10	12
Small Tug & Barge_P	6	7	8	9
Medium Tug & Barge_P	49	7	8	9
Large Tug & Barge_P	22	7	8	9
Small Research Vessel_P	0	12	12	12
Medium Research Vessel_P	1	12	12	12
Large Research Vessel_P	0	12	12	12
Small Cruise Ship_P	4	12	12	12
Medium Cruise Ship_P	2	12	12	12
Large Cruise Ship_P	0	13	13	13
Tanker_P	5	17	17	17

Note: "P" designations indicate priority vessel classes added to HarborSym to incorporate the port's operating restrictions for certain vessel classes.

2. Route Groups

Another major component of vessel at-sea costs is the vessel route groups. The original route groups used for the existing condition test runs had large variation in values, particularly for the Bering Sea Patrol, Research, and Cruise categories. There is limited information available for the vessels which travel these routes. And, the routes traveled by these vessels are not expected to change between the future without and future with project conditions. Based on the underlying uncertainty of these variables and their expected limited effect on project benefits, the average values were utilized in the triangular distribution to reduce variation in results. Table 30 presents the revised route groups.

Table 30. Revised Route Groups

Name	Prior Port Distance		
	Min	Most Likely	Max
WCUS-Nome	620	634	659
Nome Service Area	74	238	566
Bering Sea Patrol	450	450	450
Bering Sea Research	1408	1408	1408
Nome Lightering	0.4	0.8	1.2
Bering Sea Cruise	307	307	307

Name	Next Port Distance		
	Min	Most Likely	Max
WCUS-Nome	280	832	2290
Nome Service Area	74	238	566
Bering Sea Patrol	450	450	450
Bering Sea Research	1408	1408	1408
Nome Lightering	0.4	0.8	1.2
Bering Sea Cruise	1091	1091	1091

Name	Additional Sea Distance		
	Min	Most Likely	Max
WCUS-Nome	0	1944	2570
Nome Service Area	74	238	566
Bering Sea Patrol	3500	3500	3500
Bering Sea Research	1408	1408	1408
Nome Lightering	0	0	0
Bering Sea Cruise	3032	3032	3032

E. Base Case Model Outputs – Future Without Project Condition

The HarborSym model was run for the future without-project condition years 2020, 2030, and 2040. Values between these years are interpolated. All values are held constant beyond 2040. These models were run at 100 iterations (as compared to 10 for the existing condition) to further reduce the variability of some results.

Overall, the 2020 model processed an average of 284 vessels with an average of 0 deleted vessels. Total overall transportation costs averaged $124,202,321 with $23,492,054 total costs allocated to the port. On average, a total of 155,052 metric tons of commodities were transferred of the total of 160,387. Total time in system averaged 9,888 hours. Total wait time in the system averaged 183 hours, including 106 hours waiting at the dock and 76 hours waiting at the channel entrance. Cargo transfer time amounted to 9,273 hours. Docking and undocking times were 145 hours and 107 hours respectively. The 2020 model serves as the basis for the without project No Growth scenario.

The 2030 model processed 362 vessels with an average of 0.04 deleted vessels. Total overall transportation costs amounted to $139,702,085 with $25,850,261 total allocated cost to the port. The model processed an average of 183,982 metric tons of cargo out of a total of 187,438 metric tons. Total time in the system averaged 12,228 hours. Total wait time in the system averaged 294 hours including 119 hours at the dock and 175 hours at the entrance channel. Cargo transfer time amounted to 11,358 hours. Docking and undocking times were 184 hours and 137 hours respectively.

The 2040 model processed 459 vessels with an average of 0.05 deleted vessels. Total overall transportation costs amounted to $160,350,922 with $29,019,496 total allocated cost to the port. The model processed an average of 218,015 metric tons of cargo out of a total of 219,212 metric tons. Total time in the system averaged 15,374 hours. Total wait time in the system averaged 335 hours including 62 hours at the dock and 272 hours at the entrance channel. Cargo transfer time amounted to 14,316 hours. Docking and undocking times were 232 hours and 172 hours respectively.

Next is the examination of the with project condition which will be compared to these without project condition results.

VIII. FUTURE WITH PROJECT CONDITION – BASE CASE SCENARIO

A. Alternatives Considered

Initial versions of this study considered a large array of alternatives including various dock configurations at each of the three project sites: Nome, Point Spencer, and Cape Riley. As previously described, this updated analysis considers navigation improvements at Nome only. The purpose of this analysis is to reach the Tentatively Selected Plan (TSP) milestone. With that in mind, only one alternative is considered at this phase of study: an extension of the existing causeway at Nome and the addition of a 450-foot dock. The extension of the causeway would include minimal dredging to reach the natural depth of -28 feet MLLW.

This alternative was chosen for analysis as it represents the smallest possible alternative for expansion of marine infrastructure at Nome.[45] The intent of analyzing only the smallest alternative at Nome to reach the TSP milestone is to identify if any Federal navigation improvements are justified. If this alternative is justified, feasibility-level analysis after the TSP milestone will include identification of the final array of alternatives and selection of the final recommended plan. An incremental analysis will be performed during future phases of study to identify the optimal depth of the selected alternative.

B. Future With Project Modeling

HarborSym was run for a single with project condition under both the base case and no growth scenarios. The additional dock in the evaluated alternative is referred to as "New Dock 1" in the with-project condition models, and is believed to have the same capacity as the City, Middle, and West Gold docks: a maximum of 3 vessels and VSU capacity of 100.

Figure 24 illustrates the future with project condition layout of Nome with the revised HarborSym link/node network overlain.

[45] A smaller possible alternative would be dredging at the existing docks to provide a deeper channel for existing infrastructure. This alternative is not considered to be feasible at this time given the design of the existing docks.

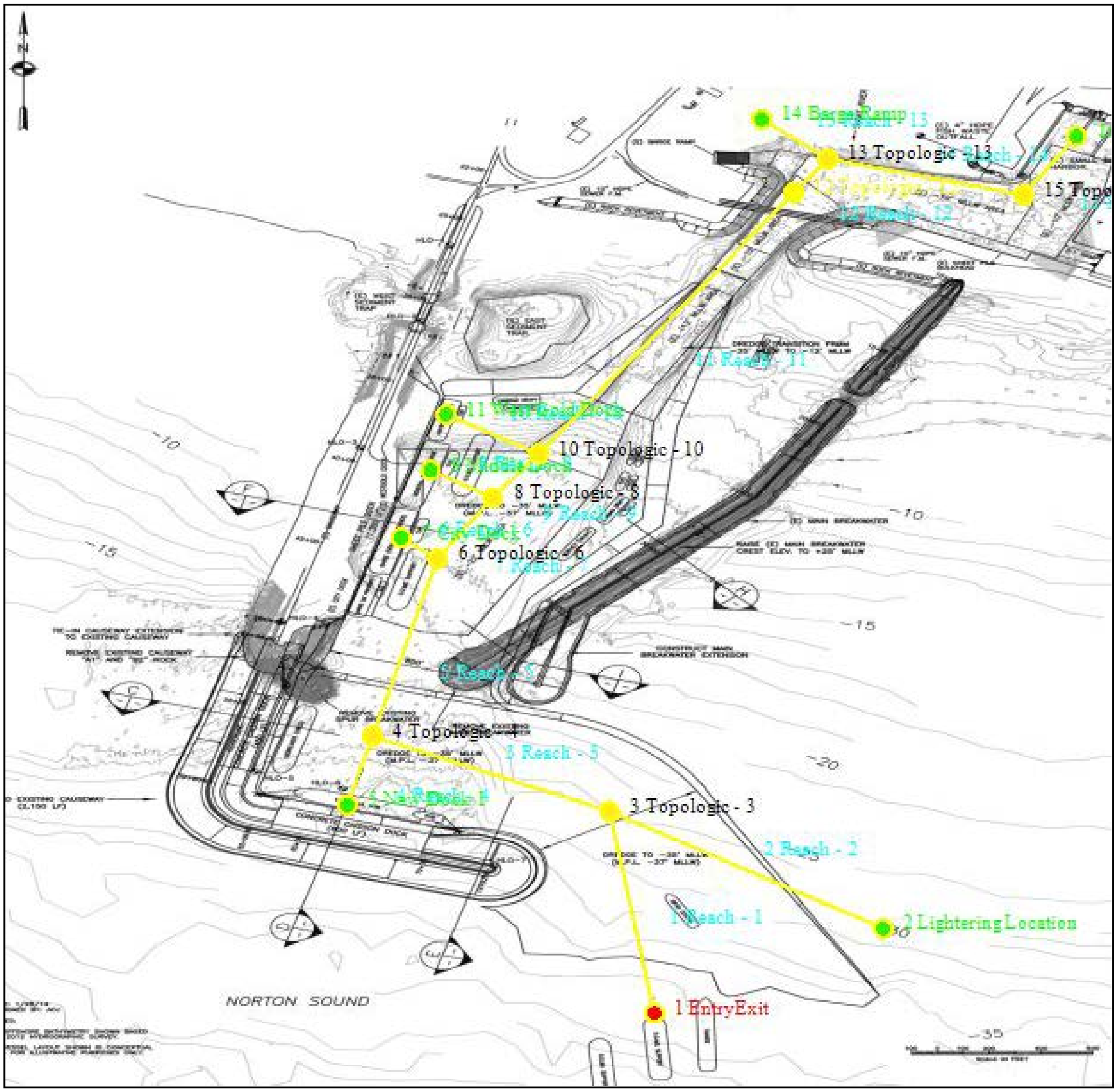

Figure 24. Nome Future With-Project Diagram, with HarborSym Link/Node Network

The base case includes future increases in commodity shipments, based on historic trends, and vessel call lists based on the percentages of each vessel type and class from the existing condition data. The no growth scenario is limited to commodity shipments and vessel calls as they are forecast for 2020.

C. Changes from the Without Project Condition

Under both the base case and no growth scenarios many of the vessels required to anchor offshore and lighter their cargo in the without project condition are now able to come to the dock. And some vessels, primarily Tankers, are able to access the dock at deeper depths, allowing for greater cargo capacity. This allows a reduction in the Tanker fleet from seven Tankers per year to four. In addition, some small tug & barge combinations that lightered petroleum from the Tankers into Nome are no longer required.

In the future with project condition with a depth of -28-feet at the New Dock 1, there are still some vessels which draft too deep to call to a dock at Nome based on their expected sailing drafts and underkeel clearances. These vessels are primarily large cruise ships and large research vessels. These vessels will continue to call at the Lightering Location in the future with project condition scenario.

Based on required safety clearances, assumed tidal availability, and other similar considerations, a channel depth of -28-feet MLLW accommodates a maximum vessel draft of 22-feet. The future with project condition underkeel clearances and vessel calls to New Dock 1 consider these depth requirements.

Based on these assumptions regarding how vessels would utilize new facilities at Nome, Table 31 summarizes the vessel calls which still draft too deep to call upon a dock at Nome.

Table 31. Depth-constrained vessel calls at Nome, Future With Project Condition Base Case

Vessel Type	Vessel Class	2020	2030	2040
Tug & Barge	Small Tug & Barge	0	0	0
	Medium Tug & Barge	0	0	1
	Large Tug & Barge	0	0	0
Landing Craft	Small Landing Craft	0	0	0
	Large Landing Craft	0	0	0
Tanker	Tanker	0	0	0
Cruise Ship	Small Cruise Ship	0	0	0
	Medium Cruise Ship	0	0	0
	Large Cruise Ship	1	1	1
Government	Cutter	0	0	0
	Buoy Tender	0	0	0
	Ice Breaker	0	0	0
Research Vessel	Small Research Vessel	0	0	0
	Medium Research Vessel	0	0	0
	Large Research Vessel	4	4	4
Tugboat	Tugboat	0	0	0
	Total	**5**	**5**	**6**

In the existing and future without project conditions, rafting of vessels at the existing causeway docks complicates docking, undocking, and cargo transfers. The provision of additional dock space under this alternative will reduce the amount of rafting at the City, Middle, and West Gold docks, so reductions of ten percent were applied for docking and undocking times while commodity transfer rates were increased by ten percent for all commodities except layberth. These reductions are applied to all vessel types based on the assumption from the future without project condition that all types of vessels may participate in rafting behavior. Assigning a flat change of ten percent to these rates is believed to be a conservative estimate of the potential benefits of reduced rafting.

At this time, this analysis assumes that the future with project navigation improvements correspond to a reduction in congestion and by extension rafting, of ten percent. A ten percent reduction is based on analysis of existing traffic at Nome, and coordination with the Port of Nome to estimate potential traffic changes. The level to which congestion and rafting are reduced under different project alternatives will be examined in more detail during future phases of study.

1. Potential Benefits Not Quantified for this Phase of study

One potential benefit category not captured by HarborSym is the changes to the lightering practices of Government, Cruise, and Research vessels. Under existing and future without project conditions, when these types of vessels call at Nome and are too deep to enter the harbor, they utilize small vessels (such as on-board life boats) to transit between the lightering location and shore to obtain supplies, change crews, and similar activities. If these vessels can call at a dock under the future with-project condition, these lightering trips are eliminated. However, these small vessel trips occur between the Lightering Location and the small boat harbor and are not tracked by the City of Nome records. These lightering activities will need to be quantified outside of HarborSym and will require a spreadsheet model which has undergone the appropriate USACE model approval process. This has not yet been conducted for this phase of study and will be pursued after the Tentatively Selected Plan milestone.

Another potential delay category which has not been quantified for this phase of study is weather delays. Wind and wave activity at Nome during storm events creates a wave climate at the Port of Nome which is not suitable for vessel loading/unloading at the dock. During these weather conditions, vessels attempting to access the existing docks at Nome must anchor offshore and wait for conditions to change, resulting in delays to operations. The causeway extension, as described for the current alternative, will affect the wave climate at the Port of Nome and may reduce these weather delays. Further investigation of this potential benefit will be undertaken after the TSP milestone. This category may also need to be quantified outside of HarborSym using a USACE-approved spreadsheet model.

D. Base Case Model Outputs – Future With Project Condition

HarborSym models were run for the with project alternative for the years 2020, 2030, and 2040. As in the without-project condition, values in the interim years were interpolated and all values are held constant after 2040. A no growth scenario includes values held constant at 2020. Modeling of the base case future with project condition was conducted at 100 iterations.

Overall, the 2020 with project model processed an average of 280 vessels with an average of 0 deleted vessels. Total overall transportation costs averaged $124,254,236 with $22,812,705 total allocated cost to the port. On average, a total of 156,424 metric tons of commodities were transferred of the total of 160,387. Total time in system averaged 8,883 hours. Total wait time in the system averaged 165 hours, including 76 hours waiting at the dock and 89 hours waiting at the channel entrance. Cargo transfer time amounted to 8,394 hours. Docking and undocking times were 134 hours and 98 hours respectively. The 2020 model serves as the basis for the with project condition under the No Growth scenario.

The 2030 with project model processed 358 vessels with an average of 0.03 deleted vessels. Total overall transportation costs amounted to $138,376,294 with $24,869,762 total allocated cost to the port. The model processed an average of 184,538 metric tons of cargo out of a total of 187,438 metric tons. Total time in the system averaged 10,929 hours. Total wait time in the system averaged 181 hours including 86 hours at the dock and 95 hours at the entrance channel. Cargo transfer time amounted to 10,336 hours. Docking and undocking times were 169 hours and 125 hours respectively.

The 2040 with project model processed 458 vessels with an average of 0.02 deleted vessels. Total overall transportation costs amounted to $158,230,482 with $27,506,610 total cost allocated to the port. The model processed an average of 219,500 metric tons of cargo out of a total of 219,212 metric tons. Total time in the system averaged 13,776 hours. Total wait time in the system averaged 213 hours including 62 hours at the dock and 152 hours at the entrance channel. Cargo transfer time amounted to 13,040 hours. Docking and undocking times were 213 hours and 158 hours respectively.

IX. PROJECT BENEFITS – BASE CASE SCENARIO

Under the base case scenario, commodity shipments are forecasted to increase from 141,987 metric tons under existing conditions to 219,212 metric tons in 2040. Vessel calls are assumed to more than double from 224 in the existing condition to 462 by 2040. Figure 25 illustrates the vessel calls in both the base case and no growth scenarios.

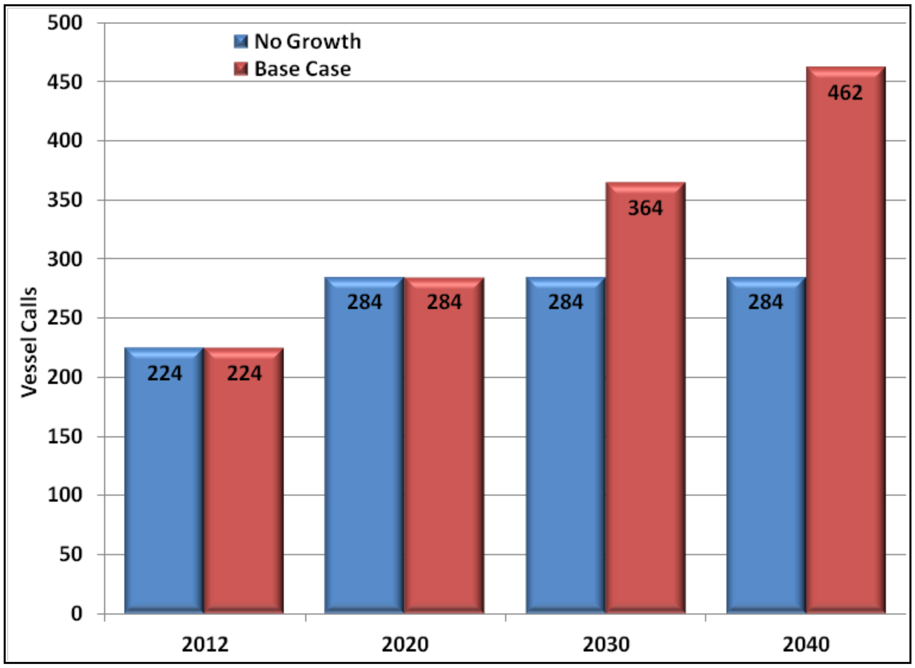

Figure 25. No Growth and Base Case Vessel Calls, by Year

Table 32 summarizes the results of the HarborSym modeling for the base case scenario and compares the future without and with project condition costs.

Table 32. Base Case Transportation Costs Allocated to the Port of Nome

Analysis Year	Total Allocated Cost To Port - Base Case		
	Future Without Project	Future With Project	Difference
2020	$23,492,054	$22,812,705	$679,349
2030	$25,850,261	$24,869,762	$980,499
2040	$29,019,496	$27,506,610	$1,512,886

Based on the results of the HarborSym modeling, the base case provides a total present value transportation cost savings of $29.280 million over the 50-year project period of analysis considering a Federal Fiscal year 2015 discount rate of 3.375 percent. This equates to an average annual equivalent transportation cost savings of $1.220 million.

The transportation cost savings (i.e. NED benefits) in the base case are derived from a reduced fleet of tanker vessels by allowing each to carry more fuel, reduced lightering vessel activity associated with fuel transfers from the lightering location, and the benefits of reduced rafting seen through reduced docking and undocking times and increased commodity transfer rates.

The no growth scenario provides a total present value transportation cost savings of $16.850 million over the 50-year period of analysis, which equates to an average annual savings of $702,000.

X. FUTURE CONDITIONS – HIGH SCENARIO

The base case scenario was intended to analyze a conservative estimate of future traffic at the Port of Nome – by looking only at projections of existing commodities and traffic. However, the intent of the Alaska Deep Draft Arctic Port System Study is to examine vessel traffic associated with expected Arctic operations. This includes vessels which have not called upon Nome in the past and traffic which will increase as a result of diminishing sea ice and increased interest in the Arctic. The "High" scenario was developed to address this future traffic.

In general, the High scenario is equal to the base case traffic at Nome, plus additional vessel traffic from:

- Offshore oil and gas development
- Development of the Graphite One Mine near Nome
- Growth in Arctic research vessel traffic
- Growth in Arctic cruise ship traffic
- Additional government vessel trips (additional presence needed to monitor oil and gas and other increased Arctic traffic)

The following sections describe the general assumptions of the High scenario, in relation to each of these components of traffic. These sections address how specific inputs vary from the base case scenario.

A. Offshore Oil and Gas Development

The key underlying assumption for the high case scenario is the inclusion of offshore oil and gas activities supported by the Nome and Port Clarence area. All indications are that offshore oil and gas exploration activities will continue in the Arctic in the near future. This assumption is supported by oil and gas companies' significant investment and continued interest in the region. Also the Bureau of Ocean and Energy Management (BOEM) plans to hold additional lease sales for the Chukchi and Beaufort regions in 2016 and 2017, respectively.[46] BOEM's decision to hold future lease sales means that their evaluation of the available resource is favorable for development activities.[47]

The oil and gas industry's interest in the Arctic Outer Continental Shelf[48] (OCS) is driven by the region's substantial resource potential. The Bureau of Ocean Energy Management (BOEM) estimates that the Chukchi Sea Planning Area may hold more than 15 billion barrels of technically recoverable oil and nearly 78 trillion cubic feet of technically recoverable

[46] BOEM 2012-2017 Leasing Schedule. http://www.boem.gov/2012-2017-Lease-Sale-Schedule/

[47] For more information on BOEM's leasing strategy, see: http://www.boem.gov/Alaska-Leasing-and-Plans/

[48] Per BOEM, the Outer Continental Shelf is generally defined as the submerged lands lying around and outside three geographical miles off each state.

natural gas, which is second only to the Central Gulf of Mexico in terms of resource potential offshore the United States. The Beaufort Sea also has significant resource potential with an estimated 8 billion barrels of oil and nearly 28 trillion cubic feet of natural gas.[49] Figure 26 illustrates the OCS Planning Areas as defined by BOEM.

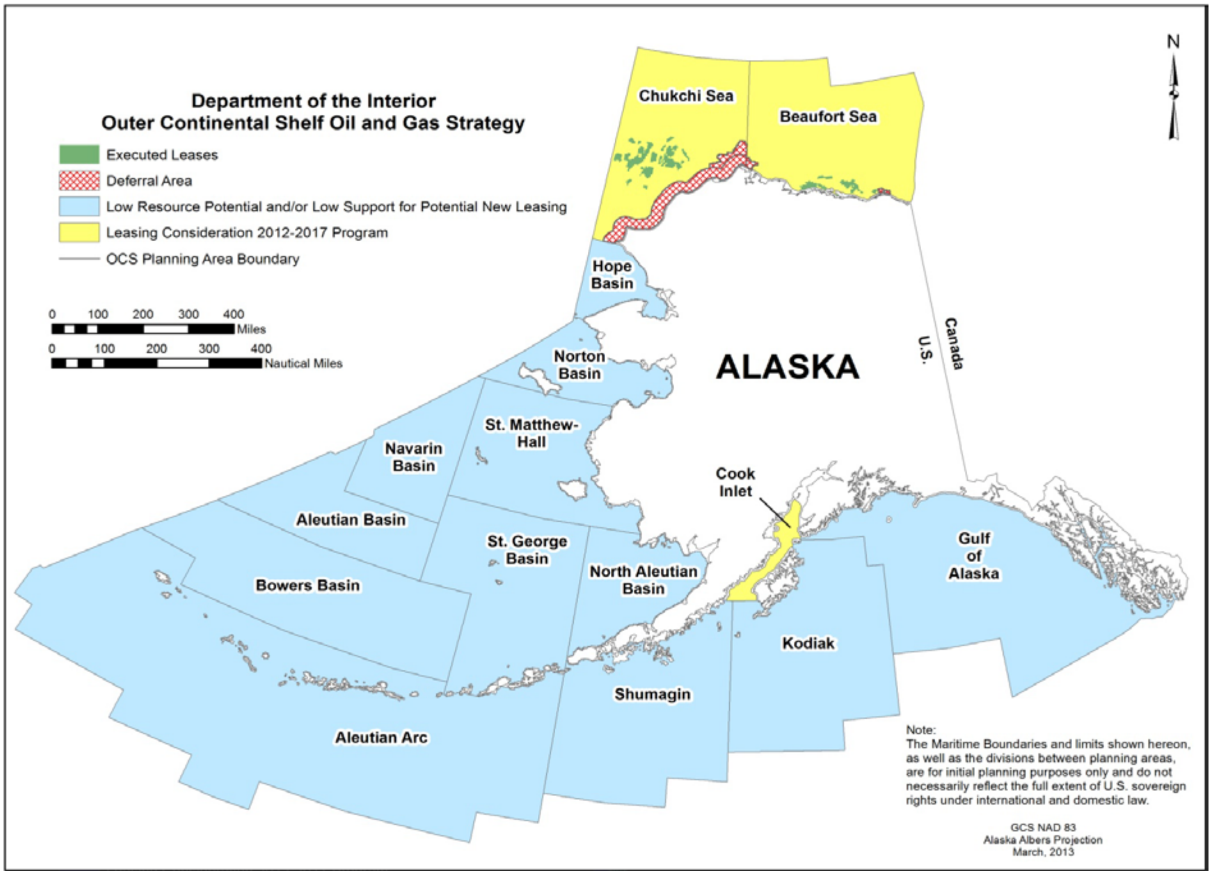

Figure 26. Outer Continental Shelf Oil and Gas Leasing Program, Alaska Planning Areas

Source: Bureau of Ocean Energy Management, Alaska OCS Region

There are significant assumptions associated with the inclusion of the oil and gas industry in the potential fleet which would call upon Nome. There is also a high level of uncertainty associated with forecasting vessel traffic in the High Scenario. These assumptions as well as a description of the risk, uncertainty, and data gaps are discussed in depth in the attached document: Offshore Oil and Gas Background and Assumptions (see Attachment 3).

To address the uncertainty associated with these assumptions, the Alaska District held an In-Progress Review (IPR) with the vertical team on October 8, 2014. The purpose of this IPR was to discuss the assumptions and gain the vertical team's buy-in before moving forward

[49] Review of Shell's 2012 Alaska Offshore Oil and Gas Exploration Program. US Department of the Interior, Report to the Secretary of the Interior. March 8, 2013.

with detailed HarborSym analysis of the High scenario. At that IPR, the vertical team agreed to the assumptions as written in the attached document.

General assumptions are summarized here with more detailed HarborSym input information provided in subsequent sections:

- Three companies (Shell, Conoco Phillips, and StatOil) will pursue exploration and production activities over the period of analysis
- Chukchi Sea drilling operations will be considered in this analysis. Beaufort Sea operations will not be considered and will be supported by existing facilities at Prudhoe Bay
- All three companies will be engaged in exploration activities by the project's base year of 2020
- All three companies will have moved into production by the second analysis year of 2030. All three companies will begin additional (new) production activities by the third analysis year of 2040
- As a company begins to produce at one site, they will begin new exploration activities – the vessel fleet will increase to support exploration and production
- A 120-day drilling season during exploration and production will be utilized, supported by pre- and post-season mobilization and demobilization vessel movements

1. Vessel Fleet

The vessel fleet expected for use by each oil and gas company is based upon Shell's 2012 Chukchi Sea drilling fleet, supplemented by information presented in Shell's 2014 Exploration Plan.[50] Table 33 illustrates the assumed representative exploration vessel fleet for each vessel company: a total of 17 vessels per company.

[50] Shell has already begun preparing for the 2014 drilling season prior to the 9th Circuit Court of Appeals ruling which caused Shell to halt planning of offshore operations. While Shell will have to revise the specifics of their exploration plan prior to another drilling season, the general information related to logistics presented in the 2014 plan is assumed representative and useful for this analysis.

Table 33. Representative Offshore Oil and Gas Exploration Fleet, per company

Vessel Description	Length (ft)	Width (ft)	Draft (ft)	Capacity	Flag
Polar Class / Multipurpose	380	85	27	4,870	Foreign
Anchor Handling (AH) Offshore Support Vessel	361	80	24	4,129	USA
AH Supply Vessel	361	80	24	4,129	USA
Polar Class / Multipurpose	380	85	27	4,870	Foreign
Offshore Supply Vessel (OSV) /Oil Spill Response (OSR)	301	60	21	4,378	USA
OSV	280	60	16.5	3,687	USA
OSV	300	64	20	5,450	USA
OSV	300	64	20	5,450	USA
Science Vessel/OSV	280	60	16.5	3,687	USA
Tug & Barge/Containment System	460	104.4	20	4,404	USA
Tug & Ware Barge	550	99	19	11,732	USA
Tug & Barge	550	99	19	11,732	USA
OSR Tug & Barge	476	76	22	4,404	USA
Landing OSR	134	32	7		USA
Mobile Offshore Drilling Unit	514	85	27	15,296	Foreign
Tug	150	40	20	1	USA
OSR Tug & Barge	295	90	15	3,030	USA

Most of these vessels will remain at the Chukchi Sea drilling grounds during the operating season, and will transit during a pre-season mobilization trip and a post-season demobilization trip. Three vessels – the Offshore Supply Vessels (OSVs or more generally, “supply vessels”) will make in-season re-supply trips to a staging location.

An important note to the analysis is that four of the vessels listed in Shell’s fleet called upon Nome (or anchored offshore) during the 2012 drilling season. As such, these vessels have already been included in the base case vessel call lists. To avoid double counting of vessels, the vessels which called at Nome in 2012 were deleted from the High scenario call lists and re-inserted under their respective oil and gas vessel class category.

Table 34 presents a summary of the exploration vessel fleet and its associated HarborSym vessel classification. Where possible, vessels were placed into similar classes from the base case to streamline modeling. Many of the inputs for the large research vessel, large tug & barge, large landing craft, tugboat, and medium tug & barge will be the same as for the equivalent vessel class from the base case. The two new vessel classes from the oil and gas fleet are supply vessel and drill ship.

Table 34. Vessel Description and Assigned Class for HarborSym modeling

Vessel Description	Vessel Class for HarborSym
Polar Class / Multipurpose	Large Research Vessel_O&G
Anchor Handling (AH) Offshore Support Vessel	Large Research Vessel_O&G
AH Supply Vessel	Large Research Vessel_O&G
Polar Class / Multipurpose	Large Research Vessel_O&G
Offshore Supply Vessel (OSV) /Oil Spill Response (OSR)	Supply Vessel_O&G
OSV	Supply Vessel_O&G
OSV	Supply Vessel_O&G
OSV	Supply Vessel_O&G
OSV	Supply Vessel_O&G
Tug & Barge/Containment System	Large Tug & Barge_O&G
Tug & Ware Barge	Large Tug & Barge_O&G
Tug & Barge	Large Tug & Barge_O&G
OSR Tug & Barge	Large Tug & Barge_O&G
Landing OSR	Large Landing Craft_O&G
Mobile Offshore Drilling Unit	Drill Ship_O&G
Tug	Tugboat_O&G
OSR Tug & Barge	Medium Tug & Barge_O&G

This analysis assumes that as each company begins production at one site, they will pursue exploration activities at a new site. This is supported by information gathered during interviews with oil and gas company representatives. There has never been an offshore oil production platform in the Chukchi Sea, so there is no historical information to use as a basis for vessel activities. Given this lack of information, this analysis assumes that vessel re-supply operations for production and exploration activities will be the same. So, as each company transitions from exploration to production at one site and begins exploration of a new site, the fleet of supply vessels will essentially double. This is a simplifying assumption and does not consider that re-supply vessels could serve more than one exploration/production platform nor does it consider that companies can have multiple exploration wells operating so would not have to wait for production to begin at one site before moving on to the next.

The vessel fleet associated with production activities is equal only to the transiting supply vessels: three supply vessels per company, per activity. This analysis assumes that production activities will be supported by a fleet of supply vessels similar to exploration activities. There has not been a production platform in the Chukchi Sea, so there is limited data available to support what the composition of the remainder of the production fleet would look like.

Utilizing only supply vessels in the fleet of production vessels is a conservative approach in terms of modeling transportation costs and vessel interactions in port.

Consistent with the other modeling for this analysis, growth in activities and vessel fleets will continue until 20 years after the base year (to 2040), at which point estimates will be held constant for the remainder of the 50-year period of analysis.

B. Mining Potential

There are several mines located near Nome and Port Clarence. Graphite Creek Mine property is located on the Seward Peninsula, 40 miles north of Nome and 27 miles southeast of Teller. Graphite Creek has the potential to be the world's largest known large flake graphite deposit.[51] The mine is in close proximity to major importers of graphite including Russia, China, Japan, and South Korea. Graphite One Resources designed a comprehensive exploration program for 2013 that includes drilling, environmental studies, permitting, metallurgy, engineering, reporting and community relations initiatives, all of which are necessary steps for bringing the deposit into production. The company currently plans to transport product by road to Nome and then on to barges at shoreside, but have indicated a preference to transport to Cape Riley due to the shorter length of road required. Current plans are for the mine to be in production by 2016 with a preferred location of Port Clarence for transport of materials to the mine and export of ore product.

Lost River Mine is a fluorspar and tungsten prospect near Port Clarence. The developer, Ron Sheardown, expects to export half a million tons per year when the mine is operational, estimated to be 2017. There is a gravel surface runway 3,650 by 100 feet at the mine site. A 17-mile road will be needed. Permits are in place to get to tidewater and the airport at the site was undergoing upgrades in 2013.

Rock Creek Gold Mine is located along the west coast of Alaska on the Seward Peninsula, 6 miles north of Nome, on private lands owned by Sitnasuak Native Corporation who owns the surface rights, Bering Straits Native Corporation (BSNC) who owns the subsurface rights, and Alaska Gold Company, LLC (AGC) who owns the land. The mine was operated by AGC, under the ownership of NovaGold Resources Inc. (NovaGold), from September 2008 to November 2008 when it was placed into care and maintenance. Phase I Reclamation was completed in October 2012, and in November 2012 BSNC purchased AGC and all interests from NovaGold, which included the Rock Creek Mine. Currently AGC (under the ownership of BSNC) is reevaluating the feasibility of the project before commencing final (Phase II) reclamation.[52]

Figure 27 shows the locations of these mining prospects. The mining activity specifically examined in this analysis is the Graphite Creek Mine as this mine plans to utilize marine facilities at Nome for transport of mined product.

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[51] http://graphiteoneresources.com/projects/graphite_creek/

[52] http://dnr.alaska.gov/mlw/mining/largemine/rockcreek/

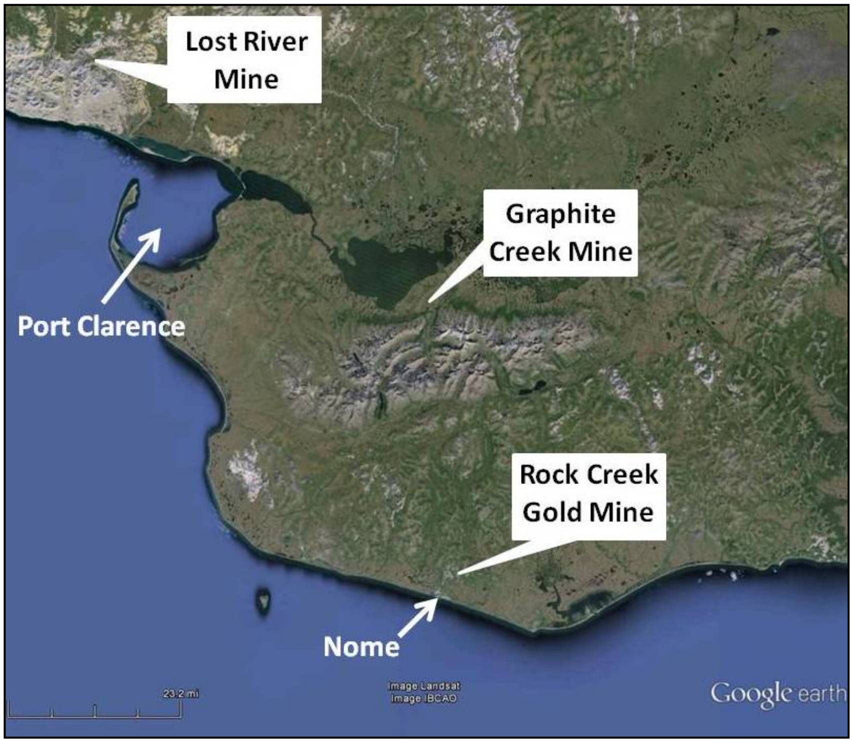

Figure 27. Nome and Port Clarence Area Map including mining locations

Source: ©Google Earth. Citations added by USACE.

C. Vessel Traffic Associated with the development of Graphite One Mine near Nome

The next industry considered in the High scenario is development of the Graphite One Mine near Nome. Graphite One Resources holds the title to 129 mineral claims at its Graphite Creek prospect on the Seward Peninsula, in the Kigluaik Mountains, approximately 40 miles north of Nome.

The company was engaged in an exploratory drilling campaign during the summer of 2014 for its "world-class" flake graphite deposit. The mine site is located about 10 miles from the existing Nome-Taylor Highway. The company would need to construct a road to the Nome-Taylor Highway or determine an alternate means of transporting mined product prior to production. Graphite One Resources is also currently engaged in pre-feasibility studies which would determine the transportation logistics associated with the mine.

Current estimates project a 50-year initial mine life, based on the available graphite resource. Flake graphite is used in lithium-ion batteries, among other products.

The company expects to collect and ship 50,000 tonnes of graphite per year from the mine. Graphite product will be moved in one-ton super sacks. Super sacks containing graphite can be moved with forklifts and other existing loading infrastructure already used at the Port of Nome.

At this time, Graphite One Resources expects first production from the mine by 2018. Graphite One believes the quantity and quality of the graphite found at its Graphite Creek prospect is on track to meet the needs of the battery-powered vehicle industry, including the recently-announced Tesla lithium battery "gigafactory", and the growing demands of the graphite sector in the US at large. According to Graphite One Resources, "Graphite consumption has doubled since 2000, with 1.2Mt consumed in 2012. China produces over 70 percent of the world's graphite, however resources are depleting and exports are declining as costs and taxes rise (36 percent export tax). The USA currently imports 100 percent of its graphite. A looming global graphite deficit is expected, with graphite deemed a 'Supply Critical Mineral' in the USA and a 'Strategic Mineral' in the EU."

Based on this information, this analysis assumes that the Graphite One Mine will be in production by the base year of 2020. Conversations with Graphite One Resources found that the company is in initial discussions with barge operators at Nome to transport mined graphite from Nome via back haul on empty barges. Many barges calling at Nome are returning south empty after delivery to Nome. This analysis assumes that graphite product will be move via tug and barge from Nome in both the future without- and future with-project condition.

1. Vessel Fleet

Based on information gathered regarding Graphite One Mine's potential operations, this analysis assumes the graphite will be shipped from Nome aboard tug and barges which already call at Nome and ship dry cargo.

Looking to the vessel fleet developed for base case modeling, there are 12 large tug and barges expected to call at Nome to deliver dry cargo in the future without-project in 2020, 18 in 2030, and 21 in 2040. Considering the capacity of these vessels and the expected amount of outbound dry cargo from Nome on each call, there is adequate capacity on board these barges for the expected 50,000 metric tons of graphite. Table 35 illustrates the remaining capacity aboard large tugs and barges calling at Nome, after considering the expected outbound dry cargo. These values are based on the future without project condition 2020 base case traffic.

In all cases, there is adequate outbound capacity to serve the Graphite One Mine so no additional barges have been added to the future high scenario for mine operations. Production at the Lost River Mine or the Rock Creek Gold Mine could limit the outgoing mine products on existing southbound barges. However, not enough is known about these mine operations to modify the future barge traffic at this time.

Table 35. Large Tug & Barge Capacity, Future Without-Project Condition, 2020

Vessel Name	Vessel Capacity	Outbound Dry Cargo	Remaining Capacity
Large Tug & Barge 1	10,597	698	9,899
Large Tug & Barge 10	10,597	698	9,899
Large Tug & Barge 11	13,426	698	12,728
Large Tug & Barge 12	13,426	1,396	12,030
Large Tug & Barge 2	10,597	698	9,899
Large Tug & Barge 3	10,597	698	9,899
Large Tug & Barge 4	10,597	698	9,899
Large Tug & Barge 5	13,426	698	12,728
Large Tug & Barge 6	10,597	698	9,899
Large Tug & Barge 7	13,426	698	12,728
Large Tug & Barge 8	10,597	698	9,899
Large Tug & Barge 9	10,597	540	10,057
Total Remaining Capacity			**129,564**

Note: Capacity in this table is in metric tons.

D. Growth in Arctic Research Vessel Traffic

The high scenario will include growth in the research vessel fleet beyond the projections from the base case. In the base case, the large and medium research vessel fleet remained constant over the period of analysis. The small research vessel fleet increased from 26 vessels in 2020 to 29 in 2040 based on the estimated commodity transfers by these vessels and the base case commodity forecasts.

The historical level of research vessel activity near Nome does not provide a basis for projecting future activity. Figure 28 presents the number of research vessel calls to the Port of Nome from 2010 through 2013 and Figure 29 illustrates the number of research vessel trips as well as the number of research vessels transiting near Nome from 2009 through 2013. Neither of these data sets presents a clear trend in research vessel traffic.

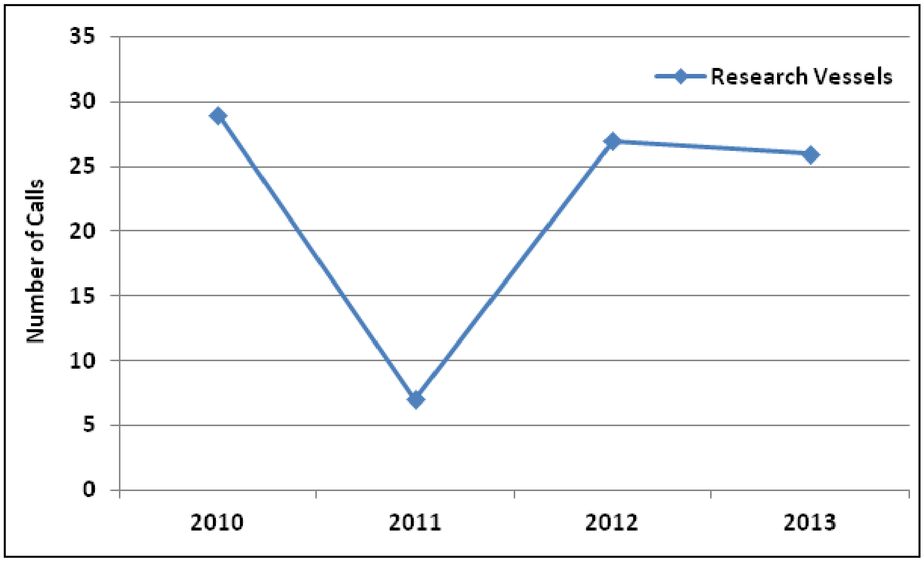

Figure 28. Research Vessel calls at the Port of Nome, 2010-2013

Source: City of Nome, Summary vessel traffic information

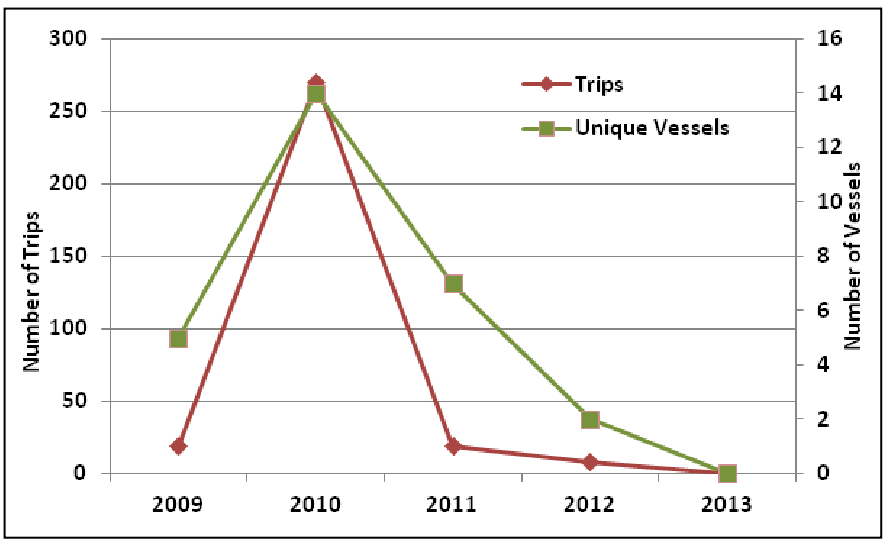

Figure 29. Research Vessel Trips and Number of Unique Vessels, Nome Region, 2009-2013

Source: Marine Exchange of Alaska

In the high scenario, increased interest in the Arctic and diminishing sea ice will increase the expected fleet of research vessels. Given a lack of historical data with which to predict future activity, this analysis assumes that research vessel calls will increase at a rate of one percent per year, or a 10 percent growth between each of the analysis years. As with the other analyses, growth will be held constant after 2040. This is a conservative estimate of the possible increase in research traffic through the period of analysis.

1. Vessel Fleet

Table 36 summarizes the expected research vessel fleet in the high scenario based on the assumptions above. As with the base case, this fleet will be the same in both the future without and future with project conditions. The only difference from the base case is that some vessels will be able to call at a dock as opposed to anchor offshore.

Table 36. Research Vessel Fleet, High Scenario

Vessel Class	Existing	2020	2030	2040
Large Research Vessel	4	4	5	5
Medium Research Vessel	3	3	3	4
Small Research Vessel	21	28	33	37
Total	**28**	**35**	**41**	**46**

E. Growth in Arctic Cruise Ship Traffic

As with research vessel traffic, Arctic cruise ship traffic is expected to increase in the high scenario based on increased interest, and therefore tourism, in the Arctic and diminishing sea ice. Base case cruise ship traffic projections were based only on the base case commodity forecast for those cruise ships which reported transferring commodities at Nome.

Figure 30 presents the number of passenger vessels and trips reported to be transiting in the Nome region, as reported by the Marine Exchange of Alaska. Once again, this historical data does not provide a consistent basis on which a vessel forecast can be made.

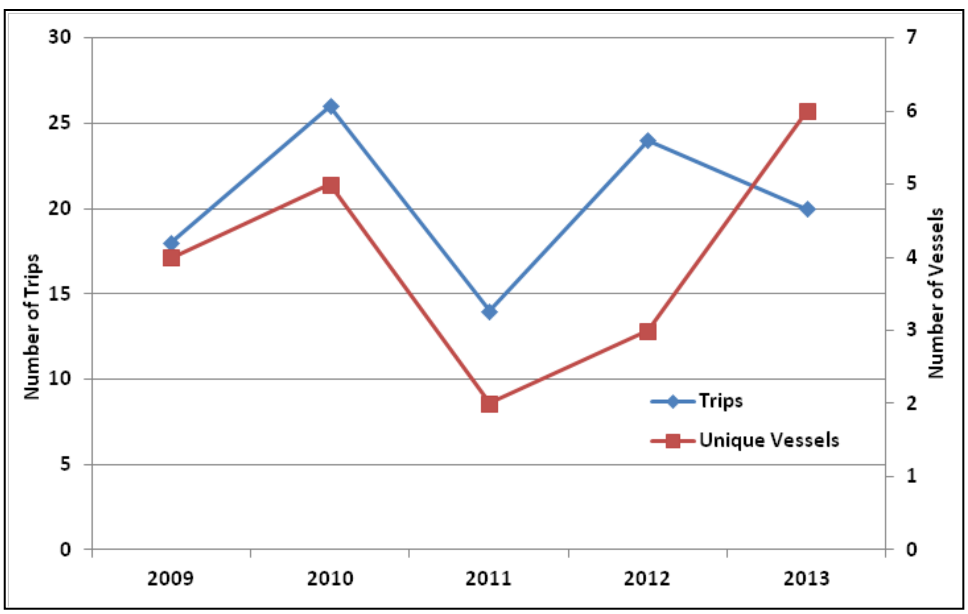

Figure 30. Passenger Vessel Trips and Number of Unique Vessels, Nome Region, 2009-2013

Source: Marine Exchange of Alaska

To address the variance in the historical data specific to cruise vessels at Nome, this analysis looks to published information about the broader cruise industry. According to the Alaska Visitor Statistics Program report, published by the State of Alaska Department of Commerce, Community, and Economic Development, the annual rate of growth for global cruise passengers from 2006 through 2010 was equal to 4.48 percent per year. This rate of change is utilized as representative of the expected growth in cruise vessel traffic over the period of analysis. This is equivalent to a 44.8 percent growth over the 10 year periods between analysis years for HarborSym modeling.

1. Vessel Fleet

Table 37 summarizes the expected cruise vessel fleet to call at Nome in the high scenario, based on the assumptions as described. This represents the expected fleet in both the future without- and future with-project conditions.

Table 37. Cruise Vessel Fleet, High Scenario

Vessel Class	Existing	2020	2030	2040
Small Cruise Ship	4	6	12	18
Medium Cruise Ship	1	3	6	8
Large Cruise Ship	1	1	2	3
Total	**6**	**10**	**20**	**29**

F. Additional Government Vessel Trips

Government vessel traffic in the base case includes vessel calls at Nome from American cutters, buoy tenders, and ice breakers. These vessel calls are comprised of both US Coast Guard and Navy vessels. In addition, based on existing condition traffic, there are two Canadian Coast Guard buoy tenders which are expected to call at Nome in the future.

In the high scenario future conditions, increased traffic in the Arctic will result in more joint maneuvers with Alaska's Arctic neighbors (e.g. Canada) resulting in additional stops at Nome for these foreign buoy tenders. These stops are expected to increase rather dramatically as US and Canadian search and rescue and oil spill response drills are deployed. Eight buoy tender trips are expected in 2020, and there will be 16 buoy tender trips by 2030.

The number of US-flagged government icebreakers is not expected to increase by 2020. The number of US-flagged icebreaker stops at Nome will increase to four from the two stops made in 2012. By 2030, an additional icebreaker is expected to join the US fleet as traffic conditions already warrant an additional icebreaker but fiscal constraints will limit the number for some time to come. By 2030, icebreaker stops at Nome will be eight as government vessels will be heavily involved in offshore oil and gas activity.

The number of cutter stops at Nome will increase to 12 in 2020 from the 7 in 2012. By 2030, the cutter stops at Nome will be 20 as a result of increased Arctic traffic and the need for government vessels to monitor Arctic activities.

Traffic levels for 2040 will be equal to 2030.

Table 38 summarizes the expected number of vessel calls at Nome in the high scenario for each analysis year.

Table 38. Government vessel calls at Nome, high scenario

Vessel Class	Existing	2020	2030	2040
Cutter	4	12	20	20
Ice Breaker	2	4	8	8
Buoy Tender	3	8	16	16
Total	**9**	**24**	**44**	**44**

XI. FUTURE WITHOUT PROJECT CONDITION MODELING – HIGH SCENARIO

This section describes the future without project condition assumptions associated with HarborSym modeling of the High Scenario.

A. Facilities

There are no changes in the expected future without project condition facilities between the base case and the high scenario.

B. Offshore Oil and Gas

1. Vessel Fleet Movement

The previous section described the assumed vessel fleet for offshore oil and gas exploration and production activities. In the future without project condition, the entire fleet of vessels is expected to make port calls similar to those made by Shell's fleet during the 2012 season. More specifically, the entire fleet will mobilize from the Pacific Northwest, stop in Dutch Harbor for pre-season staging activities, then transit north to the Chukchi Sea drilling grounds. All vessels except the three supply vessels per company, per activity will remain at the Chukchi Sea drilling grounds for the entire season. The demobilization post-season fleet movement will be the reverse of the mobilization trip.

During the drilling season, the three supply vessels per company, per activity will utilize Dutch Harbor as an in-season re-supply port. These vessels (nine total in 2020) will make periodic trips between the Chukchi Sea and Dutch Harbor during the drilling season. The primary purpose of these supply vessel trips will be to transfer drilling supplies from the staging location to the drilling grounds. These dry goods will be staged by barge service from Seattle to Dutch Harbor for pick-up by supply vessel and transit to the drilling grounds. Limited information is available regarding the exact cargo movements conducted by Shell during the 2012 season.

Exploration plans filed by Shell for the 2014 season stated that 30 total roundtrips would be needed per season between the Chukchi drilling grounds and Dutch Harbor. Lacking information about the specific cargo movements per vessel, this analysis assumes that each company will require 30 roundtrips (or an average of 10 roundtrips per supply vessel) per exploration or production activity.

In the future without project condition, oil and gas vessels will not call at Nome, but will transit directly west of Nome through the Bering Strait en route to the Chukchi Sea. To model these trips in the without project condition and to provide a consistent comparison of total travel costs in the with project condition, this analysis will assign these oil and gas vessels a "call" at the Nome Lightering Location. Their route group travel distances will be set to bypass Nome, but the vessels will be added to the call list.

2. Dock Usage

All oil and gas vessels in the future without-project high scenario will call at the Lightering Location at Nome. These vessels will be set to artificially "call" at the Lightering Location "dock" in order to include their without-project travel costs for comparison against the future with-project condition.

3. Docking/Undocking Times

For oil and gas vessels assigned to equivalent vessel classes from the base case (i.e. research vessel, tug & barge, landing craft, and tugboat), the same docking/undocking time assumptions will be utilized from the base case. Docking/undocking times for the supply vessel and drill ship vessel classes are based on the base case docking/undocking times for large vessels: large cruise ships, large tugs & barges, large research vessels, tankers, and government vessels all have the same docking/undocking times in the future without project condition base case.

4. Sailing Drafts

Sailing draft information was set equal to the base case assumptions for the vessel classes which existed in the base case. Supply vessel sailing drafts are set to a minimum of 16.5 feet and a maximum of 21 feet. These values are equal to the design drafts of the two types of supply vessels expected to be utilized. Design drafts were used given lack of information on sailing drafts and the exact amounts of cargo expected per vessel trip. Sailing drafts for drill ships are equal to the transiting drafts as reported in Shell's filed documents and exploration plans. For the purposes of comparison, this analysis examined the transiting drafts of the Noble Discoverer, Kulluk (both used by Shell in 2012), and the Polar Pioneer (planned to be used by Shell in 2014). The reported transit drafts of these vessels ranges from 27 to 41 feet. As these vessels are not expected to transport commodities, their reported transit drafts are utilized as representative for this analysis.

5. Underkeel Clearance

As with the previous categories, the underkeel clearance assumptions from the previously-existing vessel classes were utilized for the high scenario. An important consideration is that data from the Alaska District H&H Engineering section states that the maximum draft vessel which can call at a -28-foot dock is 22-feet. This 6-foot underkeel clearance requirement is based on vessel safety clearances and tidal considerations. In consideration of this data, the underkeel clearances for both the supply vessel and drill ship vessel classes are set to 6 feet.

Underkeel clearance requirements are not critical for oil and gas vessel considerations in the future without project condition given that these vessels will not call upon a dock at Nome.

6. Vessel Speeds

Table 39 presents the maximum transit speeds for the various vessels types in the fleet, as presented in Shell's exploration plans. These speeds are utilized as the maximum values for vessel speeds at sea in HarborSym. The most likely speed at sea is equal to 80 percent of the maximum and the minimum equals 80 percent of the most likely. This table does not include speeds at sea for the landing craft which are part of the oil and gas vessel fleets. Landing craft speeds at sea are set equal to the values for landing craft from the base case: 12 knots for the minimum, most likely, and maximum values.

Table 39. Maximum Vessel Speeds, by type, Oil and Gas Vessels

Vessel type	Max speed (knots)
Science Vessel	14
Tugboat	16
Tug & Barge	12
Ice Mgmt Vessel	16
Anchor Handler	15
Nearshore OSR Tug & Barge	7
OSV	14

Source: Shell's Submittal of the Revised Chukchi Sea Exploration Plan – Revision 2

For the future without project condition, the fleet of oil and gas vessels does not actually call at Nome, but are set to use the Lightering Location for modeling purposes. With this in mind, the vessel speeds in reaches are set to the most likely vessel speed at sea. In the future without-project condition, oil and gas vessels will only transit the reach between the entry/exit point and the lightering location. This is the only reach which contains vessel speed information for oil and gas vessels in HarborSym.

7. Vessel Turning Times

Table 40 presents the vessel turning time assumptions from the base case and for the new vessel classes developed for the high scenario. As with previous assumptions, vessel turning times for the vessel classes in the high scenario are equal to their equivalent class from the base case. For example, Tug & Barge from the base case is equal to O&G Tug & Barge in the high scenario. Turning times for the two new vessel classes (Drill Ship and Supply Vessel) are based on the turning time assumptions from the base case for larger vessels – tug & barge, research vessels, cruise ships, tankers, and government vessels.

Table 40. Future Without Project Vessel Turning Times, Base Case and High Scenario comparison

Vessel Type (base case)	Vessel Turning Times		
	Min	ML	Max
Tug & Barge	0.25	0.5	0.75
Research	0.25	0.5	0.75
Cruise Ship	0.25	0.5	0.75
Landing Craft	0.1	0.2	0.3
Tanker	0.25	0.5	0.75
Government	0.25	0.5	0.75
Tugboat	0.1	0.2	0.3
New Vessel types:			
O&G Research Vessel	0.25	0.5	0.75
O&G Tug & Barge	0.25	0.5	0.75
O&G Landing Craft	0.1	0.2	0.3
O&G Tugboat	0.1	0.2	0.3
O&G Supply Vessel	0.25	0.5	0.75
O&G Drill ship	0.25	0.5	0.75
Notes:			
Turning times for O&G Research vessels, tug & barge, landing craft, and tugboat based on assumptions from base case modeling for similar vessel types.			
Turning times for O&G Supply Vessels and Drill Ships equal tug & barge and research vessels from base case.			

8. Vessel Capacities

For the oil and gas vessel fleet, vessel capacities are set equal to each vessel’s deadweight tonnage (DWT). DWT information is based on Shell’s publications and internet research based on each representative vessel’s unique IMO number.

9. Vessel TPI Factors

Vessel tons per inch (TPI) factors are set equal to those from the equivalent class from the base case, as appropriate.

TPI factors for drill ships and supply vessels are calculated by extrapolating the TPI information provided in IWR’s Deep Draft Navigation Vessel Operating Costs. Extrapolation was conducted using linear regression of the reported deadweight tonnages and TPI factors. The supply vessel TPI factors used in HarborSym are equal to the average TPI value considering the deadweight tonnages of the various supply vessels, which range from 3,687 to 5,450.

10. Vessel Operating Costs

Vessel operating costs (VOCs) for the vessel classes which are “clones” from the base case are set equal to their equivalent base case value. Therefore, the VOCs for oil and gas research vessels, tugs & barges, landing craft, and tugboat are subject to the same assumptions as described in the base case. The IWR VOCs for general cargo vessels provide the basis for the VOCs for drill ships and supply vessels. The most likely VOCs for these vessel types are based on an extrapolation of the IWR VOCs using linear regression and considering the deadweight tonnages of these vessel types. The minimum and maximum VOCs are equal to 90 percent and 110 percent, respectively, of the most likely values.

11. Route Groups

There are two types of route groups which will be used by oil and gas vessels in the future without project condition: 1) the pre- and post-season route for vessel mobilization and demobilization, and 2) the in-season route for supply vessels making re-supply trips. In the future without project conditions, vessels will not stop in Nome, so route group distances have been calculated accordingly.

During the pre-season trip, the vessel fleet mobilizes in the Pacific Northwest, and moves to Dutch Harbor for pre-season staging. The fleet then moves north to the Chukchi Sea. These vessels “stop” at the Nome Lightering Location en route to the Chukchi. For the purposes of route group distances, the prior port is Dutch Harbor, the next port is the Chukchi Sea, and there is no additional sea distance, given that most vessels will stay at the drilling grounds for the entire drilling season. Route group distances to the Nome Lightering Location were determined using Google Earth by setting a point at sea immediately west of Nome. The location of the Chukchi Sea drilling grounds is determined based on examining BOEM’s Chukchi Sea lease maps and estimating the midpoint location to which vessels would travel for drilling.

The minimum and maximum values are equal to 90 percent and 110 percent, respectively, of the most likely distance. This calculation addresses some of the uncertainty in using Google Earth to estimate vessel travel paths and distances.

The post-season route group for oil and gas vessels is essentially the reverse of the pre-season route. The prior port to Nome is the Chukchi Sea drilling grounds, the next port after Nome is Dutch Harbor, and the additional sea distance includes travel to Seattle.

The in-season route group for supply vessel re-supply trips considers the distance between the Chukchi Sea drilling grounds with an artificial “stop” at the Nome Lightering Location. For the purposes of HarborSym modeling, supply vessels will stop once at Nome for each re-supply trip (as opposed to one “stop” at Nome on the way southbound to Dutch Harbor and one “stop” at Nome on the way northbound returning to the Chukchi). Utilizing these assumptions, the prior port to Nome is the Chukchi Sea drilling grounds, the next port is Dutch Harbor and the additional sea distance is the entire return leg from Dutch Harbor to the Chukchi Sea.

Table 41 summarizes the route groups for oil and gas vessels in the high scenario future without project condition.

Table 41. Future Without Project High Scenario Route Groups for Oil and Gas Vessels

Route Group Name	Prior Port Distance		
	Minimum	Most Likely	Maximum
1) Pre-season FWOP	586	651	716
1) Post-season FWOP	379	421	463
2) In-season, whole trip FWOP	379	421	463
Route Group Name	**Next Port Distance**		
	Minimum	**Most Likely**	**Maximum**
1) Pre-season FWOP	379	421	463
1) Post-season FWOP	586	651	716
2) In-season, whole trip FWOP	586	651	716
Route Group Name	**Additional Sea Distance**		
	Minimum	**Most Likely**	**Maximum**
1) Pre-season FWOP	0	0	0
1) Post-season FWOP	1,547	1,719	1,891
2) In-season, whole trip FWOP	965	1,072	1,179

Source: All distances in nautical miles.

12. Cargo Transfers

In the future without project condition, oil and gas vessels will not stop at Nome and will therefore not transfer any cargo there. All oil and gas vessels will be set to be at layberth at Nome. Each vessel will be set to 10 units of layberth, equal to a 24-hour stop at Nome. Vessels are set to stop at Nome for an entire day, rather than stopping for a short period of time as they pass through, to maintain consistency with the modeling assumptions which will be presented in the future with project scenario.

13. Cargo Transfer Rates

Only the layberth cargo transfer rate is needed for oil and gas vessels in the future without project condition. The high scenario follows the same assumptions as the base case and sets the cargo transfer rates for layberth to 0.4167 units per hour (equivalent to 10 units of layberth for 24 hours).

14. Estimated Total Trip Cargo

Estimated Total Trip Cargo (ETTC) values are utilized to determine the portion of at-sea transit costs to attribute to the subject port for each voyage. In the case of oil and gas vessels, all at-sea transit costs should be attributed to Nome. This must be true in both the future without and future with project conditions in order to ensure a consistent analysis of total transportation costs. For the purposes of modeling in HarborSym, ETTC values are set equal to the amount of commodity transferred per call. In the future without project condition for the high scenario, this means all ETTC values are set to 10 to represent the 10 units of layberth transferred per vessel call.

C. Graphite One Vessel Traffic

As described in the previous section, all graphite transfers will occur on-board existing large tug and barge traffic at the Port of Nome as part of vessel backhaul. These transfers will use the vessel class of large tug & barge from base case HarborSym modeling. All assumptions related to these vessel types are the same as the base case.

Graphite One Resources has reported that they expect graphite to be shipped to the Pacific Northwest for processing. Large tug & barge vessels in the base case are set to utilize the West Coast US route group. Given the uncertainty in the exact vessel movements of graphite vessels, this route group is utilized as representative.

1. Cargo Transfers

The exception from the base case modeling will be cargo transfer information. To model graphite transfers, the high scenario HarborSym models include a new commodity type: graphite. Based on information from Graphite One Resources, this analysis assumes that 50,000 metric tons of graphite will be outbound from the Port of Nome each year. Table 42 shows the assumptions related to the amount of graphite per large tug and barge. These assumptions are based on the number of large tugs and barges calling at Nome in the base case for each analysis year and an even split of outbound graphite per vessel call.

Table 42. High Case Scenario Graphite Cargo Amounts per vessel assumptions

	2020	2030	2040
Metric tons of graphite outbound from Nome	50,000	50,000	50,000
Large Tug & Barge calls at Nome	12	18	21
Metric tons per vessel, assuming even split	4,167	2,778	2,381

This analysis assumes that since graphite can be loaded using a forklift, transfers of graphite can occur at any of the future without-project condition docks at Nome. Therefore, the only changes to the base case future without-project condition large tugs and barge calls is to add a line to the call list for exports of graphite.

2. Cargo Transfer Rates

As the graphite mine near Nome is not yet producing, there is no information available regarding the exact vessel loading operations associated with moving product. Several assumptions regarding cargo loading behavior are necessary to address the lack of data on cargo transfers. Based on general information regarding other dry cargo and gravel transfers at Nome, this analysis assumes that graphite loading should take an average of 2 days (48 hours) at the dock. The largest amount of graphite transferred per call will occur in 2020, with approximately 4,167 metric tons per vessel call. Considering these assumptions, the most likely cargo transfer rate for graphite is equal to 86.81 metric tons per hour (4,167 metric tons / 48 hours). The minimum and maximum cargo transfer rates are equal to 80 percent and 120 percent of the most likely value, or 69.45 and 104.175 metric tons per hour.

3. Estimated Total Trip Cargo

ETTC values for large tugs and barges transporting graphite were set to the total amount of cargo transferred at Nome – equal to the dry cargo amounts aboard the vessel in the base case plus the graphite added for the high scenario. These calculations ensure that graphite is included in the ETTC values compared to those used in the base case.

D. Additional Research Vessel Traffic

The additions to the fleet of Arctic research vessels are described in the previous section. The vessel calls added to the fleet in the high scenario future without project condition utilize the same characteristics and shipping assumptions as in the base case, including calls to specific docks, arrival drafts, route group assignments, and other characteristics. All of the new research vessels are assigned to the layberth commodity. The time spent at the dock for each new research vessel call (or the amount of the layberth commodity per call) was determined by looking at the average time at the dock for similar vessels in the base case.

E. Additional Cruise Ship Traffic

The additions to the fleet of Arctic cruise ships are described in the previous section. As with research vessels, the assumptions related to the sailing and loading practices of these new cruise ship calls follow the assumptions from the base case.

F. Additional Government Vessel Trips

The previous section also describes the method used to forecast the high scenario vessel calls by government vessels. The assumptions from the base case also apply to government vessels including dock usage, sailing practices, commodity assignments, commodity amounts, and similar.

G. Model Outputs

As with the base case, HarborSym was run for the future without project condition high case scenario for the analysis years 2020, 2030, and 2040. All vessel types are interpolated in the interim years – except those related to oil and gas. The nature of the expected oil and gas development and the assumptions related to the modeling of this traffic mean that these vessels are added to the fleet at ten-year intervals or “shocks” to the system. All three companies will be engaged in exploration activities by the base year of 2020. Then, in 2030, this analysis assumes that each company will increase the size of their supply vessel fleet to support production activities while maintaining their existing fleet to continue exploration at a new site. A similar type of shift occurs in 2040. As these vessels are not added incrementally in the interim years of analysis, the values for the oil and gas vessel classes are not interpolated.

This is a simplistic approach to modeling oil and gas development as it is unlikely that all three companies will operate on the same schedule. However, these ten year shocks were utilized for this phase of study to streamline HarborSym modeling by maintaining consistency with the analysis years utilized for the base case. Sensitivity analysis during future phases of study will examine the impact of project timing assumptions on the level of benefits.

As with the base case, all values are held constant beyond 2040.

Models for the high scenario have been run for 10 iterations for this phase of analysis.

Overall, the 2020 model processed an average of 490 vessels with an average of 0 deleted vessels. Total overall transportation costs averaged $209,685,866 with $90,267,117 total costs allocated to the port. On average, a total of 199,607 metric tons of commodities were transferred. This increase from the base case is due to the addition of graphite and the layberth quantities for oil and gas, research, cruise, and government vessels. Total time in system averaged 15,627 hours. Total wait time in the system averaged 290 hours, including 146 hours waiting at the dock and 144 hours waiting at the channel entrance. Cargo transfer time amounted to 14,750 hours. Docking and undocking times were 290 hours and 206 hours respectively.

The 2030 model processed an average of 702 vessels with an average of 0.1 deleted vessels. Total overall transportation costs averaged $293,465,668 with $114,162,740 total costs allocated to the port. On average, a total of 234,072 metric tons of commodities were transferred. Total time in system averaged 21,610 hours. Total wait time in the system averaged 417 hours, including 150 hours waiting at the dock and 266 hours waiting at the channel entrance. Cargo transfer time amounted to 20,344 hours. Docking and undocking times were 426 hours and 300 hours respectively.

The 2040 model processed an average of 920 vessels with an average of 0 deleted vessels. Total overall transportation costs averaged $347,973,195 with $136,032,403 total costs allocated to the port. On average, a total of 269,632 metric tons of commodities were transferred. Total time in system averaged 27,599 hours. Total wait time in the system averaged 389 hours, including 53 hours waiting at the dock and 337 hours waiting at the channel entrance. Cargo transfer time amounted to 26,097 hours. Docking and undocking times were 560 hours and 392 hours respectively.

XII. FUTURE WITH PROJECT CONDITION – HIGH SCENARIO

This section describes the future with project condition for the high scenario. In general, the assumptions from the base case future with project scenario also apply to the high case.

A. Facilities

There is no change in the expected facilities between the base case and high scenario future with project condition.

B. Offshore Oil and Gas

All three of the oil companies with major Alaska offshore leases were contacted during the course of this study and provided varying levels of feedback. All stated that a deep draft Arctic port closer to the drilling grounds could improve their logistical operations – and therefore introduce efficiencies which could reduce transportation costs.

At this time, the oil companies are not willing to commit to one site in Alaska for deep draft port preference or for a base for their operations. This analysis assumes that in the absence of another deep draft Arctic port, oil companies, as profit-driven entities, will use Nome in the future with-project condition provided that Nome can meet their operational requirements of dock space, depth, and associated uplands.

Interviews with oil and gas companies found that Shell did not use Nome as their primary staging and re-supply location for their 2012 operations because the existing depth at Nome would not accommodate many of their vessels, the existing overcrowding at Nome, and the lack of dock space at Nome. A generalizing assumption for this analysis is that the depth and additional dock space provided in the future with project condition would provide incentive for oil and gas companies to use Nome.

The following sections detail the assumptions related to oil and gas vessels as they differ from the future without project condition. All other input data is assumed to be consistent between the future without and with project conditions.

1. Vessel Fleet Movement and Staging Location

Future with project condition vessel movements for pre- and post-season mobilization and demobilization will essentially be the same as the without-project condition, with the addition of a stop in Nome. Vessels will begin the season in the Pacific Northwest, move north to Dutch Harbor for some interim staging, then move north to Nome for continued staging activities, and finally move to the Chukchi Sea where most vessels will remain for the entire drilling season.

The exact "staging" activities conducted in Dutch Harbor in the existing and future without-project condition are unknown at this time. In conjunction with information gathered during interviews with oil and gas company representatives, this analysis assumes that there are efficiencies for the vessel fleet in conducting some of this staging at Nome rather than Dutch

Harbor. The primary efficiency for the fleet is allowing them to move northward more quickly and be pre-staged as the ice recedes in the Chukchi.

Interviews with oil and gas companies by the Alaska District and Tetra Tech as part of this study found that there are operational efficiencies which could be gained for supply vessels through utilizing a staging location closer to the drilling grounds. This analysis assumes that in-season re-supply trips will be conducted between the Chukchi Sea and Nome in the future with project condition. Supply vessels will be able to utilize Nome as a re-supply location in the with project condition given the increased dock space and increased depth.

2. Cargo Movements

The same supply chain as the future without project condition will be used, meaning that cargo will first be transported from the Pacific Northwest via barge to Nome (as compared to Dutch Harbor in the without project condition).

The City of Nome is developing additional upland area, so there will be adequate space to accommodate the laydown area needed for three oil and gas companies (4 acres per company or 12 acres total). At this time information is unavailable regarding shoreside equipment needed to transfer cargo. However, under current conditions, cargo offloading equipment is not provided by the Port of Nome, and each company is responsible for providing their own. The Port of Nome has no plans to change this arrangement, so each oil company will be expected to provide transfer equipment.

In the simplest terms, this analysis assumes that the same amount of cargo will have to be transported the same distance in support of an oil and gas drilling season. Based on current data available, the expected benefits will be derived from a change in the staging location of this cargo and a shift in the mode of cargo transport: barging from Dutch Harbor to Nome.

3. Vessel Fleet

The same assumptions regarding the trips for the vessel fleet will be used from the without project condition – the only change will be the interim staging location at Nome. Utilizing the same assumptions, supply vessels will make 30 trips between the Chukchi and Nome during the drilling season. Per input from oil and gas company representatives, cargo transfers from a re-supply base closer to the Chukchi could be supported by two supply vessels per company and exploration or production activity as compared to three in the future without project condition. So this analysis assumes that the supply vessel fleet will be equal to two per company or six total for 2020, transitioning to 12 in 2030 once production activities begin.

This analysis assumes that for each oil and gas company and for each exploration or production activity, the supply vessel to be removed is equivalent to the 300-foot long supply vessel (beam of 64 feet, and design draft of 20 feet). The determination of the supply vessel to remove from the fleet could have an impact on the optimal depth of the project alternatives. In this case, removing the larger of the supply vessels from the fleet is the conservative approach. Table 43 presents the future with project oil and gas fleet of exploration vessels, based on the removal of one supply vessel.

Table 43. Future With-project Oil and Gas Vessel exploration fleet, per company

Vessel Description	Length (ft)	Width (ft)	Draft (ft)	Capacity	Flag
Polar Class / Multipurpose	380	85	27	4,870	Foreign
Anchor Handling (AH) Offshore Support Vessel	361	80	24	4,129	USA
AH Supply Vessel	361	80	24	4,129	USA
Polar Class / Multipurpose	380	85	27	4,870	Foreign
Offshore Supply Vessel (OSV) /Oil Spill Response (OSR)	301	60	21	4,378	USA
OSV	280	60	16.5	3,687	USA
OSV	300	64	20	5,450	USA
Science Vessel	280	60	16.5	3,687	USA
Tug & Barge/Containment System	460	104.4	20	4,404	USA
Tug & Ware Barge	550	99	19	11,732	USA
Tug & Barge	550	99	19	11,732	USA
OSR Tug & Barge	476	76	22	4,404	USA
Landing OSR	134	32	7		USA
Mobile Offshore Drilling Unit	514	85	27	15,296	Foreign
Tug	150	40	20	1	USA
OSR Tug & Barge	295	90	15	3,030	USA

In addition to the oil and gas vessel fleets associated with exploration and production, the high scenario analysis also considers the additional tug and barge traffic which will call at Nome which will transport cargo for staging and pick-up by supply vessels. Shell reported that for their 2012 operations, they used scheduled barge service from the Pacific Northwest to deliver supplies for staging at Dutch Harbor. Similarly, this analysis assumes that scheduled barge service will be utilized to deliver these materials from the Pacific Northwest to Nome in the future with project condition. For modeling in HarborSym, these barge trips will be conducted by vessels in the existing Large Tug & Barge vessel class. All of the vessel characteristics and shipping operations assumptions from the base case will apply to these vessels, except for the differences noted in the subsequent sections.

4. Dock Usage

In the future with-project condition, oil and gas vessels will call at Nome during pre- and post-season mobilization and demobilization and supply vessels will call at Nome during in-season re-supply trips. There are some vessels – the oil and gas large research vessels and the drill ship – which will still be unable to call at a dock in the with project condition given the vessels' design drafts and underkeel clearance requirements. These vessels are assigned to the Lightering Location at Nome. All other oil and gas vessel types are assigned to call at docks at Nome. Most vessels will utilize the New Dock 1 based on their draft and underkeel clearance. The medium tug and barge and landing craft may be assigned to call at the City, West Gold, or Middle docks, based on availability.

5. Vessel Speeds

For vessel speeds at sea, there are no changes between the future without and future with-project conditions.

Vessel speeds in each applicable harbor reach must be considered in the future with-project condition. As with other input data in the future without-project condition in the high case, vessel speeds in reaches are set equal to the equivalent vessel types from the base case. For the case of drill ships and supply vessels (which are the two vessel types not based on an equivalent vessel class from the base case), vessel speeds in reach are equal to those for the large vessel classes in the base case: large tug & barge, large research vessel, large cruise ship, and tankers.

6. Route Groups

The future with project route groups for oil and gas vessels consider that the vessel fleet stops in Nome. There are still two types of route groups: 1) pre- and post-season and 2) in-season for re-supply trips.

The pre- and post-season trips are essentially the same as in the future without project condition with the addition of a stop in Nome. The vessel fleet will mobilize from the Pacific Northwest (Seattle), move to Dutch Harbor for preliminary staging activities, then move to Nome for final staging, and finally moves northward to the Chukchi Sea. For route group distances, the prior port is Dutch Harbor, the next port is the Chukchi, and there is no additional sea distance given that most vessels are expected to remain at the drilling grounds for the duration of the season. Most likely distances between ports were determined using Google Earth. Minimum and maximum distances are equal to 90 and 110 percent of the most likely value to address the uncertainty in this type of estimation.

The post-season route group for oil and gas vessels is the reverse of the pre-season route. The prior port to Nome is the Chukchi Sea drilling grounds, the next port is Dutch Harbor, and the additional sea distance includes the fleet’s return trip to Seattle.

The future with project in-season route group utilized by supply vessels is the distance between Nome and the Chukchi Sea drilling grounds. The prior port is the Chukchi Sea, the next port is the Chukchi Sea, and there is no additional sea distance.

In addition, the future with project condition high scenario considers the incremental barge trip to deliver supplies to Nome for pick-up by the supply vessels. HarborSym modeling of the future with project condition considers only the barge trip between Dutch Harbor and Nome. In terms of route group distances, the prior port before Nome is Dutch Harbor, the next port is Dutch Harbor and there is no additional sea distance. This method of quantifying the route group accurately represents the increment of barge traffic added in the future with project condition. Total origin to destination costs for these barges are not calculated in both the future without and with project conditions as these barges do not transit to Nome in the future without-project condition.

Table 44 presents the distances (in nautical miles) associated with each route group for oil and gas vessels.

Table 44. Future With Project Condition High Scenario Route Groups for Oil and Gas Vessels

Route Group Name	Distance from Prior Port		
	Minimum	Most Likely	Maximum
1) Pre-season FWP	593	659	725
1) Post-season FWP	417	463	509
2) In-season, whole trip FWP	417	463	509
Incremental barge route (FWP only)	593	659	725
Route Group Name	**Distance to Next Port**		
	Minimum	**Most Likely**	**Maximum**
1) Pre-season FWP	417	463	509
1) Post-season FWP	593	659	725
2) In-season, whole trip FWP	417	463	509
Incremental barge route (FWP only)	593	659	725
Route Group Name	**Additional Sea Distance**		
	Minimum	**Most Likely**	**Maximum**
1) Pre-season FWP	0	0	0
1) Post-season FWP	1,547	1,719	1,891
2) In-season, whole trip FWP	0	0	0
Incremental barge route (FWP only)	0	0	0

Note: All distances in nautical miles.

7. Cargo Transfers

In general, information published by Shell regarding the logistics of their 2012 drilling season and their proposed future drilling season forms the existing condition data for this analysis. That data, in conjunction with interviews with oil and gas companies, found that the companies plan to utilize periodic supply vessel trips to transport drilling supplies between a staging port and the Chukchi Sea drilling grounds. However, there is limited information available from Shell regarding the exact cargo movements and shipping operations conducted in 2012.

Shell reported that they transported 25,000 short tons (or approximately 22,700 metric tons) of cargo by sea in 2012. This analysis assumes that this represents the amount of cargo necessary to support a drilling season for each company. This mean the total cargo for transport in 2020 is equal to 68,038 metric tons (3 companies conducting exploration * 22,679 metric tons per company). This cargo is classified under the existing commodity category of “dry cargo”. This is appropriate given the wide array of goods already classified as “dry cargo” in the base case.

This cargo first needs to be shipped to Nome for staging and pick-up later by supply vessels. Looking to the fleet of large tugs and barges from the base case, there are essentially two vessel sizes in this class: those with a capacity of 13,426 metric tons and capacity of 10,597 metric tons. This analysis assumes that the 68,038 metric tons of cargo will be split evenly over 7 large tug and barge vessel calls, or 9,719 metric tons per call.

By 2030, a total of 136,078 metric tons of cargo is necessary to support exploration and production activities (68,039 metric tons each for exploration and production). Utilizing a similar method as 2020, this cargo will be shipped to Nome in 13 calls by large tugs and barges to Nome. These are 13 total calls, or 6 additional calls from the 2020 analysis year.

Similarly, in 2040, the total cargo amount associated with oil and gas activities is 204,117 metric tons (136,078 metric tons from 2030 plus 68,038 metric tons to support the new production activities). This requires 17 large tug and barge calls to Nome, assuming an even split among the two sizes of barge.

Once cargo has been delivered to Nome for staging, it will be picked up by supply vessels for transport to the drilling grounds. Lacking data on specific cargo movements, this analysis assumes that the amount of cargo will be evenly split among the supply vessel calls at Nome. This means that each supply vessel call at Nome results in an outbound transport of 756 metric tons of dry cargo (equal to 22,679 metric tons of cargo per company / 30 supply vessel trips per company). This amount of cargo transport per supply vessel call applies in all three of the "shock" years.

In terms of the vessel call dates associated with cargo transport, this analysis first examines the supply vessels. Supply vessel calls at Nome were spaced approximately evenly through the operating season considering the assumptions related to vessel speeds at sea and distances between the drilling grounds and Nome. Once the dates for supply vessels had been estimated, large tug and barge vessel call dates were set to ensure the appropriate amount of cargo had been delivered to Nome to facilitate the supply vessel movements.

There is limited information about the extent of the staging activities planned for the other vessel types. Given a lack of data about the exact cargo movements and staging activities for these other vessels, this analysis assumes that all other vessels which call at Nome will be at layberth. As with the future without project condition, these vessels will be assigned to 10 units of layberth – equal to 24 hours at a dock. This is consistent with estimates from industry representatives about the amount of time vessels are expected to spend at a dock.

8. Cargo Transfer Rates

Information gathered through interviews with oil companies as well as facility operators in Dutch Harbor revealed some information about cargo transfers for Shell's vessels in 2012. These parties indicated that an experienced labor crew could load a supply vessel in approximately 18 hours. Further consultation with Shell estimated that they planned for supply vessels to call at a dock for approximately 24 hours per vessel call. For the purposes of HarborSym modeling, this analysis assumes that 18 hours per call represents the most likely amount of time a vessel will spend at a dock, 24 hours of time is the maximum, and 12 hours is the minimum. Considering that each supply vessel call will transfer 756 metric tons of cargo, this equates to a commodity transfer rate distribution of 31.5, 42.0, and 63.0 metric tons per hour as the minimum, most likely, and maximum values, respectively.

For the new large tug and barge traffic to support oil and gas cargo, initial HarborSym model runs were conducted utilizing the commodity transfer rates assumptions from the base case. These commodity transfer rates were keeping vessels at the dock for too long – up to 90 days per vessel call. To address this issue, revised transfer rates were developed.

First, the amount of time spent at the dock by large tugs and barges in the base case was examined. Large tugs and barges spent anywhere between 0.08 and 10 days at the dock in the base case. This analysis assumes that large tugs and barge delivering oil and gas cargo will spend, on average, double the amount of time at the dock as their non-oil and gas counterparts. This assumption considers that the oil and gas barges will typically have significantly more cargo on board for offloading than a typical tug and barge, but also that this cargo will likely be unloaded efficiently by the crews of oil and gas workers. With these assumptions in mind, the equivalent cargo transfer rates for oil and gas tugs and barges are equal to 23.24, 184.89, and 454.42 metric tons per hour as the minimum, most likely, and maximum values.

All other vessel types in the oil and gas fleet will be at layberth in the future with project condition and will utilize the same layberth commodity transfer rate from the base case of 0.4167 units per hour (equivalent to 10 units in 24 hours).

9. Estimated Total Trip Cargo

As in the future without-project condition high scenario, the ETTC values for oil and gas vessels are set equal to the commodity units. The intent of this assumption is so all at-sea transit costs will be considered consistently at Nome in both the future without- and with-project conditions.

C. Graphite One Vessel Traffic

There is no difference expected in the Graphite One vessel traffic between the future without- and with-project conditions.

D. Additional Research, Cruise, and Government Vessel Traffic

The only difference between the without- and with-project conditions related to the additional research, cruise, and government vessel traffic is that some vessels can now call at a dock at Nome, as opposed to using the lightering area.

This corresponds to reduced lightering activities for these vessels. The benefits of reduced lightering will be quantified in a separate spreadsheet model for future phases of study. These benefits are not expected to have a significant impact on the justification of navigation improvements.

E. Model Outputs

HarborSym was run for the future with project condition high scenario for the analysis years 2020, 2030, and 2040. As with the future without project condition high case analysis, vessel types are interpolated in the interim years – except those related to oil and gas. As with the base case, all values are held constant beyond 2040. Models for the high scenario have been run for 10 iterations for this phase of analysis.

Overall, the 2020 model processed an average of 478 vessels with an average of 1 deleted vessel. Total overall transportation costs averaged $198,130,891 with $80,703,948 total costs allocated to the port. On average, a total of 334,562 metric tons of commodities were transferred. This increase from the base case is due to the addition of graphite and dry cargo for oil and gas vessels, and the layberth quantities for oil and gas, research, cruise, and government vessels. Total time in system averaged 14,671 hours. Total wait time in the system averaged 662 hours, including 78 hours waiting at the dock and 584 hours waiting at the channel entrance. Cargo transfer time amounted to 13,410 hours. Docking and undocking times were 266 hours and 186 hours respectively.

The 2030 model processed an average of 697 vessels with an average of 2.8 deleted vessels. Total overall transportation costs averaged $275,014,995 with $102,759,077 total costs allocated to the port. On average, a total of 505,529 metric tons of commodities were transferred. Total time in system averaged 20,859 hours. Total wait time in the system averaged 1,367 hours, including 111 hours waiting at the dock and 1,256 hours waiting at the channel entrance. Cargo transfer time amounted to 18,601 hours. Docking and undocking times were 397 hours and 275 hours respectively.

The 2040 model processed an average of 918 vessels with an average of 3 deleted vessels. Total overall transportation costs averaged $323,571,648 with $120,775,475 total costs allocated to the port. On average, a total of 676,711 metric tons of commodities were transferred. Total time in system averaged 27,631 hours. Total wait time in the system averaged 2,510 hours, including 73 hours waiting at the dock and 2,438 hours waiting at the channel entrance. Cargo transfer time amounted to 23,957 hours. Docking and undocking times were 517 hours and 359 hours respectively.

XIII. PROJECT BENEFITS – HIGH SCENARIO

Under the high scenario, commodity shipments through Nome are expected to increase from 341,743 metric tons in 2020 to 677,445 in 2040. This includes the commodity forecast developed in the base case and also considers oil and gas dry cargo in the future with project condition as both an inbound and outbound commodity. Vessel calls are expected to increase from 495 in 2020 to 930 in 2040 (including base case vessel calls). Figure 31 illustrates the expected growth in vessel calls in the High Scenario, and a comparison to the No Growth and Base Case scenarios.

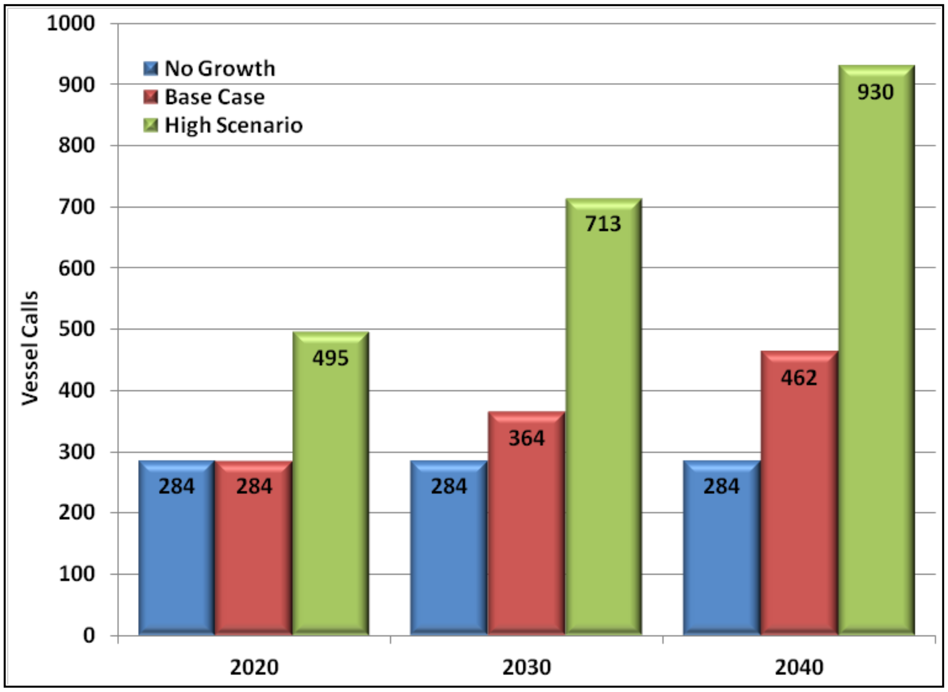

Figure 31. Vessel Call Comparison, by scenario

Table 45 summarizes the results of the HarborSym modeling for the high scenario.

Table 45. High Scenario Transportation Costs Allocated to the Port of Nome

Analysis Year	Total Allocated Cost To Port – High Scenario		
	Future Without Project	Future With Project	Difference
2020	$90,267,117	$80,703,948	$9,563,169
2030	$114,162,740	$102,759,077	$11,403,663
2040	$136,032,403	$120,775,475	$15,256,928

Note: This table includes all vessel activity for the high scenario.

As described in previous sections, the transportation costs associated with the oil and gas fleet are not appropriate for interpolation between analysis years. Table 46 summarizes the transportation costs for interpolation and those associated with oil and gas activities which will not be interpolated.

Table 46. High Scenario Transportation Costs – Values for Interpolation

Year	Future Without Project		
	Interpolated	Not Interpolated	Total
2020	$30,587,853	$59,679,264	$90,267,117
2030	$34,620,366	$79,542,373	$114,162,740
2040	$36,620,644	$99,411,759	$136,032,403
Year	Future With Project		
	Interpolated	Not Interpolated	Total
2020	$29,520,300	$51,183,648	$80,703,948
2030	$39,499,248	$63,259,829	$102,759,077
2040	$45,075,688	$75,699,787	$120,775,475

Note: Values noted as "Not Interpolated" are those associated with oil and gas vessels. This table includes all vessel activity for the high scenario.

Based on the results of the HarborSym modeling, the high scenario provides a total present value transportation cost savings of $276.95 million over the 50-year project period of analysis considering a Federal fiscal year 2015 discount rate of 3.375 percent. This equates to an average annual equivalent transportation cost savings of $11.54 million.

The transportation cost savings (i.e. NED benefits) in the High Scenario are equal to the benefits as claimed in the base case, plus those from the shift in staging location and transportation mode for oil and gas cargo transfers. The primary benefit is the reduced supply vessel travel between Dutch Harbor and Nome in the future with project condition, with consideration for the increased barge trips between Dutch Harbor and Nome for cargo transport.

Table 47 summarizes the benefits associated with oil and gas activities related to exploration and production. This table addresses the issue that there are different levels of risk associated with the assumptions of oil and gas companies moving to exploration and production. (See Attachment 3: Oil and Gas Assumptions document for more information.) Oil and gas activities in 2020 include only exploration activities. For 2030 and 2040, the benefits associated with production are equal to the total benefits minus the expected benefits for exploration vessels. This method provides an estimate of the breakdown of benefits in exploration and production. A more detailed analysis of transportation cost savings can be conducted during future phases of study.

Table 47. Benefits for Oil and Gas Vessels in Exploration and Production Comparison

Analysis Year	Benefits – Oil and Gas Vessels	
	Exploration	Production
2020	$8,495,616	$0
2030	$8,495,616	$7,786,929
2040	$8,495,616	$15,216,356

Note: This table includes only transportation costs associated with the fleet of oil and gas vessels.

Considering the benefits of an exploration-only scenario is similar to examining a no-growth scenario as was conducted in the base case. If the transportation cost savings for oil and gas vessels only are held constant after 2020, HarborSym modeling shows a total present value transportation cost savings of $210.72 million, or $8.78 million average annual value.

XIV. PROJECT COSTS

The alternative considered for this phase of study includes an extension of the existing causeway at Nome, the construction of a 450-foot dock along the extended causeway, and minimal dredging to accommodate a project depth of -28-feet.

Cost estimates for this plan are presented in 2014 price levels. Cost estimates include mob and demob, local service facilities, general navigation features, and navigation aids. Costs for Operations, Maintenance, Repair, Replacement, and Rehabilitation are included. Present value and average annual costs are based on the Federal Fiscal Year 2015 discount rate of 3.375 percent and a 50-year project period of analysis.

The estimated construction cost including interest during construction, preliminary engineering and design, real estate costs, construction supervision and administration, and contingency is $207.7 million. OMRR&R includes causeway armor rock replacement at 25 year intervals, channel dredging every 10 years, caisson repair every 20 years, and dolphin anode repair every 15 years. OMRR&R costs for this alternative are estimated at a present value of $5.852 million, or $244,000 annually. The average annual cost for this alternative is $9.195 million.

Table 48. Total Project Cost Summary, Evaluated Alternative

Alternative	First Cost	Interest During Construction	PV OMRR&R	Total PV Project Costs	Average Annual Costs
1	$207,714,000	$7,050,000	$5,853,000	$220,617,000	$9,195,000

Notes:

- Cost estimates as of October 30, 2014. Costs are in 2014 dollars.
- All costs are rounded to the nearest thousand.
- Project costs assume a 2-year (24-month) construction window with construction beginning in 2018 and completed in 2020.
- Present value and average annual costs are calculated using a 50-year project period of analysis and a Federal fiscal year 2015 discount rate of 3.375 percent.
- OMRR&R costs include causeway armor replacement every 25 years, channel dredging every 10 years, caisson repair every 20 years, and dolphin anode repair every 15 years.

XV. SUMMARY OF BENEFITS AND COSTS

Table 49 presents a summary of the total present value future without project costs, future with project costs, benefits, and average annual benefits.

Table 49. Summary Present Value Transportation Costs and Benefits, by Scenario

Scenario Name	Total Present Value Transportation Costs			Average Annual Benefits
	Future Without Project	Future With Project	Benefits	
Base Case	$667,694,000	$638,414,000	$29,280,000	$1,220,000
No Growth	$582,690,000	$565,839,000	$16,850,000	$702,000
High Scenario	$2,860,570,000	$2,583,621,000	$276,948,000	$11,542,000

Notes: All transportation costs presented are the total cost allocated to the subject port. Present values calculated using the Federal Fiscal Year 2015 discount rate of 3.375 percent and a 50-year project period of analysis. All values rounded to the nearest thousand.

Table 50 presents a summary of first costs, interest during construction, OMRR&R, along with the associated present value and average annual costs.

Table 50. Summary of Costs for the Evaluated Alternative

Alternative	First Cost	Interest During Construction	PV OMRR&R	Total PV Project Costs	Average Annual Costs
1	$207,714,000	$7,050,000	$5,853,000	$220,617,000	$9,195,000

The economic benefits for the evaluated alternative are the future without project transportation costs minus the future with project transportation costs. The benefit to cost ratio is the average annual benefits divided by the average annual construction costs. Table 51 summarizes the benefits and costs of the current evaluated alternative for each future scenario.

Table 51. Summary of Benefits and Costs, for the evaluated alternative, by future scenario

Scenario Name	Present Value Benefits	Average Annual Benefits	Present Value Costs	Average Annual Costs	Benefit to Cost Ratio	Net Annual NED Benefits
Base Case	$29,280,000	$1,220,000	$220,617,000	$9,195,000	0.13	-$7,975,000
No Growth	$16,850,000	$702,000	$220,617,000	$9,195,000	0.08	-$8,493,000
High Scenario	$276,948,000	$11,542,000	$220,617,000	$9,195,000	1.26	$2,347,000

The National Economic Development (NED) Plan is defined as the plan which maximizes the net annual NED benefits. At this phase of study, only one alternative has been evaluated. Future phases of study will include additional alternative plans and an identification of the optimal project depth.

Evaluation of the benefits and costs reveal that the “High” scenario has a benefit to cost ratio of 1.26 and net annual NED benefits of $2.35 million.

XVI. REGIONAL ECONOMIC DEVELOPMENT

Employment and income changes due to project construction in Nome are shown in Table 52. Regional output is estimated at $73.4 million; statewide output is $141.4 million, and national output is $276 million. Jobs created or retained on the regional level are estimated at 728, statewide is 1,347, and nationally is 2,314. Labor income impacts for the region are approximated at $33.5 million, statewide is $64.5 million, and nationally is $111.8 million. Impacts to gross regional product are $43.7 million, gross state product are $87.5 million, and gross national product are $162.5 million for the initial year of construction.

Table 52. Annual Impacts from Construction

Impact Areas	Regional	State	National
Output	$73,385,089	$141,386,316	$275,964,820
Job	727.9	1,346.9	2,313.9
Labor Income	$33,451,333	$64,455,283	$111,838,828
GRP/GSP/GNP	$43,669,667	$87,508,235	$162,522,629

Note: Impacts shown in this table are for one year of what is presumed to be a 2-year project construction season.

Repair and maintenance of the expanded marine infrastructure at Port of Nome will continue to provide employment and income to the region at various years during the project period of analysis.

See Attachment 4 for detailed discussion of the Regional Economic Development effects from the Tentatively Selected Plan.

XVII. OTHER SOCIAL EFFECTS

Of greatest concern for the Other Social Effects evaluation is the lack of infrastructure in the region which reveals itself in the Health and Safety factors with a project at Nome. Mental and physical health and physical safety are all seen as improved with the Tentatively Selected Plan. Many see this port development as the stepping stone to increased economic development in the region with the promise of additional work-for-wages employment. One potential negative social factor is the loss of cultural identity as the Alaska Native way of life and individuals may be faced with the difficult choice of balancing a subsistence way of life with wage employment or having to choose between the two.

Table 53 Nome Alone Social Factors Metrics Evaluation

Social Factors	Metrics	Without-Project	Nome Alone
Health and Safety	Mental Health	0	+
	Physical Health	0	++
	Physical Safety	0	++
	Special Issues - Arctic	0	+
Economic Vitality	Business Climate	0	+
	Employment Opportunities	0	++
	Financial Impacts	0	+
	Tax Revenues	0	+
	Special Issues - Subsistence	0	0
Social Connectedness	Community Cohesion	0	0
	Community Facilities	0	0
	Special Issues – Traditional Knowledge	0	0
Identity	Cultural Identity	0	-
	Community Identity	0	0
	Special Issues – Alaska Native Way of Life	0	0

Social Factors	Metrics	Without-Project	Nome Alone
Social Vulnerability and Resiliency	Residents of Study Area	0	+
	Socially Vulnerable Groups	0	+
	Special Issues	0	0
Participation	Public Participation	0	+
	Special Issues	0	0
Leisure and Recreation	Recreational Activities	0	+
	Special Issues	0	0

See Attachment 5 for detailed discussion of the Other Social Effects.

XVIII. SUMMARY

USACE planning guidance establishes four accounts to facilitate and display effects of alternative plans. Previous studies have relied primarily on the use of the National economic Development account showing the changes in economic value of the national output of goods and services. A benefit/cost ratio and an indication of the change in net benefits is the out of the NED evaluation and this study forms the basis for the selected plan.

Included as part of this study are also evaluations of the Environmental Quality (EQ), the Regional Economic Development (RED) effects, and the Other Social Effects (OSE). Environmental Quality displays the non-monetary effects of the alternatives and natural and cultural resources and is described more fully in the Environmental Assessment. The RED benefits result in increased employment and income for the region and the state, and the OSE are generally positive and beneficial.

The Tentatively Selected Plan for the Alaska Deep Draft Arctic Port System study is the Nome Alone alternative with a 2,150-foot causeway extension, a 450-foot long dock, and dredged channel and dock face to minus 28 feet. Table 54 shows the four accounts for this alternative under each of the scenarios used in this evaluation.

Table 54 Four Accounts Summary for the Tentatively Selected Plan

Scenario Name	NED Net Benefits (B/C Ratio)	EQ	RED	OSE
Base Case	-$7,975,000 (0.13)	Positive	Increased employment and income for the region and the state	Beneficial
No Growth	-$8,493,000 (0.08)	Positive	Increased employment and income for the region and the state	Beneficial
High Scenario	$2,347,000 (1.26)	Positive	Increased employment and income for the region and the state	Beneficial

ATTACHMENT 1 – DEEP DRAFT ARCTIC PORT PERSONAL INTERVIEW FORM

Deep-Draft Arctic Port Survey

(Personal Interview)

OMB 0710-0001

U.S. Army Corps of Engineers

Agency Disclosure Notice

The public report burden for this data collection effort is estimated to average 60 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this data collection, including suggestions for reducing this burden, to Department of Defense, Washington Headquarters Services, Executive Services Directorate, Information Management Division, 1155 Defense Pentagon, Washington DC, 20301-1155 and the Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, DC 20503, Attn: Desk Officer for US Army Corps of Engineers. Respondents should be aware that notwithstanding any other provision of law, an agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

PLEASE DO NOT RETURN YOUR RESPONSE TO THE ABOVE ADDRESS

Deep-Draft Arctic Port Survey

Name of Firm: ____

Name of Interviewee: ____

Job Title of Interviewee: ____

Mailing Address: ____

State and Zip: ____

Phone Number: (____)____

- -

The Corps of Engineers received Automated Identification System (AIS) data from the Marine Exchange of Alaska for the Nome/Port Clarence (Teller) area. It was found that your company operated vessels greater than 100 feet in length in this area in 2012. The Corps of Engineers, in partnership with the State of Alaska Department of Transportation and Public Facilities, is evaluating the need for enhanced marine infrastructure in this region to support commercial vessel operations. The following questions will assist in developing alternatives to meet the needs of larger commercial vessels, encourage economic development, and protect the environment and the Alaska communities that rely on subsistence in the region.

1. Type of service provided by your company. (Check all that apply.)

   _____Scheduled line   _____Charter

   _____Other (specify) ____

2. Type of vessels operated by your company that presently or may in the future operate in northern Alaska waters: (Check all that apply.)

   _____Container   _____Tanker

   _____General Cargo   _____Research

   _____Breakbulk   _____ Dry bulk

   _____Government   _____Towing

   _____Ice Breaker   _____Passenger

   _____Tug   _____Drill Ship

   _____Charter   _____ NEO bulk

_____ Oil barges _____ Fish Processing

_____Offshore Supply Vessels _____Seismic Vessels

Other (specify) ____

3. Please list the vessels, ship sizes, and types operated by your firm or that could operate in northern Alaska waters:

Vessel Name (Existing and New Q 6)	Type of Vessel	Length (feet)	Beam (feet)	Maximum Draft (feet)	# of sailings now (Q 4)	# of sailings in 2020 (Q 5 and Q 6)

4. How often do these vessels sail in the Port Clarence/Nome region now? _______________ (indicate numbers in previous table for each vessel)

5. NOAA predicts that the Arctic will be ice-free by 2020, would the number of sailings increase/decrease for your company by that time?
(indicate numbers in previous table for each vessel)
    a. _____ number of additional sailings
    b. _____ number of decrease in sailings

6. Given NOAA's ice-free prediction by 2020, would your company bring on new or different vessels? (yes/no) What type of vessel and size would you think you would use and how many sailings would these ships make? (indicate numbers in previous table for each vessel)

____

7. The current plan is to examine potential for enhanced marine infrastructure at three specific sites: 1. Nome, 2. Point Spencer (end of spit by retired USCG LORAN Station), and 3. Cape Riley

(eastern side of Port Clarence just south of Teller). Please indicate marine infrastructure that you would like to see in the Port Clarence/Nome area (please check all that apply):

_____fuel for purchase _____ fuel storage

_____ crew change _____ housing

_____ fresh water _____ sewage dump station

_____ moorage buoys _____ groceries

_____ breakwater _____ laydown area

_____ cranes _____ access to medical services

_____ dock/piers _____ port operator (harbormaster)

_____ airport access _____ dockside power

_____ dredged channel to _______ feet

_____ tugs _____ customs and immigration

_____ heated storage _____ vessel repair services

_____ navigation aids _____ search and rescue

_____ emergency response _____ oil spill response

_____other: (please specify)____

8. If enhanced marine infrastructure were in place, would the change in the number of sailings you indicated for 2020 be more or less? _____ # more ______ # less

9. What problems do you currently experience when operating in the Port Clarence/Nome area?

Problem	How often does this occur?	Duration of problem?
Delays delivering cargo		
Delays at fuel dock		
Inability to enter harbor		
Need for safe harbor		
Other:		
Other:		

Following are some hypothetical situations which you may or may not have encountered. Please think about the situation and how you would respond if this were to happen to you.

10. a. Your vessel is sailing in the Nome/Port Clarence area and you need to get north of the Bering Strait. The ice cover in the Bering Strait is thick and you are concerned about operating in this area. What do you do to ensure the safety of your vessel and crew and how would this change with enhanced marine infrastructure? ____

____

____

b. Has this happened before? Yes/No How many times during a typical year? ____________

11. a. Your crew has been on the vessel for an extended voyage and the vessel experienced heavy seas. The vessel is sailing in the Nome/Port Clarence area. You would like to reprovision the ship, take on fuel, and/or conduct crew changes. What do you do now and how would that change if you could conduct these activities in the Nome/Port Clarence area?

____

____

____

b. Has this happened before? Yes/No How many times during a typical year? ____________

12. a. Please describe a situation where you would choose to stay in the Nome/Port Clarence area if enhanced marine infrastructure were available. Please tell us your current operations and how that would change. ____

____

____

b. Has this happened before? Yes/No How many times during a typical year? ___

13. Have you experienced any other problems while operating in the Nome/Port Clarence area? (yes/no) (please explain) ____

____

____

14. How would correcting the problems affect your operations? ____________________________

____

____

15. Please provide recommendations you may have for improvements to the Nome/Port Clarence regional waterways.____

____

____

16. Do you have any additional comments you would like to share with the project study team?

____

____

____

Thank you for your participation.

ATTACHMENT 2 – INVESTIGATION OF APPLICABILITY OF PL 09-13 SECTION 6009 BENEFITS FOR THE DEEP DRAFT ARCTIC PORT STUDY

Investigation of Applicability of PL 09-13 Section 6009 Benefits

Deep-Draft Arctic Port Study

October 2013

U.S. Army Corps of Engineers
Alaska District

Tetra Tech, Inc.
1420 5th Avenue, Suite 550
Seattle WA 98101

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APPENDICES

1. Information Packet
2. List of Contacts

A. Overview

The scope of this study was to assess whether the establishment of a deep draft Arctic port in the Nome/Port Clarence region of northwest Alaska would result in "potential future offshore oil and gas exploration and production benefits" as defined by Section 6009 of the *Emergency Supplemental Appropriations Act for Defense, the Global War on Terror, and Tsunami Relief, 2005 (PL 109-13) – Offshore Oil and Gas Fabrication Ports* (referred to hereafter as Section 6009). This Section 6009 analysis, conducted as part of the ongoing *Deep Draft Arctic Port System Feasibility Study*, investigated the potential for new offshore oil and gas (OO&G) exploration contracts as a result of the proposed port project.

To obtain information, the study team engaged the major oil companies holding leases in the Chukchi Sea (Shell, Conoco-Phillips, and StatOil). Repeated conversations with contacts at these companies, allowed the team to draw a number of conclusions about existing and future OO&G operations in the region. *These key findings include*:

- Following Shell's 2012 Chukchi Sea campaign and subsequent regulatory uncertainty, leaseholder contacts have stated that their current OO&G exploration and production plans are suspended until at least 2015. The companies have not yet finalized their Arctic operations plans for future exploration.
- At the time of this study, all three companies indicated that they had no timeline for resuming operations in the Chukchi (consistent with the news reports that 2013 and 2014 operations have been suspended). All three companies were in the stage of operational planning – the high cost of Arctic operations commanding a cautious approach. News reports placed Shell's cost of exploration leading up to and including the 2012 season at $4.5 billion or more[1].
- The economic incentive for OO&G exploration in the Chukchi Sea is a function of market prices and potential profitability. As exhibited by past exploration, the incentive of profitability has led to the ongoing planning of OO&G exploration campaigns in the area by all leaseholders; and in 2012, execution of an OO&G exploration campaign by Shell. This occurred without a deep draft Arctic port.
- Identified challenges for resumed exploration include uncertainty in regulatory requirements, variability in environmental/climatic conditions, and complicated logistics and operational cost in the Arctic.
- Discussion with and data from contacts with OO&G companies did not result in any identified additional fabrication contracts related to Arctic operations that would result from development of the deep draft port. Uncertainty in timing and extent of future operations is too high at this point in time for OO&G companies to be able to provide certified estimates of future OO&G exploration and production contracts in the region as required by USACE policy for a Section 6009 analysis.
- A functional deep draft port in the region could result in reduced support contracts from the level required during the most recent 2012 Chukchi Sea exploration campaign.
- An Arctic deep draft port could provide significant opportunities to modify and simplify the logistics of Arctic operations for the OO&G industry. While these potential benefits do not conform to Section 6009, they likely would result in policy compliant transportation efficiency benefits if defensible assumptions were possible for timing and extent of exploration activity.

[1] http://www.theguardian.com/business/2013/mar/15/shell-barred-drill-oil-Arctic

Subsequent sections of this memorandum summarize, in aggregate, the discussions held with the contacts, key data points they provided, and other considerations that may be useful for the feasibility study's traditional navigation benefits analysis.

B. Background & Methodology

B.1. Section 6009 of PL 109-13

In 2005, Congress passed Public Law 109-13, Emergency Supplemental Appropriations Act for Defense, the Global War on Terror, and Tsunami Relief, 2005. Section 6009 of PL 109-13 addresses economic justification of navigation projects involving Offshore Oil and Gas Fabrication Ports. In September 2012, the Corps published Implementation Guidance for Section 6009. The guidance defined offshore oil and gas fabrication ports as "those ports with facilities that fabricate, build, refurbish, provide upgrades to, or inspect either entire oil and gas rigs or partial components of oil and gas rigs."

Section 6009 expands the typical USACE navigation benefits analysis to include the incremental value of future energy exploration and production fabrication contracts that would result from a proposed navigation improvement project. The incremental increase in value of these types of contracts may be counted toward justification of the project. The USACE implementation guidance requires that estimation of this incremental benefit must be based on actual contract data at current price levels, sourced from oil and gas companies.

B.2. Applicability to the Evaluation of a Proposed Arctic Deep Draft Port

To apply Section 6009 analysis of proposed improvements at an existing port, the incremental value of future OO&G fabrication contracts would be calculated for the port. For example, if channel deepening at a Gulf port were being evaluated, the without project and with project value of OO&G exploration and production contracts would be estimated, and only the net increase in value would be a benefit.

In the case of Nome/Port Clarence, where no deep draft port currently exists, all expected future OO&G exploration/production contracts would need to be assessed to determine if the contract was attributable to the port, or if it would have occurred in the future without project condition. For USACE projects, a 50-year planning horizon is typically considered. Thus, the goal would be to estimate the future value of contracts which would have occurred between 2017 and 2067 only because of the existence of the Arctic deep draft port. It would be further assumed that the fabrication contracts[2] can occur at *any* fabrication port facility, not just Nome/Port Clarence, if and only if it is located in the U.S.

B.3. OO&G Industry Coordination

The study team developed an information packet to guide discussion with oil industry contacts. The packet contained a cover letter, study background information, informed consent form, and excerpts

[2] Defined by implementation guidance as those ports with facilities that fabricate, build, refurbish, provide upgrades to, or inspect either entire oil and gas rigs or partial components of oil and gas rigs.

from related public law and USACE guidance. **Appendix 1** to this memorandum provides a copy of the information packet.

Contact was made with appropriate representatives of major oil companies holding leases in the Chukchi Sea who are known to be planning exploration of those leases, which included Shell, Conoco-Phillips, and StatOil. Crowley Maritime Corporation, a marine services contractor to Shell during their 2012 exploration campaign, was also contacted. A short summary of the primary contacts for each company listed above follows. Contact information for each is provided in **Appendix 2** of this memorandum.

i) Shell

Curtis Smith (Shell Alaska Spokesperson) and Cam Toohey (Government Affairs Manager) provided information for this study. Multiple discussions with Cam and Curtis provided insight into the Shell 2012 campaign, the risks and uncertainties of OO&G operation in the Arctic, and the ways in which an Arctic port could offer logistics efficiencies and reduced costs.[3]

ii) Conoco-Phillips

The study team contacted Kurt Hallier at Conoco-Phillips (Marine Specialist, Anchorage). Kurt coordinated with his operations team and determined that the best information they could provide was in the form of narrative about the potential benefits of an Arctic deep draft port. Kurt provided good information on potential uses of the deep draft port by OO&G companies.

iii) StatOil

Jocelyn Fenton (Regulatory and Compliance Coordinator) and Elle Ede (Stakeholder Engagement Manager) in the Anchorage StatOil office provided information for this study. Elle indicated that she had coordinated with the StatOil logistics team in Norway and provided limited but useful information regarding StatOil's operational plans in the Arctic. StatOil indicated that they were in the preliminary stages of Arctic OO&G exploration and production planning, and provided as much information as they were comfortable providing at this time. StatOil indicated that their internal operational feasibility studies were still ongoing.

iv) Crowley

Geoff Baker of Crowley Marine (Business Development Manager, Anchorage) provided information on maritime service provider operations in general, on Crowley operations in general, and on Crowley's role in Shell's 2012 campaign.

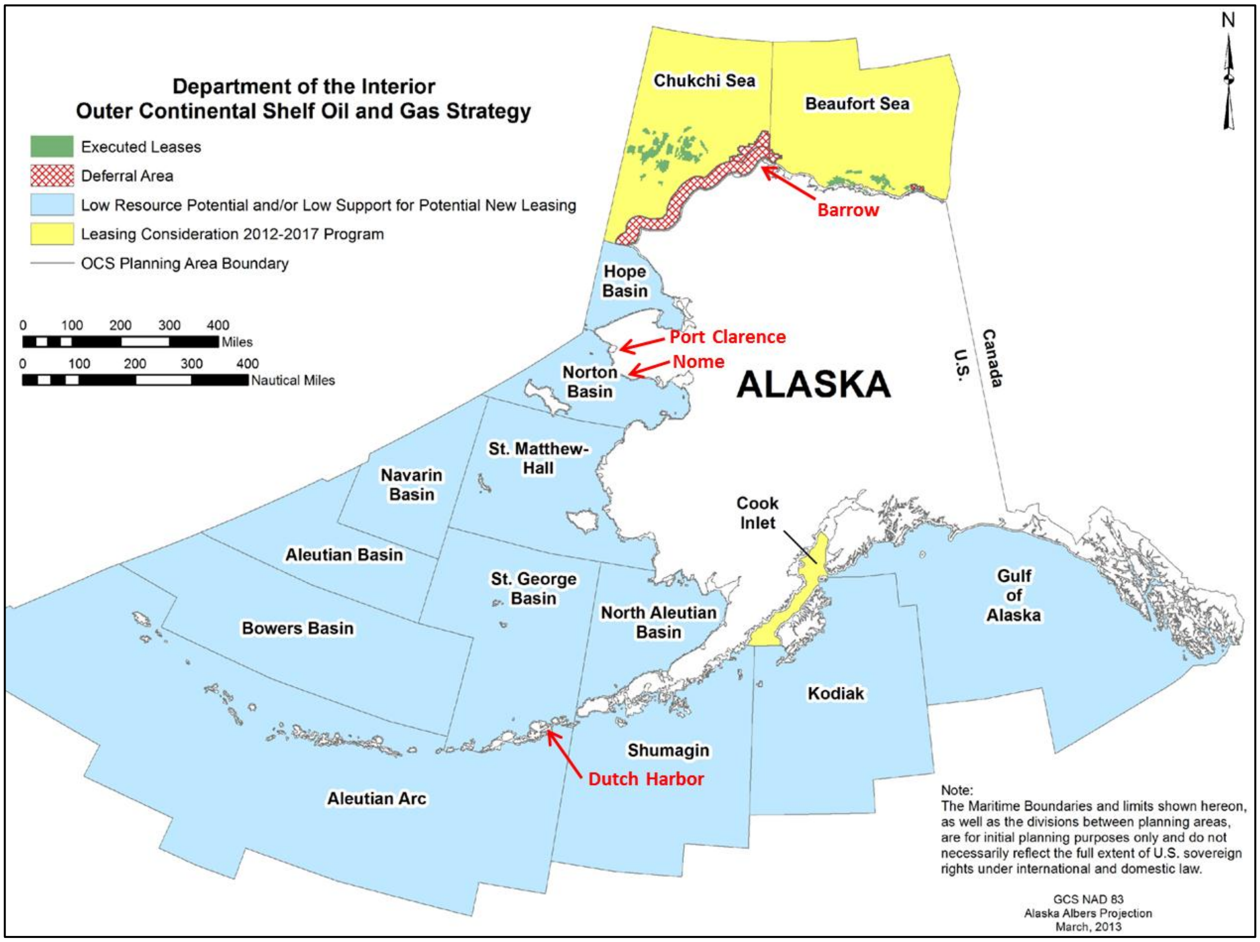
---

[3] Cam Toohey indicated he would provide the information packet to two members of the operations planning team in Houston for their input as well (Mark Newell and Elio Gonzales). However, at his time, no further information has been provided by Shell.

C. Arctic Geography and Drilling Leases

The Department of the Interior manages the Outer Continental Shelf Region drilling lease areas. In the Arctic, oil companies hold offshore leases in both the Chukchi and the Beaufort seas. The BOEM estimates that the Chukchi Sea Planning Area may hold more than 15 billion barrels of technically recoverable oil and nearly 78 trillion cubic feet of technically recoverable natural gas, which is second only to the Central Gulf of Mexico in terms of resource potential offshore of the United States. The Beaufort Sea also has significant resource potential – an estimated 8 billion barrels of oil and nearly 28 trillion cubic feet of natural gas[4].

The figure below shows the Outer Continental Shelf planning area, including the executed leases in the Chukchi and Beaufort seas. Callouts have been added for Nome, Port Clarence, Dutch Harbor, and Barrow.



Source: Bureau of Ocean Energy Management, 2013.

The second figure, below, provides a better overview of the Bering Strait, and the role it plays in vessel movement to the Chukchi and Beaufort. The Bering Strait provides access to the leases for the vessel

[4] BOEM Assessment of Undiscovered Technically Recoverable Oil and Gas Resources of the Nation's Outer Continental Shelf, 2011.

fleets each summer. By early summer the Bering Sea is essentially free of ice. Bering Strait generally clears by late June. Ice concentration north of Bering Strait decreases as summer progresses and the ice edge retreats further into the northern Chukchi Sea, eventually merging into one continuous edge that reaches a maximum northward position during the latter half of September[5].

Source: Wikimedia Commons / CC-BY-SA-3.0

While vessel fleets heading for both the Chukchi and the Beaufort are likely to pass through the Bering Strait at the beginning and end of each drilling season, it is also expected that drill sites in the Chukchi may frequent Port Clarence during the drilling season for personnel changes, refueling, resupply, or other services/facilities, whereas drill sites in the Beaufort are more likely to rely on Prudhoe Bay for these tasks. As such, further discussion of offshore oil and gas production as related to the Nome/Port Clarence area Arctic deep draft port focuses on the Chukchi Sea.

C.1. Overview of Arctic OO&G Exploration History

Many Arctic countries are moving forward with offshore oil and gas exploration in the Arctic Ocean, including Russia, Norway, Canada, Denmark, and Iceland. Chevron operates two exploration licenses in the Canadian Beaufort Sea, and in 2012 Chevron undertook an exploratory seismic program there. The Norwegian Arctic is seen as a future potential source. In 2010, Greenland began awarding exploration licenses in its Baffin Bay[6].

[5] Alaskook, University of Alaska Anchorage. 2004. Alaska Regional Profiles – Northwest Region: Sea Ice. Retrieved from http://www.alaskool.org/resources/regional/nw_reg_pro/seaice.html.
[6] U.S. Department of the Interior. 2013. Report to the Secretary of the Interior, Review of Shell's 2012 Alaska Offshore Oil and Gas Exploration Program.

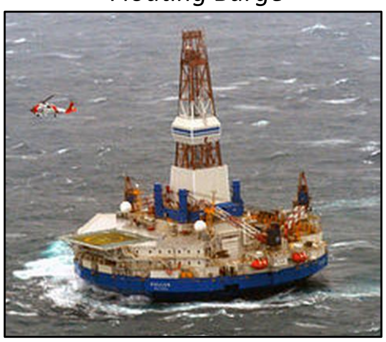
On the U.S. Arctic Outer Continental Shelf, exploration activities have taken place in the Chukchi and Beaufort Seas in the past. Most of the exploration wells in Federal waters in the Beaufort and Chukchi Seas were drilled over twenty years ago. Previous activity in the Chukchi includes four exploration wells drilled by Shell in the late 1980's to early 1990's, and one exploration well drilled by Chevron. None of these wells were put into production, as the market at the time did not render them commercially viable. Prior to Shell's 2012 campaign, only three exploratory wells had been drilled in Alaska's Outer Continental Shelf in the last 18 years, with the most recent activity being in the Beaufort Sea.

C.2. Overview of Offshore Exploration and Production Vessel Fleets

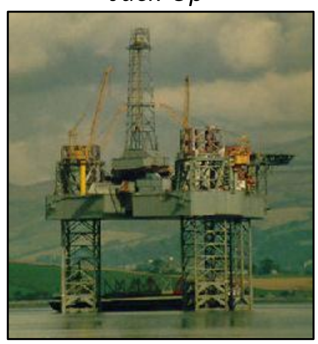
i) Drilling Vessels

In discussion with contacts, the two types of rigs being considered are floating barge rigs (used by Shell in 2012) and jack-up rigs. There are advantages and disadvantages of each, and contacts did not indicate that one method was definitely preferred over the other. The figure below provides an example of each type of rig. The pictured floating barge is the Shell Kulluk, used in their 2012 Chukchi campaign, with a diameter of 266 feet.

Floating Barge



Jack-Up



Source: Wikimedia Commons / CC-BY-SA-3.0

ii) Support Vessels

In addition to the drilling rigs, many support vessels are required, serving functions such as oil spill response, anchor handling, ice management, offshore supply, scientific data gathering, crew quarters, shallow water landing craft, icebreaking, tanker functions, tugs, barges, etc. Most vessels can serve multiple functions. Below are some examples of vessels used in Shells 2012 campaign[7]. Following the campaign, the U.S. Department of the Interior completed an after action report, *Review of Shell's 2012 Alaska Offshore Oil and Gas Exploration Program*, which provides some additional details on the characteristics and utilization of the fleet.[8]

[7] Shell Gulf of Mexico Inc. May 2011. Revised Outer Continental Shelf Lease Exploration Plan, Chukchi Sea, Alaska.
[8] U.S. Department of the Interior. 2013. Report to the Secretary of the Interior, Review of Shell's 2012 Alaska Offshore Oil and Gas Exploration Program.

Ice Management Vessel (380 feet)

Anchor Handler (275 feet)

Offshore Supply Vessel (280 feet)

Shallow-Water Landing Craft (134 feet)

Oil Spill Response (300 feet)

Oil Spill Response Barge (350 feet)

Oil Storage Tanker (853 feet)

Ocean Going Tug (130 feet)

D. Summary of Arctic OO&G Operations

D.1. Overview of Recent Arctic OO&G Leaseholder Actions

At the time of this study, Shell is the only company to have conducted offshore exploration in the Chukchi in recent years. Conoco-Phillips had intended to do so in 2013, but suspended plans following Shell's drillship grounding at the end of the 2012 season and subsequent regulatory uncertainty. StatOil had originally planned to be ready for initial exploration in 2014, but similarly suspended their timeline following Shell's 2012 season. None of the companies have released new timelines.

In discussions with Shell, they appear to be working through new regulatory requirements and beginning evaluation of production pipeline options for their Chukchi wells. However, these efforts remain preliminary.

Discussion with StatOil gave the impression that they are least far along in terms of operational planning. Contacts indicated that their internal operational feasibility plans were still in a draft phase, and not yet finalized even internally (studies to determine everything from what types of rigs to use to how to navigate the permitting requirements).

Based on discussions with Conoco-Phillips, they appeared to be in a similar position to Shell, further along in operational planning, but now having to react to new scrutiny and regulatory requirements since the 2012 season.

Because these companies are not currently in full exploration or production mode, they were reluctant to speculate in quantitative terms about how their own operational plan might differ from what Shell used in 2012. As such, Shell's 2012 campaign was often referenced in discussion of a "typical" vessel fleet and operation plan under existing conditions.

D.2. Shell's 2012 Chukchi OO&G Campaign

The 2012 campaign is the only example of this scale of operation in the Chukchi and illustrates many challenges with Arctic exploration. It was indicated by the contacts that Shell's 2012 campaign is not the only way to execute OO&G exploration in the Arctic, though many aspects of the campaign are typical and dictated by Arctic conditions and the remote nature of the drill sites.

As such, details about the 2012 Shell campaign provide insight into the characteristics of a typical exploration campaign. All contacts also provided some preliminary thoughts on where their approach might differ from Shell's 2012 approach, and these instances are noted in the text below. All contacts (Shell included) identified potential cost savings that would result from a deep draft port in the area associated with not having to mobilize from Dutch Harbor or make any supply runs to it due to the time and distance required.

Shell's 2012 campaign, which was for two exploration wells, included approximately 20 vessels, split into two teams, one for the Chuckchi Sea, and one for the Beaufort Sea. Vessel types included tugs, barges, drilling rigs, drill ships, ice management vessels, response equipment, lightering/landing craft, wear barges, etc. Ships required for offshore oil and gas exploration can be up to 500 feet long. Shell chartered the vessels from marine services companies such as Crowley Maritime Corporation, Foss Maritime Company, and Edison Chouest Offshore. These companies provided vessels and other services to Shell's specifications for the duration of the season.

Shell's 2012 campaign utilized the drillship Kulluk, a floating barge design. StatOil noted that in their preliminary planning, jack-up drill rigs were being considered instead.

Due to available capacity at Alaskan ports, Shell was unable to use port facilities in Alaska to prepare their vessels and other equipment for the Arctic. The volume of laborers, crew, and ships that needed to be serviced required that Shell use multiple ports along the northwest, including Portland, Tacoma, Seattle, Everett, and Bellingham. Shell indicated that they exhausted the local supply of steel workers and others skilled laborers and had to bring in others from around the country – noting that this spoke to the scale of effort required to prepare an OO&G campaign in the Arctic.

Following preparation of the fleet and some training exercises in Washington, the fleet mobilized to Valdez (about 1,400 miles) for another month of final preparations and training drills (spill response, ice management, etc.). From Valdez, the fleet mobilized to Dutch Harbor (about 900 miles), which is currently the closest deep draft port to the drill sites. The oil companies did note that Dutch Harbor was a long distance from the Bering Strait (about 830 miles) and that it is too small and doesn't have the necessary facilities/services to support an OO&G exploration or production campaign, especially if there were multiple companies working simultaneously. For example, Shell noted that they had to have special plans in place to prevent their crews and personnel from exhausting the resources of Dutch Harbor, disallowing resupply from grocery stores in Dutch Harbor, and making an effort not to overwhelm local restaurants, both so that Shell's operations didn't jeopardize the existing economy of the community, and that Shell wasn't responsible for depleting their food and equipment stores. This was a prevalent concern for all the oil companies, noting that their relationship with local communities was important and that they worked to ensure their operations were not to the detriment of the existing economies of the community.

Conoco-Phillips noted that they had been investigating a way in which the extra mob/demob mileage associated with going through Dutch Harbor might be avoided all together, and concluded that one option would be to use large wear barges (large supply and drill-waste barges) to carry additional supplies to avoid stopping in Dutch Harbor.

From Dutch Harbor, the fleet moved to the Nome/Port Clarence area, where some minimal resupply or crew changes may have taken place at Nome. The natural harbor at Port Clarence was used as a final regroup/staging location before moving through the Strait to the drill sites in the Beaufort and Chuckchi as the ice cleared. Most of the fleet would remain at the drill sites for the duration of the season, with only a few vessels making supply runs as far as Dutch Harbor if needed. Transportation logistics for the Chuckchi included flights from Anchorage to Barrow, Barrow to Wainwright, and then helicopter from Wainwright to the drill site. In the Beaufort, landing craft vessels used Prudhoe Bay.

The scale of operations for Arctic exploration in the Chukchi is illustrated by these data points from the Department of the Interior's *Review of Shell's 2012 Alaska Offshore Oil and Gas Exploration Program*.

- Shell conducted 23 ice reconnaissance missions

- Participated in 500 vessel-to-vessel personnel movements
- Transferred 3.25 million gallons of fuel in 23 operations
- Coordinated 12,000 passenger trips on flights to/from the North Slope
- Had approximately 650 personnel stationed offshore at any given time
- A total of 562 helicopter and 535 fixed wing flights during the 2012 operation

At the end of the season, the fleet moved to Dutch Harbor, performed some demobilization activities, and then moved nearly all assets south to Washington.

D.3. Role of Maritime Services Companies

Crowley provided details on how the maritime services sector is involved in OO&G exploration in the Arctic. For Shell's 2012 campaign, Shell chartered two tug/barge sets from Crowley for the entire season. This system of using contractors was used for nearly all of the support vessels. Shell contracted to maritime services companies to outfit the vessels to their specifications and then chartered those vessels for the season, with the vessels remaining in the contractor's ownership. Shell noted that some of the largest maritime services contractors in the Arctic are Crowley Maritime, Edison Chouest, and Foss Maritime.

Crowley further noted that the maritime services sector would make use of a deep draft port as well, even outside the OO&G industry. The port would likely be used as a logistics hub, possibly altering the scope and scale of supply chain and logistics services that Crowley could provide to clients. Crowley further noted that much of their operations, and where they have assets at a given time, is driven by their clients. If a port existed at Port Clarence, Crowley might be contracted to provide fueling services or spill response staged out of Port Clarence, rather than being contracted to provide those services by making runs to Dutch Harbor, which might involve different types or quantity of equipment.

Crowley further noted that the port would be a hub of activity for OO&G companies, with a combination of mooring for response vessels (such as the large oil tanker, which can be some distance from the drill site until needed), use of laydown areas, refueling and resupply point, and use for personnel movement (depending on the extent of development of airport facilities).

Crowley indicated some potential for overwinter moorage at Port Clarence, especially if the road from Nome were maintained, making it possible to fly into Nome and drive to Port Clarence for maintenance of assets during the winter. The OO&G contacts did not indicate that they expected to overwinter vessels in the Arctic, though they did indicate the potential for storing "kits" in laydown areas over the winter, reducing the amount of equipment/supplies that need to be brought up at the beginning of the next season.

D.4. Existing Condition Uses of Nome/Port Clarence

Shell used Nome/Port Clarence during mobilization to the drilling sites in 2012, with Port Clarence providing natural safe harbor for the fleet. The contacts concurred that Port Clarence provides natural safe harbor and would likely be used to shelter a fleet as the ice receded in the Strait. However, because no companies currently have a timeline for drilling in the Arctic, they were unable to estimate quantitatively when and how much they would be using Port Clarence during the period of analysis. The contacts at the oil companies suggested that Foss Maritime and Edison Chouest Offshore be contacted for information they have regarding private commercial plans or public-private partnerships for port facilities in the Arctic. Because these plans did not appear to be related to OO&G, our study team did not contact these companies. However, they may provide useful information for the overall navigation benefits analysis.

Without an Arctic deep draft port and related facilities, Shell's 2012 strategy was to make resupply runs to Dutch Harbor during the drilling season. Another strategy preliminarily considered by the logistics teams is to float all supplies and materials necessary for the season up the drill site at the beginning of the season, requiring more barges upfront, but removing the need for long supply runs that might delay operations if the supply runs are late returning to the drill site due to inclement weather or vessel breakdown. It is likely that Nome and Port Clarence would be used as a final regroup/staging area in this scenario as well, with the fleet pausing in Port Clarence as needed to wait for the ice to recede.

D.5. Nome/Port Clarence as the Selected Location for Proposed Deep Draft Port

Due to relationships with other local communities in the Arctic, there was some hesitation to fully endorse Nome/Port Clarence, and instead responses focused on general benefits of a deep draft port in the Arctic, though no preference for a different site surfaced during conversation. Contacts indicated that while Nome/Port Clarence made sense, they would also find value in a deep draft port at other locations as well. The contacts noted that multiple ports would be most preferable, but understood that such a scenario was likely very long term. Still, there was concurrence that Nome/Port Clarence offered substantial opportunities for a deep draft port due to its location and natural geography, especially for serving operations in the Chukchi.

StatOil provided some additional information on the benefits of a port at Nome/Port Clarence based on their preliminary internal operational planning. StatOil determined that the most cost efficient solution to resupply logistics would be at this location, based on a deepening of Nome harbor. The StatOil logistics report assumed that with a vessel fleet based around a jack-up drilling rig, a deepwater port at Nome (or Port Clarence) could:

- Cut down the required number of offshore supply vessels
  - Assuming that the fleet relied on wear barges for the majority of supplies during the season, the port would allow cutting the fleet by between 0.5 and 1 vessels
  - Assuming the fleet relied on supply vessels running to/from Dutch Harbor during the season, the fleet could be cut by 4 vessels with the port in place
- Improve availability of rental facilities for storage/staging
- Result in cost savings in facility rental fees compared to the crowded and limited Dutch Harbor
- Provide a closer area for crew changes and vessel refueling, limiting need for these once in the lease area
- Provide potential for rig staging and limit towing distance to drill location

D.6. Potential With Project Uses of Nome/Port Clarence by the OO&G Industry

i) Refueling and Resupply

Currently, refueling or resupply requires long trips back and forth from the drilling site (for example, resupply runs from the Chuckchi to Dutch Harbor can take 10+ days). One or more deepwater ports with facilities to support refueling more near the drill sites would be expected to result in time savings, cost savings, require fewer supply vessels, and allow operations to proceed with reduced schedule uncertainty (lower risk of delays in resupply based on weather, ice, accidents, etc.). Additional facilities at ports for personnel would also lessen the impact on existing communities, where hotels, airports, and restaurants can be overwhelmed not just by the OO&G company personnel, but others such as members of the regulatory agencies or the media.

ii) Laydown Areas

A deep draft port designed with laydown areas would reduce the need for/size of wear barges used at drilling sites. In the existing condition, the wear barges are used to store all necessary mud, cuttings, pipe, and other material and equipment, as well as overflow storage for extra supplies. Laydown area near the drill sites could help streamline logistics and offer cost and time savings.

Another potential use for laydown areas is for OO&G companies to store complete supply kits over the winter in preparation for the following season's drilling. For example, at the end of the current season, the OO&G company might store a kit of all supplies necessary to head to the drill site the following season at Port Clarence, and would then only need to bring up vessels and personnel to Port Clarence the following year. The kit could be lightered to the vessels before heading to the drill site. Having this option would allow time and cost savings from improved supply chain logistics.

iii) Personnel Support and Services

In the existing condition, personnel logistics are limited by the number of locations which crews can be changed. In the Beaufort, Prudhoe Bay provides for personnel change by boat. In the Chuckchi, helicopters fly to and from the drill site by way of Wainwright. In both cases, personnel then go through Barrow's airport to get to Anchorage. With an Arctic port near the Bering Strait, personnel logistics may not be substantially affected at the drill site. However, the port would provide flexibility during mobilization and demobilization for the season, and provide better access to medical care during these phases as well. If the port included shoreside facilities designed to accommodate large numbers of personnel, the fleets could more easily serve their crews shoreside without overwhelming local communities at smaller existing ports, potentially harming existing industries counting on the availability of services and supplies.

iv) Overwintering Vessels and Other Assets

Discussion of overwintering vessels at an Arctic port produced differing opinions among the OO&G contacts. It was noted that the marine services providers or the Coast Guard might choose to permanently moor or overwinter a vessel at the Arctic port, but that in general, the OO&G companies were unlikely to keep a vessel in the port for long. It was noted that the OO&G vessels and onboard infrastructure require constant upgrade, service, and maintenance that couldn't be provided in the Arctic (even with the deep draft port in place) and that the vessels would be brought up each season for the foreseeable future. It was also noted that these maintenance/upgrade services weren't likely to be altered in the with project versus the without project, as they are driven more by the life of the equipment when operating in demanding Arctic conditions, as well as by upgrades to keep up with the state of the art drilling equipment.

As a result, the OO&G companies related that temporary moorage or tie-up for ships to allow refueling/resupply/lightering would be extremely beneficial, but that it was unlikely that ships would receive significant maintenance or be docked for long periods in the port. However, Crowley did note that a Canadian company did anchor a large steel structure in Port Clarence for a few years, and that inclusion of some creative mooring/anchoring infrastructure in the port would likely receive use from third parties.

v) Safe Harbor and Staging Location

The OO&G companies concurred that Port Clarence provides optimal safe harbor during inclement weather or while staging and waiting for the ice to recede at the beginning of the season. The OO&G companies related that this would be a common use of the port, regardless of whether some other services were provided elsewhere; Port Clarence would still provide the final regroup/staging area before heading through the Strait.

vi) Potential Pipeline and Other Production Support

The OO&G companies noted that while they are in the preliminary stages of exploration, consideration is also being given to the production side, especially with regard to how oil will be moved to market from the Arctic. The logistics teams are currently in the beginning stages of considering pipeline infrastructure needs. Whether the port could play a significant role, either in support of the pipeline, or in support of related production services, was not yet known to the OO&G contacts.

D.7. Overall Messaging from Oil Companies

The biggest obstacle to efficient Arctic exploration and production is the logistics of operations in the Arctic. Access to and egress from the drill sites, with no developed port infrastructure in the Arctic, is both costly and presents many uncertainties and risks (weather, ice, etc.) which make operating on a tight schedule during the open water months very challenging. In addition, existing harbors in the region do not have the types and quantity of facilities required by large scale drilling campaigns – like deepwater to accommodate large ships, or shoreside facilities like hotels, medical care, grocery, etc. The predominant use of a deepwater port in the Arctic by the OO&G companies would be to reduce complexity in their operational logistics plans, reduce cost of operation, and mitigate risks and uncertainties associated with Arctic operations.

The companies did not predict that the Arctic port would be a *fabrication port,* as defined by Section 6009 as “those ports with facilities that fabricate, build, refurbish, provide upgrades to, or inspect either entire oil and gas rigs or partial components of oil and gas rigs.” Instead, they predicted that the port would be integral to the supply chain logistics in support of the drill sites in terms of storage, transfer and staging of materials, equipment, personnel, fuel, Coast Guard operations, etc. The OO&G contacts viewed the greatest potential utility of the deepwater port to be a drilling season base of operations and logistics management, including use of laydown area for offseason storage and staging.

It was noted by the OO&G companies on multiple occasions that, from their perspective, multiple ports, each serving a specific niche, could be a valuable asset in the Arctic, as it might allow for smaller natural harbors to serve an essential function without requiring as substantial a level of navigation improvements to accommodate all vessels at once. For example, a port could be developed to cater to Coast Guard emergency response and spill response operations, and another to cater to refueling and supply lightering for drilling campaigns, etc. This multi-port scenario was suggested more in terms of how Arctic development might play out over the long term, and not as a proposed alternative for the currently feasibility study.

Other items brought Up by OO&G companies that may be relevant to navigation analysis included:

- Shipping is still the most cost effective means of moving assets and supplies (air travel is expensive, road/rail not feasible in Arctic) and is best investment from perspective of OO&G.
    - However, OO&G companies estimate that a large opportunity for cost savings is in reducing vessel travel distances from drill sites to fueling and supply sites.
    - There is also an opportunity to reduce the required number of supply vessels.
- Port design should consider opportunities for wintering vessels (more likely for Coast Guard or other third parties than for OO&G), creative mooring solutions rather than docks, wintering supplies and other assets in laydown areas.
- Arctic operations are costly because it is difficult to run on schedule. Fuel/supply ship delays, weather delays, floating ice delays, uncertain season start and end dates, remote conditions, long travel distances, and etc., all result in increased cost and schedule uncertainty, requiring contingency plans and cost contingencies. A deep draft port would improve logistics and improve ability of OO&G companies to operate on schedule and achieve desired return on investment.
- Capacity of existing ports, port services, and shoreside services is a concern for OO&G companies. In 2012, Shell was the only OO&G exploration campaign in the Chukchi. In the future, with multiple campaigns in a season, even more port support will be required. A deep draft port that had necessary capacity would make exploration more efficient and possibly reduce the cost of port rental and services fees.

D.8. Potential for Supply Vessel Cost Savings

Following coordination with OO&G contacts, Crowley was contacted again to provide further information on potential transportation cost savings. Information obtained focused on supply vessel costs and port-related support services for the OO&G industry.

Supply vessels moving to and from the drill sites throughout the season are often contracted vessels. Typical OO&G operations might include anchor and tug handling vessels, crewboats, maintenance/utility vessels, offshore supply vessels, and other support vessels. The most common type of offshore supply vessels have a large open deck aft on which offshore containers and deck cargo can be transported. Types of supplies might include casing and drill pipe, fuel tanks, potable water, drilling water, drilling mud, drilling brine, chemicals, and dry bulk goods. These ships typically range from about 180 to 260 feet in length[9].

Based on reduction in fuel burn and a reduction in the days of travel, Crowley estimated that a typical oilfield supply vessel that could go to Port Clarence rather than Dutch Harbor would save approximately $270,000 per round trip. Based on an approximate distance savings of 1,500 miles per round trip supply run, this translates to a per-mile operating cost of $180 for supply vessels. Based on previous discussion with OO&G contacts, resupply runs to Dutch Harbor from the Chukchi can take around ten days. Round trip from Dutch Harbor the Chukchi drillsites is approximately 2,200 miles, implying the vessels travel about 220 miles per day. This suggests a potential time savings of about six to seven days per supply vessel round trip. It also implies an approximate charter rate of $27,000 per day for a typical oilfield supply vessel in the Arctic. This estimate of charter rate is consistent with the upper end of the range specified in industry news articles and reports[10,11].

Based on a scale of operation similar to Shell's 2012 exploration campaign, Crowley estimated that a ship might make as many as six trips over the season, a total savings of $1.6 million for that supply vessel's operation over the season [1,500 miles X $180 X 6]. The number of vessels required by each exploration or drilling operation would vary depending on the number of drillsites being supported.

Additionally, Crowley indicated that fueling and lightering services/facilities at Port Clarence may also offer cost savings. The fuel industry in Alaska requires that fuel be stored at regional terminals and fuel hubs throughout the state and lightered by smaller coastal tugs to community fuel farms and storage tanks. Typically, Crowley will transport fuel to the fuel storage hubs (tank farms) via linehaul barges in the summer months. It also transports fuel to community tanks via smaller vessels to fill annual fuel orders for communities. Crowley operates gas stations and aviation and marine fueling terminals at Nome, and development of Port Clarence would likely result in similar refueling services there, where a large tank farm (upwards of 1 million gallons of storage) would provide fuel services. Crowley indicated that the cost of fuel is typically a function of the distance from the refinery of origin, and the number of times the fuel is handled. The potential for large delivery volume to Port Clarence or directly to OO&G companies during the summer (via barge) months would improve fuel cost.

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[9] Rose R. February 2011. Thesis: Future Characteristics of Offshore Support Vessels. Massachusetts Institute of Technology School of Engineering. Accessed online http://dspace.mit.edu/handle/1721.1/64580

[10] http://www.maritime-rh.com/maritime_docs/osc_press_releases/Offshore_Support_Vessels_to_2020.pdf

[11] http://www.offshore-mag.com/articles/print/volume-73/issue-9/engineering-construction-installation/deepwater-work-in-gulf-of-mexico-spurs-strong-platform-supply-vessel-market.html

Crowley indicated that other service providers would likely provide air freight, drilling materials and supplies, drilling tools, cement and other services specifically for oil exploration, all of which might see a reduction in cost based on the improved logistics of operating from Port Clarence.

Finally, Crowley noted that any services they provide at Port Clarence, such as the the property, facilities, vessels, assist tugs, spill response, crewing, logistics, cargo and fuel services, would be managed by the Bering Strait/Crowley partnership.

Appendix 1
Information Packet

Investigation of Applicability of PL 09-13 Section 6009 Benefits

Deep-Draft Arctic Port Study

October 2013

U.S. Army Corps of Engineers
Alaska District

Tetra Tech, Inc.
1420 5th Avenue, Suite 550
Seattle WA 98101

TETRA TECH

To:	Curtis Smith, Shell
From:	James Carney, Tetra Tech
Subject:	**Information Request for Deep Draft Arctic Port Study**
Date:	24 July 2013
Attachments:	1. Informed Consent Letter 2. Background Information 3. List of Questions 4. Section 6009 PL 109-13 and related USACE Guidance

Hello Mr. Smith,

We've been contracted by the U.S. Army Corps of Engineers Alaska District to perform an analysis of potential future economic benefits that would result from constructing an arctic deep draft port in the Northern Bering Sea region. Specifically, we have been contracted to estimate economic benefits of the port attributable to offshore oil and gas exploration and production.

Enclosed you'll find an informed consent letter which speaks to how any information you provide will be used. Other attachments include background on our analysis, and a list of questions for you, and a copy of Section 6009 PL 109-13 and relevant USACE guidance. These items summarize the purpose of our analysis and the information we need from you in order to produce a meaningful and data-driven estimate of these potential economic benefits.

Please let me know if you have any questions or would like to discuss any of the enclosed materials. We greatly appreciate your time and any information you're able to provide.

Thank you,
James Carney

James.Carney@tetratech.com
206-838-6259

Tetra Tech, Inc.
1420 5th Ave Ste 550, Seattle, Washington, 98101
206-728-9655 (Phone)
Ridge.Robinson@tetratech.com

Deep Draft Arctic Port System Study – Section 6009 Benefits Analysis
Tetra Tech, Inc. under contract to the U.S. Army Corps of Engineers, Alaska District
July 2013

Informed Consent Form

Description of the Study
Tetra Tech Inc (Tetra Tech) has been contracted by the U.S. Army Corps of Engineers, Alaska District (Corps) to conduct an economic benefits analysis as part of the Deep Draft Arctic Port System Feasibility Study. The analysis will estimate the value of future energy exploration and production fabrication contracts that would be attributable to a deep draft port in the Northern Bering Sea region. Guidance for this benefit category is provided by Section 6009 of the Emergency Supplemental Appropriations Act for Defense, the Global War on Terror, and Tsunami Relief, 2005 (Public Law 109-13) – Offshore Oil and Gas Fabrication Ports. Section 6009 requires that data used in the analysis be based on actual contracts at existing offshore oil and gas fabrication ports in order to accurately estimate the without project condition (no arctic deep draft port) and the with project condition (arctic deep draft port in place). It is important that the analysis rely on current and accurate information from the companies that would be affected by the construction of a deep draft port.

Risks and Benefits of Being in the Study
This study is intended to provide accurate information to assist in the development of an estimate of potential economic benefits which fall under Section 6009 of the Emergency Supplemental Appropriations Act for Defense, the Global War on Terror, and Tsunami Relief, 2005 (Public Law 109-13) – Offshore Oil and Gas Fabrication Ports. As such, any relevant information that helps more accurately estimate those benefits will improve the quality of the economic analysis for the Deep Draft Arctic Port System Study. Information gathered during the course of this study will be kept confidential.

Anonymity
Your name will not be used in our study without your permission.

Confidentiality
All information provided will remain confidential and only aggregated data will be included in the report.

Voluntary Nature of the Study
Your decision to take part in the study is voluntary. You are free to choose not to take part in the study or to stop taking part at any time without any penalty to you.

Contacts and Questions
If you have questions, please contact:
Ridge Robinson, Tetra Tech, 206-728-9655
Lorraine Cordova, USACE Alaska District, 907-753-2672

Statement of Consent
I understand the procedures described above. My questions have been answered to my satisfaction, and I agree to participate in this study.

____________________________ Signature & Date

____________________________ Printed Name

ATTACHMENT 2 – Background Information

The goal of our analysis is to answer the question:

> *What is the incremental value of future energy exploration and production fabrication contracts that would result from a deep draft port along the Arctic Alaskan coast?*

Tetra Tech has been contracted by the USACE Alaska District to assist with a portion of the Alaska Arctic Deep Draft Port Feasibility Study (latest report available here). Specifically, we've been contracted to perform an economic analysis of "potential future offshore oil and gas exploration and production benefits" falling under Section 6009 of the Emergency Supplemental Appropriations Act for Defense, the Global War on Terror, and Tsunami Relief, 2005 (Public Law 109-13) – Offshore Oil and Gas Fabrication Ports. The USACE guidance for Section 6009 defines an "offshore oil and gas fabrication port" as "those ports with facilities that fabricate, build, refurbish, provide upgrades to, or inspect either entire oil and gas rigs or partial components of oil and gas rigs." *(See Attachment 4 for a copy of PL 109-13 and the related USACE guidance)*

Thus, Section 6009 expands the typical USACE navigation benefits analysis to include the incremental value of future energy exploration and production fabrication contracts that would result from an arctic deep draft port. The incremental increase in value of these types of contracts may be counted toward justification of the project. The USACE implementation guidance requires that estimation of this incremental benefit must be based on data sourced from oil and gas companies.

The data provided will be used to estimate the present value of the future stream of economic benefits attributable to the proposed port from "future energy exploration and production fabrication contracts" related to the arctic offshore oil and gas industry. Only the incremental value of the energy exploration and the production fabrication contracts to be executed in the future that exceed any work planned in the without project condition, and that can only be accommodated with the deep draft port in place, will be included in the calculation. It is assumed that the fabrication can occur at any fabrication port facility if and only if it is located in the U.S.

In this case, no arctic deep draft port currently exists, and so all future contracts attributable to the port, above and beyond those that would already be expected to occur under without project conditions, may be counted. For USACE projects, a 50-year planning horizon is considered. Thus, the goal is to estimate the future value of contracts which would have occurred between 2017 and 2067 because of the existence of an arctic deep draft port.

Contract value data provided by the POC's should exclude the value of owner furnished equipment. Acceptable documentation of estimates under Section 6009 requires documentation of actual contracts at current price levels.

ATTACHMENT 3 – List of Questions

The following bullets provide some general questions to guide the estimation of the benefits described above.

The overall question being addressed: What is the value of future energy exploration and production fabrication contracts that would be attributable to the new port?

1. What types of port facilities/services would be required for exploration and production in the northern Bering Sea? In other words, what would benefit your company most?
2. If these facilities were in place, would you initiate exploration and production more quickly than currently planned? What other changes would there be in your operations?
3. What types of new contracts[1] would be attributable to the port? *(Note that "attributable" does not mean only contracts that are let to companies at the arctic port; it may include, for example, contracts let to ports in Washington which occur or only because of the arctic port, or simply sooner than they would have otherwise)*
4. How many contracts of each type (fabrication, inspection, refurbishment, upgrade)?
5. What is the estimated timing of the contracts over a 50-year horizon? It may be assumed that the port is operational in 2017, and that the planning horizon runs through 2066.
6. Provide documentation for value of each contract type. This should include examples of actual contract values. *(Note that all data should be in current price level (FY2013). If not in FY13 price level, please note the price level of the data so that it may be adjusted.)*
7. Any other clarifying information related to port facilities/services that would complement your planned/future arctic exploration?

[1] Contracts: Contracts to fabricate, build, refurbish, provide upgrades to, or inspect either entire oil and gas rigs or partial components of oil and gas rigs. Contracts let to any domestic port should be considered.

ATTACHMENT 4 - Section 6009 PL 109-13 and related USACE Guidance

See following pages

MC CLELLAN KERR NAVIGATION SYSTEM ADVANCED OPERATIONS AND MAINTENANCE

118 Stat. 2940.

SEC. 6004. The last proviso under the heading "Operation and Maintenance" in title I of division C of Public Law 108–447 is amended by striking "Public Law 108–357" and inserting "Public Law 108–137".

ENVIRONMENTAL INFRASTRUCTURE

33 USC 2221.

SEC. 6005. Section 101 of title I of division C of Public Law 108–447 is amended by striking "per project" and all that follows through the period at the end and inserting "for all applicable programs and projects not to exceed $80,000,000 in each fiscal year.".

DE SOTO COUNTY, MISSISSIPPI

SEC. 6006. Section 219(f)(30) of the Water Resources Development Act of 1992 (106 Stat. 4835; 106 Stat. 3757; 113 Stat. 334) is amended by striking "$20,000,000" and inserting "$55,000,000" in lieu thereof, and by striking "treatment" and inserting "infrastructure" in lieu thereof: *Provided,* That the Secretary is authorized and directed to reimburse the non-Federal local sponsor of the project described in section 219(f)(30) of the Water Resources Development Act of 1992 (106 Stat. 4835; 106 Stat. 3757; 113 Stat. 334) for costs incurred between May 13, 2002, and September 30, 2005, in excess of the required non-Federal share if the Secretary determines that such costs were incurred for work that is compatible with and integral to the project: *Provided further,* That the non-Federal local sponsor, at its option, may choose to accept, in lieu of reimbursement, a credit against the non-Federal share of project cost incurred after May 13, 2002.

FORT PECK FISH HATCHERY, MONTANA

114 Stat. 2605.

SEC. 6007. Section 325(f)(1)(A) of Public Law 106–541 is modified by striking "$20,000,000" and inserting in lieu thereof "$25,000,000".

INTERCOASTAL WATERWAY, DELAWARE RIVER TO CHESAPEAKE BAY, SR–1 BRIDGE, DELAWARE

118 Stat. 2939.

SEC. 6008. The first proviso under the heading "Operation and Maintenance" in title I of division C of Public Law 108–447 is amended by striking "October 1, 2003, and September 30, 2004" and inserting "October 1, 2004, and September 30, 2005".

OFFSHORE OIL AND GAS FABRICATION PORTS

SEC. 6009. In determining the economic justification for navigation projects involving offshore oil and gas fabrication ports, the Secretary of the Army, acting through the Chief of Engineers, is directed to measure and include in the National Economic Development calculation the value of future energy exploration and production fabrication contracts and transportation cost savings that would result from larger navigation channels.

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET, NW
WASHINGTON, DC 20314-1000

REPLY TO
ATTENTION OF

SEP 13 2012

CEMP-SWD

MEMORANDUM FOR MAJOR SUBORDINATE COMMANDERS

SUBJECT: Implementation Guidance for Section 6009 of the Emergency Supplemental Appropriations Act for Defense, the Global War on Terror, and Tsunami Relief, 2005 (Public Law 109-13) – Offshore Oil and Gas Fabrication Ports

1. Section 6009 of Public Law 109-13 (Section 6009) provides that in determining the economic justification for navigation projects involving offshore oil and gas fabrication ports, the Secretary is directed to measure and include in the National Economic Development (NED) calculation, the value of future energy exploration and production fabrication contracts and transportation cost savings that would result from larger navigation channels. A copy of Section 6009 is enclosed.

2. Transportation cost savings have traditionally been the basis of NED benefit evaluations for proposed navigation projects. Section 6009 expands the NED benefit calculation for navigation projects to include the value of future energy exploration and production fabrication contracts that would result from larger navigation channels. While Section 6009 allows for additional NED benefits for navigation projects, it does not obviate the requirement to evaluate navigation projects in accordance with established Corps planning policies and practices.

3. Policy and procedures. Each decision document for navigation projects involving offshore oil and gas fabrication ports, including any currently underway as of the date of this guidance, will document and display the NED benefits identified through the established benefit evaluation procedures in ER 1105-2-100, Appendix E, Section II. In addition, the decision document will document and display the additional benefits directed by Section 6009 in accordance with the guidance in the following paragraphs during the formulation, evaluation, and selection of alternatives.

a. Offshore oil and gas fabrication ports will include those ports with facilities that fabricate, build, refurbish, provide upgrades to, or inspect either entire oil and gas rigs or partial components of oil and gas rigs. Such ports shall be evaluated as participating in energy exploration and production fabrication under Section 6009. The present value (PV) of future energy exploration and production fabrication contracts will be based on accepted industry practices: the actual or estimated contract value, excluding the value of owner furnished equipment.

b. Only the incremental value of the energy exploration and the production fabrication contracts to be executed in the future that exceed any work planned in the without project condition and that can only be accommodated with the proposed channel improvement will be permitted in this NED benefit calculation, regardless if work was displaced from foreign or domestic yards.

c. The incremental contract value, as described above, must have a clear nexus to the evaluated channel depth; in other words, the value of the contract must be related to specific channel depths or widths required for the transport vessel to maneuver safely and efficiently. The benefits will accrue at those depths or widths corresponding to the least-cost, safe channel parameters for the transport vessel.

d. The inclusion of the Section 6009 contract value benefits in the NED benefit calculation shall be contingent upon the non-Federal sponsor providing the following information:

(1) Documentation of actual values of contracts (at current price levels) to fabricate, build, refurbish, provide upgrades to, or inspect either entire oil and gas rigs or partial components of oil and gas rigs, in order to ascertain the without project condition.

(2) Reasonably acceptable documentation from the same facilities that fabricate, build, refurbish, provide upgrades to, or inspect either entire oil and gas rigs or partial components of oil and gas rigs of the anticipated increase in the scope and value of the contracts as a result of the anticipated navigation project.

e. Information provided by sponsors shall be treated as proprietary information, shall not be publicly disclosed, and shall be used solely to determine the NED benefits directed by Section 6009. The decision document will display a benefit to cost ratio calculated using the traditional NED benefits. The decision document will also display a benefit to cost ratio using the traditional NED benefits and the additional NED benefits directed by Section 6009.

f. The Corps of Engineers shall accept the information provided by the non-Federal sponsor, if it is certified in writing by the Chief Executive Officer (or equivalent) of each facility involved that fabricates, builds, refurbishes, provides upgrades to, or inspects either entire oil and gas rigs or partial components of oil and gas rigs that the information provided is true and correct and represents the company's best and accurate estimate of the information.

4. These policies and procedures apply to any reevaluation study of specifically authorized projects and any pre-authorization studies involving offshore oil and gas fabrication ports. Upon completion of a study, the decision document will be submitted to the appropriate Headquarters Regional Integration Team for review and transmittal

to the Assistant Secretary of the Army (Civil Works). Any further action on the decision document is subject to the review and approval by the Secretary.

5. This guidance is effective immediately and will be incorporated into ER 1105-2-100 upon the next revision.

FOR THE COMMANDER:

Encl

STEVEN L. STOCKTON, P.E.
Director of Civil Works

DISTRIBUTION:
COMMANDER, GREAT LAKES AND OHIO RIVER DIVISION
COMMANDER, MISSISSIPPI VALLEY DIVISION
COMMANDER, NORTH ATLANTIC DIVISION
COMMANDER, NORTHWESTERN DIVISION
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COMMANDER, SOUTH ATLANTIC DIVISION
COMMANDER, SOUTH PACIFIC DIVISION
COMMANDER, SOUTHWESTERN DIVISION

Section 6009 of the Emergency Supplemental Appropriations Act for Defense, the Global War on Terror, and Tsunami Relief, 2005 (Public Law 109-13)

SEC 6009. OFFSHORE OIL AND GAS FABRICATION PORTS

In determining the economic justification for navigation projects involving offshore oil and gas fabrication ports, the Secretary of the Army, acting through the Chief of Engineers, is directed to measure and include in the National Economic Development calculation the value of future energy exploration and production fabrication contracts and transportation cost savings that would result from larger navigation channels.

Enclosure

Appendix 2
Contact List

Investigation of Applicability of PL 09-13 Section 6009 Benefits

Deep-Draft Arctic Port Study

September 2013

U.S. Army Corps of Engineers
Alaska District

Tetra Tech, Inc.
1420 5th Avenue, Suite 550
Seattle WA 98101

Contacts

Company	Name & Title	Email	Office	Cell
Crowley	Bruce Harland *Director, Operations*	Bruce.Harland@crowley.com	907-382-5179	n/a
Crowley	Geoff Baker *Business Development Manager*	Geoff.Baker@crowley.com	907-777-5464	907-231-1223
StatOil	Elle Ede *Stakeholder Engagement Manager*	eede@statoil.com	907-433-5700	907-444-3473
StatOil	Jocelyn Fenton *HSE & Regulatory Compliance*	jocf@statoil.com	907-433-5705	907-242-7687
StatOil	Lars A. Sunde *Exploration Manager for Arctic*	lasun@statoil.com	907-433-5700	n/a
Conoco-Phillips	Kurt Hallier *Marine Specialist*	Kurt.M.Hallier@conocophillips.com	907-276-1215	n/a
Shell	Cam Toohey *Government Affairs Manager*	Cam.Toohey@shell.com	907-646-7108	907-301-3966
Shell	Curtis Smith *Shell Alaska Spokesperson*	Curtis.Smith@shell.com	907-646-7182	n/a

ATTACHMENT 3 – OFFSHORE OIL AND GAS BACKGROUND AND ASSUMPTIONS

Offshore Oil and Gas Background and Assumptions

The document serves to provide a basis and explanation of the assumptions used in modeling Arctic offshore oil and gas activities in relation to the Alaska Deep Draft Arctic Ports System study.

1. **Background:**

This section provides a brief history of offshore oil and gas exploration in Alaska and describes recent drilling activities and investment. This serves as a basis for describing the potential for future development in the region. Shell conducted an abbreviated drilling season in the Chukchi and Beaufort Seas in the summer of 2012. This was not a complete drilling season, but it offers a look into how offshore drilling would operate in Alaska waters. Other oil companies have indicated that Shell's 2012 operations are representative of the logistics of a drilling campaign.[1]

The oil and gas industry's interest in the Arctic Outer Continental Shelf[2] (OCS) is driven by the region's substantial resource potential. The Bureau of Ocean Energy Management (BOEM) estimates that the Chukchi Sea Planning Area may hold more than 15 billion barrels of technically recoverable oil and nearly 78 trillion cubic feet of technically recoverable natural gas, which is second only to the Central Gulf of Mexico in terms of resource potential offshore the United States. The Beaufort Sea also has significant resources potential with an estimated 8 billion barrels of oil and nearly 28 trillion cubic feet of natural gas.[3] Figure 1 illustrates the OCS Planning Areas as defined by BOEM.

[1] See: Investigation of Applicability of PL 09-13 Section 6009 Benefits, prepared by Tetra Tech for USACE Alaska District, October 2013. Also anecdotal evidence gathered during personal interviews with oil company representatives supports this assumption.
[2] Per BOEM, the Outer Continental Shelf is generally defined as the submerged lands lying around and outside three geographical miles off each state.
[3] Review of Shell's 2012 Alaska Offshore Oil and Gas Exploration Program. US Department of the Interior, Report to the Secretary of the Interior. March 8, 2013.

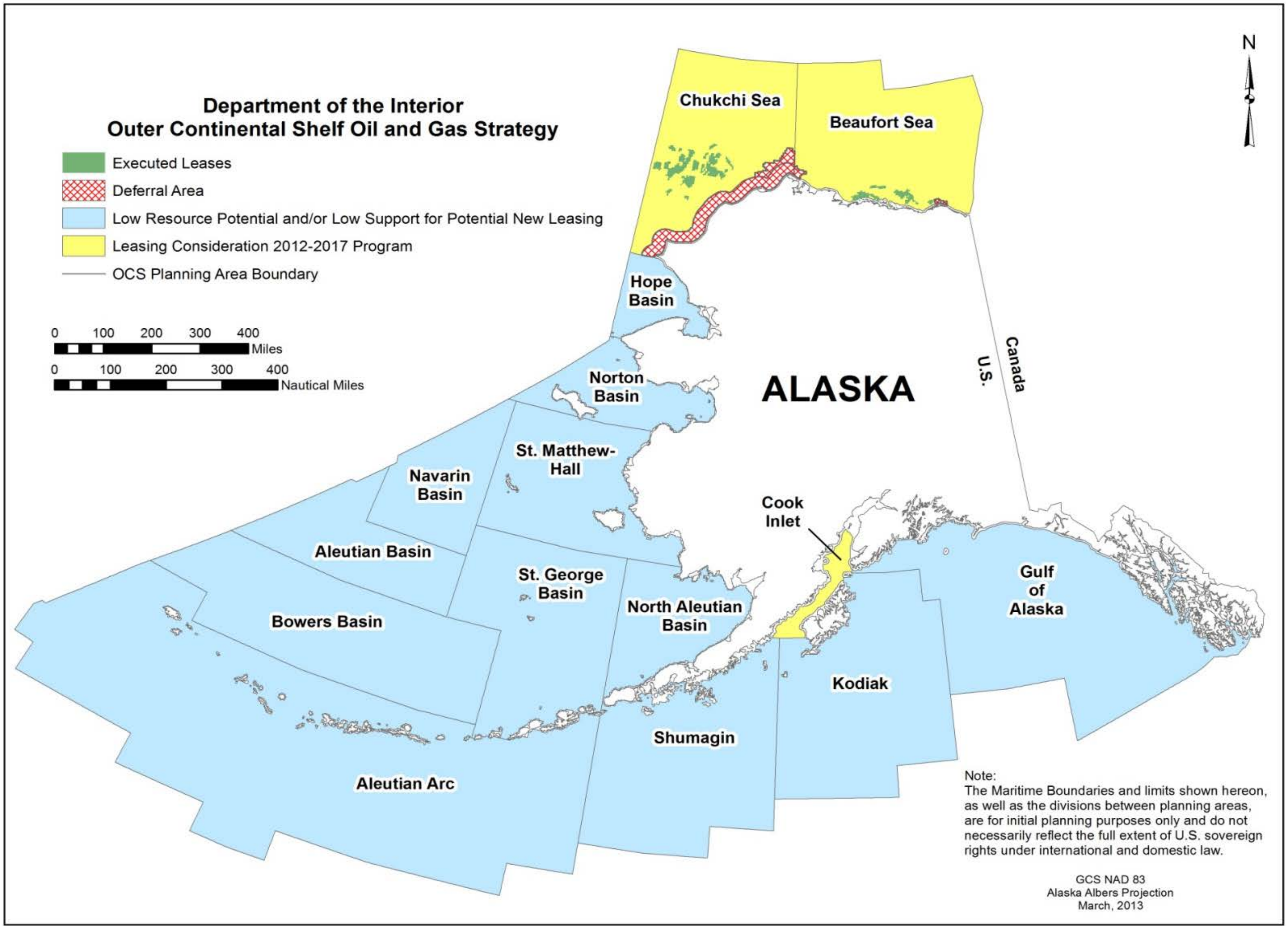

Figure 1. Outer Continental Shelf Oil and Gas Leasing Program, Alaska Planning Areas
Source: Bureau of Ocean Energy Management, Alaska OCS Region

Between 1989 and 1991, Shell drilled four exploration wells in the Chukchi Sea at its Burger, Klondike, Crackerjack, and Popcorn prospects. All of the wells resulted in the discovery of hydrocarbons, although none was considered commercial for development at the time. All of the leases under which these exploration wells were drilled have expired.[4]

Chukchi Sea Oil and Gas Lease Sale 193, held in 2008, reflected renewed industry interest in the Arctic OCS and resulted in 487 leases sold for approximately $2.7 billion. Shell alone purchased 275 Chukchi Sea leases for about $2.1 billion. The areas with previous hydrocarbon discoveries remain among the most desirable for further exploration, with Shell's 2012 Chukchi Sea exploration program concentrating on the Burger prospect. Shell's Chukchi Sea and Beaufort Sea exploration programs evolved over the course of a number of years and in response to changes in regulatory and operational requirements, legal challenges, and lessons learned from the Deepwater Horizon oil spill.[5]

In May 2009, along with its Beaufort Sea program, Shell submitted an exploration plan proposing drilling in the Chukchi Sea during the 2010 season, which the Minerals Management Service[6] approved in December 2009. However, in the midst of the ongoing response (and court injunction on offshore drilling) to the Deepwater Horizon blowout and oil spill in the Gulf of Mexico, Shell withdrew its drilling application in early June 2010 and did not move forward with exploration drilling offshore Alaska in 2010. The Court lifted its injunction of activity under the Sale 193 leases in October 2011, after which BOEM proceeded with its review of Shell's revised 2012 Chukchi Sea exploration plan for exploration drilling at the Burger prospect. Shell's Chukchi Sea exploration plan proposed drilling up to six exploration wells beginning in the 2012 drilling season and continuing over multiple seasons. The well sites are located about 85 miles northwest of Wainwright, in waters approximately 140 feet deep (maps of the exploration sites are presented in the next section). Shell's 2012 Chukchi Sea revised exploration plan was approved in December 2011.[7]

During 2012, Shell was able to drill top hole sections in both the Chukchi and Beaufort Sea theaters. Shell could not obtain permits to drill into potential hydrocarbon-bearing zones for the 2012 drilling season due to missing approval of its Arctic Containment System and other issues with their vessels.

Shell then experienced issues with demobilizing its fleet at the end of the drilling season, most significantly the lost tow and grounding of the drilling rig Kulluk during a winter storm in late December. The rig was en route to Seattle from Dutch Harbor and grounded near Kodiak Island. After this mishap, and other mechanical and air quality issues, Shell chose to suspend its drilling operations for the 2013 season.

In January 2014, a Federal appeals court ruled that BOEM's decision to open the 30 million acres of the US Arctic OCS to energy exploration was illegal. Shortly after the appeals court

[4] Ibid.
[5] Ibid.
[6] Minerals Management Service is a now-disbanded Federal agency which was a predecessor of the Bureau of Ocean Energy Management.
[7] Review of Shell's 2012 Alaska Offshore Oil and Gas Exploration Program. US Department of the Interior, Report to the Secretary of the Interior. March 8, 2013.

ruling, Shell announced it would not drill offshore of Alaska for the 2014 season.[8] In April 2014, a US District judge ruled that BOEM must redo their environmental impact statement, which had previously underestimated the amount of recoverable oil.[9] The US Interior Department announced in May 2014 that they plan to have an updated environmental impact analysis completed by March 2015. This could allow Shell to resume offshore drilling as early as the 2015 season.[10]

Media reports have estimated that Shell has spent approximately $6 billion to date in support of its offshore exploration efforts.[11] This includes lease purchases ($2.1 billion), as well as permits, research, and support for operations.

2. **Assumptions**

a. Future Operations

The key underlying assumption to including offshore oil and gas activities in the analysis of Nome and Port Clarence is that offshore oil and gas exploration activities will continue in the Arctic in the near future. This assumption is supported by oil and gas companies' significant investment and continued interest in the region. Also BOEM plans to hold additional lease sales for the Chukchi and Beaufort regions in 2016 and 2017, respectively.[12] BOEM's decision to hold future lease sales means that their evaluation of the available resource is favorable for development activities.[13]

There are risks associated with this assumption. A recent report published by Northern Economics on behalf of Bering Straits Native Corporation and Crowley Maritime on the feasibility of support base at Port Clarence, Alaska, identifies some of the uncertainties in future exploration.[14] Key pieces of information from that report gathered from interviews with oil and gas companies include:

- the impacts from Shell's well-publicized problems in 2012 are far-reaching and additional regulations and oversight are expected for future seasons,
- one major oil company disbanded their OCS exploration team for the near term and are waiting for additional regulations and oversight, and
- the costs associated with the regulations and oversight are unknown at this time, and could, at the extreme, remove much of the incentive to drill.

The economic incentive for offshore oil and gas exploration is a function of market prices and potential profitability. Risks to profitability which may create a disincentive for continued exploration for current companies include: uncertainty in future regulatory requirements,

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[8] "Shell won't drill offshore in Alaska Arctic this year". Alaska Dispatch News, January 30, 3014.
[9] "Judge suspends Arctic drilling, orders new environmental report". Los Angeles Times. 25 April 2014.
[10] "Review of environmental impact of proposed Chukchi drilling expected within 10 months". Alaska Dispatch, by Yereth Rosen, 29 May 2014.
[11] "Shell won't drill offshore in Alaska Arctic this year". Alaska Dispatch News, January 30, 3014.
[12] BOEM 2012-2017 Leasing Schedule. http://www.boem.gov/2012-2017-Lease-Sale-Schedule/
[13] For more information on BOEM's leasing strategy, see: http://www.boem.gov/Alaska-Leasing-and-Plans/
[14] Northern Economics, Inc. *Feasibility Analysis: Port Clarence Support Base.* Prepared for Bering Straits Native Corporation and Crowley Maritime Corporation. June 2014.

variability in environmental and climatic conditions, and complicated logistics and operational costs in the Arctic.

The premise of benefits related to this analysis is that a deep draft port closer to the Arctic drilling grounds could result in efficiencies and cost savings to the oil and gas vessel fleet, which may increase the potential for profitability. Not quantified in our analysis, is the benefit of having oil spill response and search and rescue vessels located nearer to the drilling platforms.

An additional assumption is that exploration activities will lead to identification of viable reserves and companies will transition to production activities. Very little is known about what offshore production facilities would look like in the Arctic. There are existing offshore facilities in Alaska, but they are relatively near shore and close to existing on-shore oil and gas infrastructure at Prudhoe Bay and are supported by man-made islands and on-shore facilities.[15]

b. Number of Companies

Tetra Tech's report[16] to the Alaska District regarding offshore oil and gas exploration focused on three companies: Shell, Conoco Phillips, and StatOil. Tetra Tech selected these three companies as they are, "major oil companies holding leases in the Chukchi Sea who are known to be planning exploration of those leases". Figure 1 shows the current[17] lease holdings in the Chukchi Sea. The map shows that Shell owns the largest lease area, followed by a joint venture between Conoco Phillips, StatOil, and OOGC America Inc. The next largest amount of lease area is owned by Repsol E&P USA, Inc. Conoco Phillips and StatOil have smaller areas of wholly-owned lease areas.

This analysis considers the future operations of Shell, Conoco Phillips, and Stat Oil as these companies are assumed to be the most likely to pursue exploration activities, and to maintain consistency with Tetra Tech's report.

This analysis assumes that these three companies will engage in offshore exploration during the period of analysis. It may be conservative to assume only three companies as a major success by one (or more) company could entice others to enter the market. BOEM has additional lease sales planned for the Chukchi in 2016 and for the Beaufort in 2017.[18] Alternatively, a catastrophic failure by any one company (particularly the first to exploration) could lead to a disincentive or legal prohibition for others to enter the market.

[15] This refers to the two drill sites operated by BP Exploration (Alaska): Liberty and Northstar. For more detail in these production operations, see: http://www.boem.gov/About-BOEM/BOEM-Regions/Alaska-Region/Leasing-and-Plans/Plans/Alaska-DPPs.aspx

[16] Investigation of Applicability of PL 09-13 Section 6009 Benefits, prepared by Tetra Tech for USACE Alaska District, October 2013. Also anecdotal evidence gathered during personal interviews with oil company representatives supports this assumption.

[17] As of June 21, 2013. This is the most up-to-date lease ownership map available.

[18] BOEM's Alaska Leasing Office. http://www.boem.gov/About-BOEM/BOEM-Regions/Alaska-Region/Leasing-and-Plans/Leasing/Index.aspx

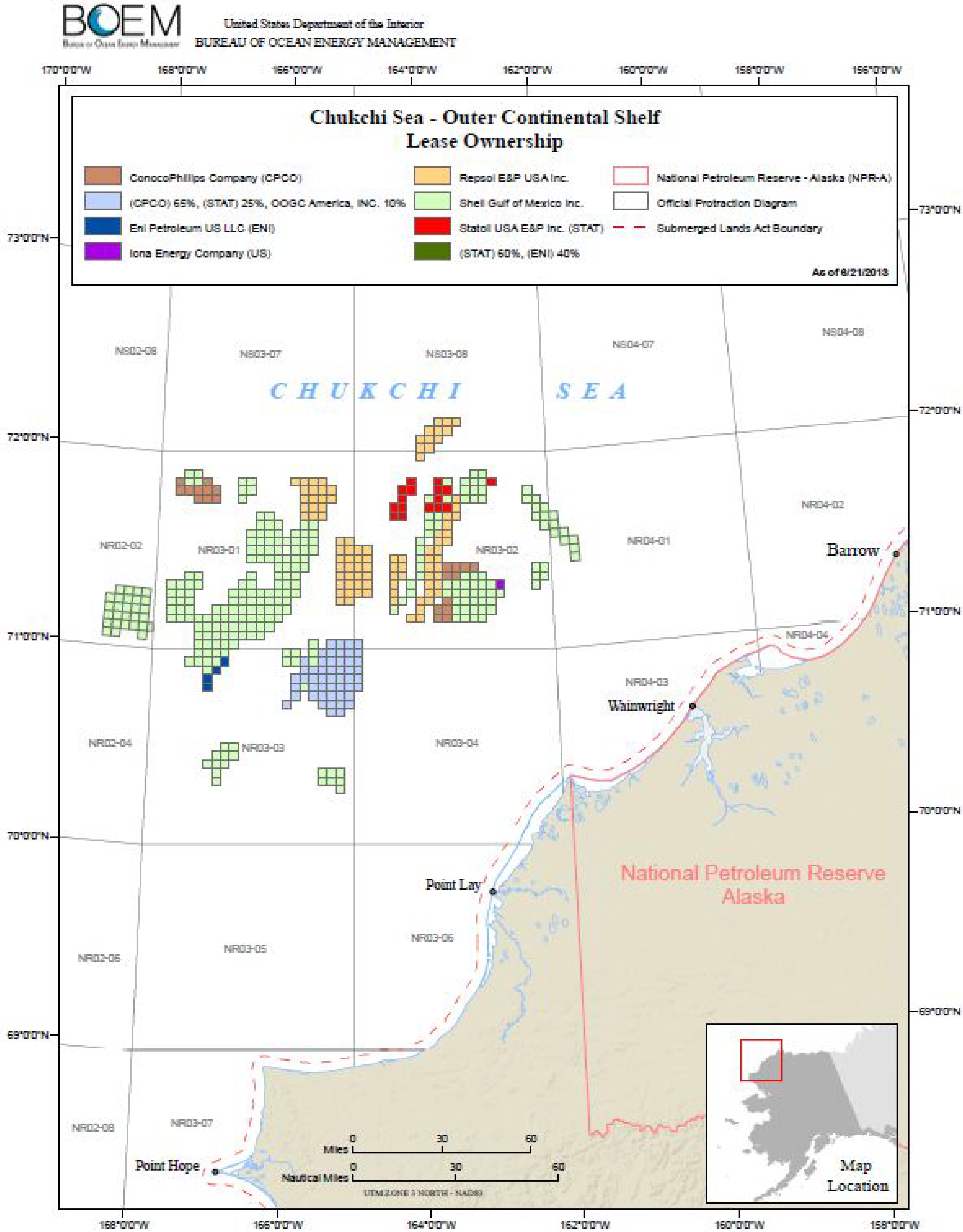

Figure 2. Current Chukchi Sea lease ownerships, by company
Source: BOEM Alaska OCS Region, Leasing and Plans.

c. Drilling Locations – Chukchi and Beaufort Seas

Figure 2 shows the current offshore leases in the Beaufort Sea, by company. The first important note is that these lease areas are significantly closer to shore than the Chukchi Sea leases. In particular, these leases are close to Deadhorse and Prudhoe Bay which already have significant land-based infrastructure to support on-shore oil and gas drilling (and some offshore production which is conducted on man-made islands at BP's Liberty and Northstar sites). Tetra Tech's report found that drill sites in the Beaufort Sea are more likely to rely upon Prudhoe Bay for personnel changes, refueling, and resupplying vessels. Similarly, Shell's website[19] indicates they planned to use shallow draft landing craft vessels to resupply Beaufort Sea drilling operations from Prudhoe Bay. There is an existing shallow draft causeway (West Dock) at Prudhoe Bay. In addition, Shell announced in 2013 that their future exploration activities would focus on the Chukchi Sea in the near term.[20]

Chukchi Sea drilling could be supported by facilities on the west coast of Alaska, so this analysis focuses on Chukchi Sea drilling activities. Vessels headed toward the Beaufort Sea could be included in potential fleets to utilize ports at Nome or Port Clarence for pre- and post-season mobilization and demobilization. Insufficient information is available at this time to include these fleets in modeling.

Based on this information, this analysis examines only the vessel fleets associated with Chukchi Sea drilling.

[19]Offshore Alaska Exploration Vessels (as of February 2012). http://www.shell.us/aboutshell/projects-locations/alaska/events-news/02152012-vessels.html#textwithimage_6

[20] "Shell mulls Chukchi-only drilling for 2014, minus troubled Kulluk rig". Alaska Dispatch News, October 31, 2013.

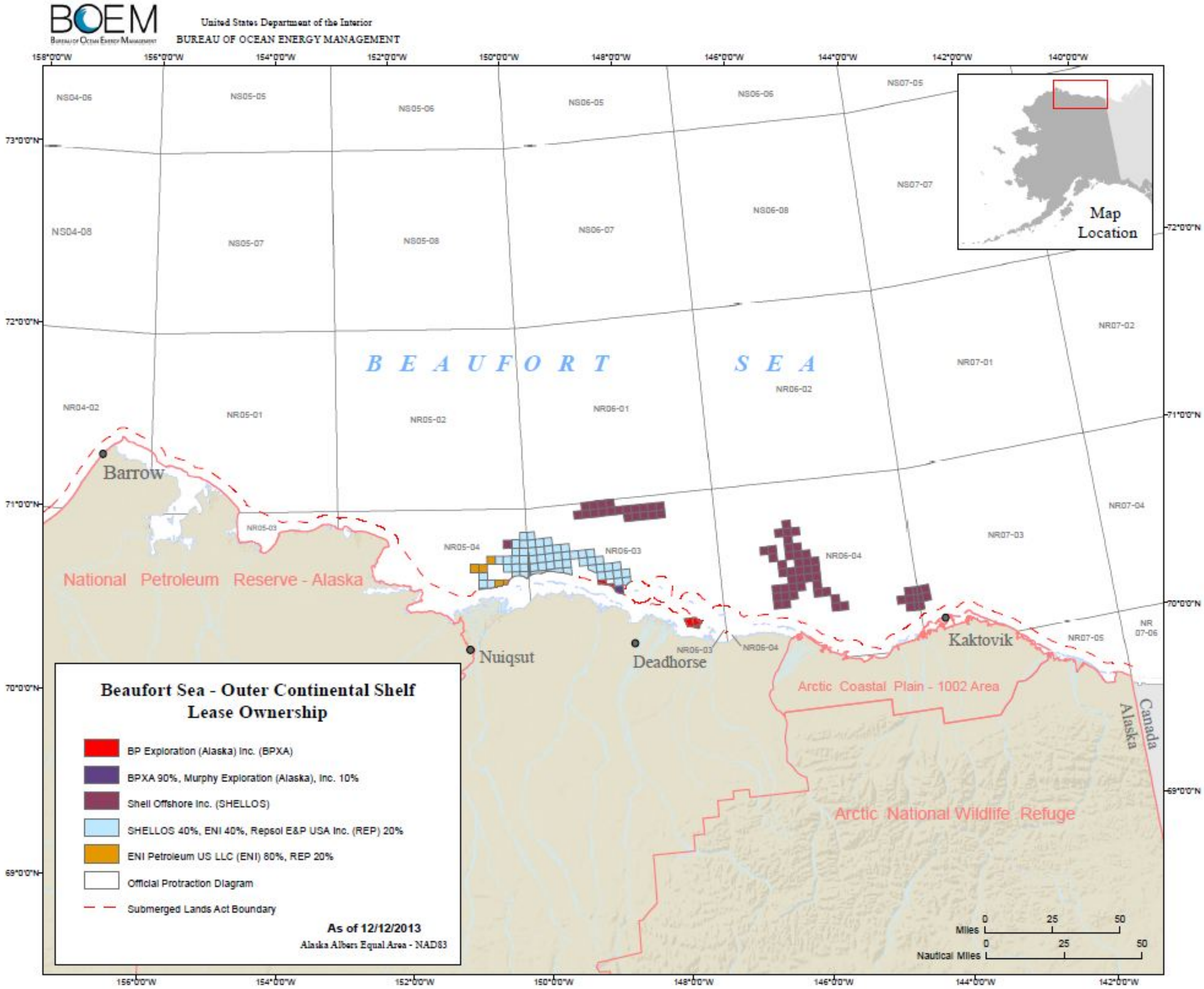

Figure 3. Current Beaufort Sea lease ownerships, by company
Source: BOEM Alaska OCS Region, Leasing and Plans.

d. Timing of Exploration and Production

The timing of each company beginning (or resuming, in the case of Shell) their exploration/production activities will have an impact on the level of potential NED benefits. Given the tumultuous nature of offshore activities in the last several years, there is uncertainty associated with timing assumptions. To address some of this uncertainty, the Alaska District consulted with the BOEM Alaska OCS Region office to determine their predictions for the most likely timing scenario.[21]

[21] Information gathered via phone with BOEM Alaska Region. Part of BOEM's mission includes evaluation of potential resources and their development. (See: http://www.boem.gov/Alaska-Resource-Evaluation/)

BOEM's timing scenarios were recently presented in the "Feasibility Analysis: Port Clarence Support Base", conducted by Northern Economics, Inc. (NEI) for the Bering Straits Native Corporation and Crowley Maritime Corporation.[22] The NEI report initially considered exploration and development scenarios developed using the BOEM MAG-PLAN software. However, the MAG-PLAN software and estimates are only developed in 5-year intervals. And, results of the most recent model (May 2012) differed significantly from known permitting and public announcements of the recent past. Revised information presented in the NEI report and supported by BOEM suggests that the earliest expectations for exploration activities in the Arctic range from 2015 to 2017 with possible first oil from production in 2025 to 2028.

This analysis assumes that exploration activities for all three companies will be underway by the first year of the project period of analysis: 2020. This simplifying assumption is made to maintain consistency with the oil and gas scenario development timelines and the existing HarborSym years of analysis (also to streamline HarborSym modeling for this phase of study). Similarly, this analysis assumes that production activities will begin in 2030. Interviews conducted by the Alaska District with oil and gas company representatives found that the expected transition from exploration to production of Arctic offshore sites will be 10 to 15 years.

This analysis assumes that as each company begins production at one site, they will continue exploration activities at a new site. This assumption is supported by information gathered during interviews with oil and gas company representatives. There has never been an offshore oil production platform in the Chukchi Sea, so there is no historical information to use as a basis for vessel activities. Given this lack of information, this analysis assumes that vessel re-supply operations for production activities will be the same as for exploration. So, as each company transitions from exploration to production at one site and begins exploration of a new site, the fleet of supply vessels will essentially double. This is a simplifying assumption and does not consider that re-supply vessels could serve more than one exploration/production platform nor does it consider that companies can have multiple exploration wells operating so would not have to wait for production to begin at one site before moving on to the next.

Consistent with the other modeling for this analysis, growth in activities and vessels will continue until 20 years after the base year (to 2040), at which point estimates will be held constant. As part of the sensitivity analysis, growth activities will be expanded to the full 50 year project period of analysis.

According to the NEI report and the MAG-PLAN development scenarios, all exploration activities in the Chukchi are set to begin before 2020 (the base year for analysis). Oil and gas production for any discoveries is forecasted to start in 2026 for the Chukchi. Therefore, setting production timing to 2030 for HarborSym modeling stays closer to this study's more conservative estimate of 15 years for the transition from exploration to production.

In order to address some of the uncertainty associated with timing, different scenarios may be analyzed during future phases of study to determine the sensitivity of benefits to the impacts of timing.

[22] Northern Economics, Inc. *Feasibility Analysis: Port Clarence Support Base.* Prepared for Bering Straits Native Corporation and Crowley Maritime Corporation. June 2014.

e. Season Length

The length of the exploration and production seasons is a major determining factor in the amount of vessel support (i.e. number of supply vessel trips) needed per season. Currently, exploration drilling activities are limited by ice conditions and by regulation. Shell has to wait for ice conditions to clear from the Bering Strait before heading north to the drilling grounds. And, the Environmental Assessment conducted by the Bureau of Ocean Energy Management (BOEM) regulates the dates at which Shell must remove drill rigs and begin to vacate the Arctic.[23] These dates are based on ice forecasts and historical information and may vary from year-to-year.

The only recent historical information available about the timing of exploration activities is Shell's 2012 abbreviated drilling season. Shell's operations in 2012 were delayed due to the company attempting to secure approval of an oil containment system vessel. In 2012, the first Shell vessel to transit north of the Bering Strait was the icebreaker Nordica on July 22. Next were the anchor handlers Tor Viking and Aiviq, which pre-laid anchors for the Noble Discoverer drill rig at the Burger A drill site in the Chukchi from August 8 through 10. The Noble Discoverer left Dutch Harbor for the Chukchi Sea on August 25.[24]

For the 2012 drilling season, BOEM established rules governing when Shell would be required to stop drilling in hydrocarbon-bearing zones at the end of the drilling season. BOEM required Shell to cease drilling within 38 days of a "trigger date" of November 1, established by BOEM based on analysis of historical data from 2007 through 2011 regarding the date of first ice encroachment over the proposed Burger drill site. This condition was designed to provide time for open water emergency response in the event of an incident occurring near the end of the drilling season. The initial end date for Shell to cease drilling in 2012 was September 24. However, BOEM provided for adjusting the trigger date based on reliable, scientific ice forecasting data capable of predicting with a high degree of certainty when ice would encroach on each drill site. Shell would be able to conduct other activities, including drilling short of hydrocarbon-bearing zones, up to October 31.[25]

In Shell's 2014 Integrated Operations Plan for the Chukchi Sea[26], the company stated that they intended to stage equipment and vessels in Dutch Harbor during the month of June and will mobilize northward during the latter part of the June or first part of July depending on ice forecasts and timing of regulatory approvals.[27]

Based on information about Shell's 2012 operations, the assumed length of the drilling season is 120 days (July 1 through October 31). Actual drilling seasons may be longer or shorter each year, depending on ice conditions, or each company's use of ice-breaking vessels to lengthen

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[23] Chukchi Sea Planning Area, Shell Gulf of Mexico, Inc., Shell Revised Chukchi Sea Exploration Plan, Environmental Assessment. BOEM. December 2011.
[24] Review of Shell's 2012 Alaska Offshore Oil and Gas Exploration Program. US Department of the Interior, Report to the Secretary of the Interior. March 8, 2013.
[25] Ibid.
[26] Shell had already begun preparing for the 2014 drilling season prior to the 9th Circuit Court of Appeals ruling which caused Shell to halt offshore operations. While Shell will have to revise the specifics of this plan prior to another drilling season, the general information related to logistics presented in the 2014 plan is assumed representative and useful for this analysis.
[27] 2014 Integrated Operations Plan for the Chukchi Sea, Shell, November 2013.

shoulder seasons. However, this analysis utilizes a 120-day drilling season for modeling, with the potential for pre- and post-season vessel movements to occur just outside of that window.

f. Vessel Fleet

Shell's 2012 drilling campaign was supported by the vessels listed in Table 1. Highlighted vessels are those which called upon Nome in 2012 (either to a dock or anchored offshore). Tetra Tech's report for USACE[28] states that Shell's 2012 fleet moved to the Nome/Port Clarence area on its way north to the drilling grounds and some minimal resupply or crew changes occurred at Nome. Additional information is not available at this time regarding specific vessel calls, commodity movements, or personnel transfers at Nome.

Table 1. Vessels used for Shell's 2012 drilling campaign

Vessel Name	Vessel Type	Length (ft)	Width (ft)	Draft (ft)
Chukchi Sea Vessels:				
Noble Discoverer	Drill Rig	514	71	27
Klamath	Spill Recovery (Barge)	320	76	22
Guardsman	Spill Recovery (Tug)	126	34	17
Affinity	Fuel Supply & CSR Tanker	748	106	47
Arctic Challenger	Containment System	310	104.4	19.3
Corbin Foss	Containment System	149.8	40	18.5
Landing Craft (TBA)				
Fennica	Primary Ice Management Vessel	380.5	85	27.5
Tor Viking II	AHTS & Secondary Ice Management	275	59	20
Nanuq	Spill Recovery & Accommodation v/l	301	60	19
Harvey Explorer	Supply Vessel	240	56	15.5
Harvey Spirit	Supply Vessel	280	60	16.5
Beaufort Sea Vessels:				
Kulluk	Drill Rig	266	266	41
Nordica	Primary Ice Management Vessel	380.5	85.3	28
Aiviq	AHTS & Secondary Ice Management	360.6	80	24
Tuuq	Supply & Waste Storage	149.8	40	18.5
Lauren Foss	Supply & Waste Storage	400	99.5	19.33
Sisuaq	Supply Vessel/Waste	300	64	19.9
Arctic Seal	Landing Craft	134	32	7
Endeavor	Spill Recovery (Barge)	205	90	
Pt. Oliktok	Spill Recovery (Tug)	190	32	8.5

Note: Highlighted vessels called at Nome in 2012, either to a dock or anchored offshore.
Source: Shell's Offshore Alaska Exploration Vessels. http://www.shell.us/aboutshell/projects-locations/alaska/events-news/02152012-vessels.html#textwithimage_6

[28] Investigation of Applicability of PL 09-13 Section 6009 Benefits, prepared by Tetra Tech for USACE Alaska District, October 2013.

According to documentation provided to BOEM, Shell planned to use a larger fleet for their future operations in the Chukchi. The vessels envisioned for the 2014 season, as listed in the Integrated Operations Plan for the Chukchi Sea, are shown in Table 2. Vessels highlighted in blue will be staged in Dutch Harbor as part of emergency response preparedness, according to Shell's Integrated Operations Plan for the Chukchi Sea. The Port of Dutch Harbor is more than 1,000 miles from the Chukchi drilling operations. The reason for the differences in the fleets could include that the 2012 campaign was only a partial drilling season, and due to lessons learned by Shell and BOEM about Arctic operations and vessel needs.

Table 2. Vessels for Shell's 2014 Chukchi Sea campaign.

Vessel	Type/Class	Length (ft)	Width (ft)	Draft (ft)
Nordica	Polar Class / Multipurpose	380	85	27
Fennica	Polar Class / Multipurpose	380	85	27
Tor Viking	Ice Class Anchor Handling Tug Supply (AHTS)	274	59	20
Aiviq	Anchor Handling (AH) Offshore Support Vessel	361	80	24
TBN	AH Supply Vessel	~250	~50 - 60	~18
Nanuq	Offshore Supply Vessel (OSV) /Oil Spill Response (OSR)	301	60	21
TBN	OSV	240 - 300	54 - 64	15 - 20
TBN	OSV	240 - 300	54 - 64	15 - 20
Sisuaq	OSV	300	64	20
Science Vessel	OSV	240 - 300	54 - 64	15 - 20
Arctic Endeavor	OSR Barge	205	90	15
Point Oliktok	Endeavor Tug	90	32	9
Guardsman	OSR Tug	126	34	20
Klamath	OSR Barge	350	76	22
TBN	Tug	146	46	25
TBN	Deck Barge	400	99	19
Arctic Challenger	Barge / Containment System	na	na	na
Corbin Foss	Tug	150	40	20
Tuuq	Ware Barge	400	99	19
Lauren Foss	Tug	150	40	19
TBN	Tanker (Fuel & OSR)	853	112	45
TBN	Landing OSR	134	32	7
Noble Discoverer	Mobile Offshore Drilling Unit	514	85	27

Polar Pioneer	Mobile Offshore Drilling Unit	279	233	30
TBN	Polar Pioneer Tugs (2)	146	46	21
TBN	Landing Craft			
TBN	Tug			
TBN	Tug			
TBN	Barge			

Note: Vessels highlighted in yellow (or similar) called at Nome in 2012. Vessels highlighted in blue will be staged in Dutch Harbor as part of emergency response preparedness, according to Shell's Integrated Operations Plan for the Chukchi Sea.

Source: 2014 Integrated Operations Plan for the Chukchi Sea. Shell. November 2013.

For the purposes of comparison, Table 3 shows the vessels which StatOil indicated that they would use for an Alaskan Arctic offshore drilling campaign. An important note is that StatOil is earlier in the planning phases than Shell, which may explain the difference in the expected fleets and need for vessels in the area at this time.

Table 3. Assumed vessels for StatOil's offshore operations

Vessel type	Number needed	Length (ft)	Beam (ft)	Draft (ft)
Platform support vessels	2	289	62	21
Ice Alert vessel	1	381	85	41
Anchor handler	1	299	66	25
Oil spill response	4	230	49	11
Oil spill tanker	1	328	66	26
Smaller vessels (which could fit into Nome today)				
Boom boat	1			
Shallow draft landing craft	1			
Support tug	2			

This analysis assumes that the fleet proposed by Shell for their 2014 Chukchi operations[29] is the representative fleet per offshore oil and gas company. This fleet is based on published data from Shell's Integrated Operations Plan and Exploration Plan. The basis for this assumption is that Shell is the only company that has actually drilled in the Arctic in recent years, and is the farthest along in their operational planning. Vessels from Shell's 2012 fleet will be used as representative where other data is lacking. Vessels which called upon Nome in 2012 are already included in the base case HarborSym modeling at Nome, since base case models are based on 2012 traffic only.

[29] Shell's plans to drill in 2014 were put on hold when a US 9th Circuit Court of Appeals judge ruled in April 2014 that BOEM must redo the Chukchi Sea EIS. However, Shell has reported that they are still preserving their options to drill for the 2015 season. The Integrated Operations Plan and Exploration Plan for the 2014 season are the most up-to-date information available regarding possible offshore activities and are believed to be representative.

Future HarborSym modeling scenarios including additional oil and gas vessels will consider these vessels in the existing call lists and will avoid double counting.

Based on these assumptions, the baseline fleet for exploration activities is 18 vessels per oil and gas company (considering tug and barge combinations as one vessel rather than two).

The uncertainty associated with this assumption is that Shell has not yet employed the fleet proposed in their 2014 plan, so no information is available on exactly which vessels would be used. Lack of information on the exact vessels means that many generalizing assumptions will be needed to model this fleet in HarborSym including: vessel dimensions, capacities, underkeel clearances, speeds, and operating costs.

In addition, neither ConocoPhillips nor StatOil have submitted public exploration plans to BOEM, so no documentation is available on their expected vessel operations. As previously stated, Shell's lease purchase and area is larger than ConocoPhillips and StatOil. So there is risk in the assumption that the scale of exploration activities by the other two companies will equal that of Shell's. However, Shell's operations could be much larger than currently envisioned in this analysis due to the greater footprint for this company. In support of this assumption, information gathered by Tetra Tech and the Alaska District through interviews found that oil companies referred to Shell's 2012 operations as "typical". One representative of an oil company other than Shell specifically stated that information presented by Shell should be utilized as representative of the operations of the other companies.

g. Supply Vessels

Supply vessels in particular are expected to benefit from deep draft navigation improvements at Nome (additional detail about these expected benefits will be presented in subsequent sections). This analysis again looks to the fleet of vessels used by Shell in 2012 and documents for the 2014 fleet as a baseline. In 2012, Shell utilized the vessels Harvey Explorer and Harvey Spirit as supply vessels. These vessels were 240 and 280-feet long, respectively, with design drafts of 15.5 and 16.5 feet. Data on sailing drafts or underkeel clearances during the 2012 season is unavailable at this time.

Interviews with Shell and information in their published exploration plan for the Chukchi Sea suggest that the company intends to use larger supply vessels for future seasons.[30] This analysis assumes that the published exploration plan for 2014 serves as adequate documentation of the shift toward larger vessels. Shell's 2014 exploration plans indicate that there are essentially five vessels which will be filled using offshore supply vessels: one offshore supply vessel used for oil spill response, one used as a science vessel, and three used for in-season re-supply trips. Of those five vessels, only two are specifically named: Nanuq (oil spill response vessel, 301 feet long x 60 feet wide x 21 foot design draft) and Sisuaq (re-supply vessel, 300 feet long x 64 feet wide x 20 foot draft). The other three vessels are listed as "to be named" or TBN in Shell's plans. Two of TBN vessels are expected to make frequent re-supply trips and are of particular interest to this

[30] Shell's Revised Outer Continental Shelf Lease Exploration Plan for the Chukchi Sea states that Shell expected to rely upon 3 supply vessels for the 2014 season and stated that these vessels would make no more than 24 total trips between the drilling grounds and Dutch Harbor for resupply.

anlaysis. The other TBN vessel is expected to stay with the drill rig and will utilize port facilities during pre- and post-season mob and demob.

In order to estimate the future vessel fleet, this analysis assumes that one of the TBN vessels will have similar characteristics as the Sisuaq and the other will have similar characteristics of the Harvey Spirit. This is a generalizing assumption which is made based on a combination of data from Shell's 2012 operations and their plans for the future.

This fleet of supply vessels will be used as representative for each oil and gas companies, so a total of nine supply vessels will make re-supply trips in a scenario which includes three oil companies.

Based on limited information available regarding future production operations, this analysis assumes that the same type of supply vessels utilized for exploration activities will also support production activities. This means that for the year 2030 modeling, the fleet of supply vessels will increase to 18.

3. **Vessel and Cargo Operations (Existing and Future Without Project Conditions)**

In general, for the following sections, existing conditions/baseline information is based on Shell's 2012 season operations, supplemented by 2014 plans, as appropriate. The future without project condition is based upon assuming existing condition operations are representative for all three companies.

a. **Vessel Fleet Movements**

Existing Condition: According to Tetra Tech's report, Shell was unable to use port facilities in Alaska to prepare their vessels and equipment for the Arctic, due to limited port capacity. The volume of laborers, crew, and ships that needed to be serviced required that Shell use multiple ports along the Pacific Northwest, including Portland, Tacoma, Seattle, Everett, and Bellingham.[31] Following preparation of the fleet and some training exercises in Washington, some of the fleet mobilized to Valdez, Alaska for another month of final preparations and training drills. The fleet then mobilized to Dutch Harbor, Alaska, which is currently the closest deep draft port to the drill sites. [32] At this time, there is not specific data available regarding any cargo or fuel transfers which may have occurred at Dutch Harbor. Interviews with the Harbormaster at the OSI dock in Dutch Harbor reveal that there was sufficient laydown area and depth at the dock for the oil and gas vessels which by company rules require 6 feet of underkeel clearance and a minimum of 4-acres of uplands to conduct their pre-season operations.

From Dutch Harbor, the fleet moved to the Nome and Port Clarence region, where some minimal resupply or crew changes may have taken place at Nome. The natural harbor at Port Clarence

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[31] Review of Shell's 2012 Alaska Offshore Oil and Gas Exploration Program. US Department of the Interior, Report to the Secretary of the Interior. March 8, 2013.

[32] Ibid

was used as a final regroup and staging location before moving through the Bering Strait to the drill sites in the Beaufort and Chukchi Seas as the ice cleared.

Most of the vessels remained at the drill sites for the duration of the season, with only a few vessels making supply runs as far as Dutch Harbor if needed. Without an Arctic deep draft port and related facilities, Shell's 2012 strategy was to make resupply runs to Dutch Harbor during the drilling season to pick up supplies which had been dropped off via scheduled barge service. At the end of the season, the entire fleet moved to Dutch Harbor, performed some demobilization activities, and then moved nearly all assets south to Washington.[33]

Future Without Project Condition: This analysis assumes that all three oil and gas companies will mobilize their fleet from the Pacific Northwest with Dutch Harbor used as an in-season resupply port. Interviews with oil industry representatives confirmed that in the future without a deep draft Arctic port, the OO&G industry is most likely to continue to stage operations out of the Pacific Northwest and Dutch Harbor.

b. Supply Vessels and Re-Supply Operations

Existing Condition: According to data from Shell regarding their 2012 season, most of the vessel fleet remained at the Chukchi Sea drilling sites for the duration of the season, with supply vessels making supply runs to Dutch Harbor, as needed.[34] At this time, data is unavailable about the number of supply vessel trips made between the Chukchi and Dutch Harbor in 2012 or about the exact amounts and types of cargo aboard each supply vessel. Shell reports moving 25,000 tons of cargo at sea for their 2012 campaign. Between mobilization, operations, and demobilization, Shell reported having 23 vessels travel 240,000 total nautical miles.

Documents submitted by Shell for the 2014 drilling season stated that they again planned to utilize Dutch Harbor as a re-supply location.[35]

Future Without Project Condition: This analysis assumes that Dutch Harbor will be utilized as the in-season location for cargo staging and vessel re-supply trips.

c. Supply Vessel Cargo Movements

Existing Condition: The supply vessel runs during the drilling season between Dutch Harbor and the Chukchi Sea drilling grounds serve primarily for transporting cargo. Shell's 2012 operations and their 2014 Integrated Operations Plan show that the company plans to continue relying upon air support for transporting personnel for crew changes. Shell plans to transport workers from Anchorage to Barrow via commercial flights then onto the drill rig via helicopter by way of Wainwright.

[33] Ibid
[34] Ibid
[35] Revised Outer Continental Shelf Lease Exploration Plan, Chukchi Sea, Alaska, Revision 2. Shell Gulf of Mexico, Inc., submitted to US Department of the Interior, Bureau of Ocean Energy Management. November 2013. (pg. 13-4).

According to the revised exploration plan submitted for the 2014 season, Shell planned to utilize three offshore supply vessels to make periodic trips to Dutch Harbor for resupply. According to the document, these vessels will make up to 30 round trips (total for all three vessels) for resupply between the drillship and Dutch Harbor.[36] Due to a lack of data on cargo transfers, this analysis assumes that these three supply vessels can carry the amount of cargo needed to support a drilling campaign with materials staged in Dutch Harbor. This analysis assumes that three supply vessels are needed to support each exploration and production campaign. So as a company shifts to production at one site and exploration at a new site, three new supply vessels will be added to the fleet. This is a conservative estimate as exploration activity could be taking place at more than one location at a time.

Items expected to be carried aboard supply vessel resupply trips include casing and drill pipe, fuel and fuel tanks, potable water, drilling water, drilling mud, drilling brine, chemicals, and dry bulk goods. As previously stated, data is unavailable at this time on the amounts and types of cargo carried during the 2012 season. The 2012 season was abbreviated due to issues with Shell's vessels, so the amount of cargo moved during this season could be considered low.

Shell reported that in 2012, they utilized scheduled barge service to transport materials from the Pacific Northwest to Dutch Harbor. Materials were then picked up in Dutch Harbor by supply vessels and transported to the drilling grounds. This analysis assumes this same type of supply chain will be used for future seasons.

Information is unavailable at this time regarding the shoreside facilities needed to facilitate cargo transfers and staging activities. Shell reports that each company needs 4 acres of laydown area for staging their supplies. The Dutch Harbor harbormaster reported that there was adequate space available for future exploration activities, including the ability to serve all three companies.

A small portion of the total cargo report by Shell may also include perishable food items for crew members. Representatives from Shell and Crowley Maritime (which was contracted to Shell for the 2012 season for operational support) estimated that the amount of perishable foods needed to support a drilling rig is equal to approximately five pounds per person, per day. Shell reported having 667 personnel offshore. Assuming a drilling season ranging from 120 to 240 days, the total amount of perishable foods ranges from 400,200 pounds to 800,400 pounds. Therefore, total perishable goods for the season represented only approximately 0.8 to 1.6 percent of total cargo transported by sea.

Oil industry representatives stated that the barge trip from Seattle to Dutch Harbor followed by a supply vessel trip from Dutch Harbor to the Chukchi was too far to ensure fresh produce. Therefore, perishable goods were shipped by air to Dutch Harbor, for loading on a supply vessel. Or, goods were air freighted to Barrow and then on to the drill rigs. Altering the staging location for supply vessels may change the transportation mode for these perishable goods and represent a transportation cost savings.

Future Without Project Condition: Supply vessels will conduct cargo transfers from Dutch Harbor. Per Shell's exploration plan, a total of 30 supply vessel round-trips will be needed per

[36] Ibid

season to transport this cargo. Generalizing assumptions will be made regarding the types and amounts of cargo moved per vessel trip.

The same supply chain as the existing condition will be used, meaning that cargo will first be transported from the Pacific Northwest via barge. The lack of data about total cargo movements means that generalizing assumptions will be made related to this barge traffic.

Risk/Uncertainty: Tetra Tech's analysis found that an alternate scenario to relying upon supply vessel runs to Dutch Harbor during the drilling season is to use wear barges instead. By using wear barges, companies might be able to avoid Dutch Harbor all together by staging additional supply on large supply and drill-waste barges rather than in Dutch Harbor. Floating all supplies and materials necessary for a drilling season up to the drill site aboard wear barges at the beginning of a drilling season may require more travel costs up front. But, wear barges remove the need for long supply runs that might delay operations if the supply runs are late returning to the drill site due to inclement weather or vessel breakdown.

4. **Future With Project Condition**

The future with project condition in this document refers, in general, to deep draft navigation improvements at Nome. Specifically for this phase of analysis, the current alternative under consideration at Nome includes an extension of the causeway including a new 450-foot dock at a depth of 35 feet. (The actual depth will be optimized based on vessel needs. Ice-breaking vessels are reported to need the 35-foot depth.)

a. Port Location Preference

All three of the oil companies with major Alaska offshore leases were contacted during the course of this study and provided varying levels of feedback. All stated that a deep draft Arctic port closer to the drilling grounds could improve their logistical operations – and therefore introduce efficiencies which could reduce transportation costs.

Many publications related to Arctic OCS drilling cite the many challenges associated with Arctic operations, not the least of which is lack of infrastructure. The Department of the Interior's Review of Shell's 2012 Offshore Oil and Gas Exploration program report cites that sparse Arctic infrastructure and geographical and logistical challenges associated with bringing equipment and resources to the region pose risks to safe and responsible operations in the Arctic. Providing additional infrastructure through a deep draft port closer to the drilling grounds would mitigate some of these logistical challenges and risks and introduce transportation efficiencies and safer operations for oil and gas companies and the environment and the people who live there.

At this time, the oil companies are not willing to commit to one site in Alaska for deep draft port preference or for a base for their operations. This analysis assumes that in the absence of another deep draft Arctic port, oil companies, as profit-driven entities, will use Nome in the future with project condition provided that Nome can meet their operational requirements of dock space, depth, and associated uplands.

Interviews with O&G companies found that Shell did not use Nome as their primary staging and re-supply location for their 2012 operations because the existing depth at Nome would not accommodate many of their vessels, the existing overcrowding at Nome, and the lack of dock space at Nome. A generalizing assumption for this analysis is that the depth and additional dock space provided in the future with project condition would provide incentive for oil and gas companies to use Nome.

Risks: In June 2014, Northern Economics published a report on behalf of the Bering Straits Native Corporation and Crowley Maritime Corporation examining the feasibility of a support base at Port Clarence.[37] The report found that development of a support base in Port Clarence may be feasible in a scenario where oil and gas production activities are occurring in the Chukchi. The report is highly speculative about future activities and does not recommend construction or indicate that construction of a port and support base is likely in the near future. The report does present that other entities are considering construction of a port to serve the oil and gas industry. However, this analysis does not have sufficient information about other port construction to form the basis for the most likely future without project condition.

Oil and gas companies are unable to provide firm commitment to using one site as an operational base. Interviews with oil and gas company representatives found that companies are not willing to commit to one specific site over another due to the risk of damaging relationships with other communities. Data gathered by Tetra Tech in their report to USACE generally reached the same conclusion: a hesitation to endorse Nome or Port Clarence specifically.

5. **Vessel and Cargo Operations (Future With Project Condition)**

a. Vessel Fleet Movements

Future with project condition vessel movements for pre- and post-season mobilization and demobilization will essentially be the same as the without-project condition, with the addition of a stop in Nome. Vessels will begin the season in the Pacific Northwest, move north to Dutch Harbor for some interim staging, then move north to Nome for continued staging activities, and finally move to the Chukchi where most vessels will remain for the entire drilling season.

The exact “staging” activities conducted in Dutch Harbor in the existing and future without project condition are unknown at this time. In conjunction with information gathered during interviews with oil and gas company representatives, this analysis assumes that there are efficiencies for the vessel fleet in conducting some of this staging at Nome rather than Dutch Harbor. The primary efficiency for the fleet is allowing them to move northward more quickly and be pre-staged as the ice recedes in the Chukchi.

Since little is known about specific vessel calls and commodity transfers associated with this pre- and post-season staging, significant generalizing assumptions will be made for modeling in HarborSym.

[37] Port Clarence is a bay located approximately 60 nautical miles northwest of Nome, Alaska and serves as a natural safe harbor location.

b. Supply Vessels and Re-Supply Operations

Interviews with oil and gas companies by the Alaska District and Tetra Tech as part of this study found that there are operational efficiencies which could be gained for supply vessels through utilizing a staging location closer to the drilling grounds. This analysis assumes that in-season re-supply trips will be conducted between the Chukchi Sea and Nome in the future with project condition. Supply vessels will be able to utilize Nome as a re-supply location in the with project condition given the increased dock space and increased depth.

c. Supply Vessel Cargo Movements

The same assumptions regarding the amount of cargo transferred will be used from the without project condition – the only change will be the interim staging location at Nome. Utilizing the same assumptions, supply vessels will make 30 trips between the Chukchi and Nome during the drilling season. Per input from oil and gas company representatives, cargo transfers from a re-supply base closer to the Chukchi could be supported by two supply vessels. So this analysis assumes that the supply vessel fleet will be equal to two per company, or six total for 2020, transitioning to 12 in 2030 once production activities begin.

The same supply chain as the future without project condition will be used, meaning that cargo will first be transported from the Pacific Northwest via barge to Nome (as compared to Dutch Harbor in the without project condition).

The City of Nome is developing additional upland area, so there will be adequate space to accommodate the laydown area needed for three oil and gas companies (4 acres per company or 12 acres total). At this time information is unavailable regarding shoreside equipment needed to transfer cargo. However, under current conditions, cargo offloading equipment is not provided by the Port of Nome, and each company is responsible for providing their own. The Port of Nome has no plans to change this arrangement, so each oil company will be expected to provide transfer equipment.

In the simplest terms, this analysis assumes that the same amount of cargo will have to be transported the same distance in support of an oil and gas drilling season. Based on current data available, the expected benefits will be derived from a change in the staging location of this cargo and a shift in the mode of cargo transport: barging from Dutch Harbor to Nome. Significant assumptions will be necessary to quantify these vessel movements.

ATTACHMENT 4 – REGIONAL ECONOMIC DEVELOPMENT EVALUATION

Alaska Deep Draft Arctic Port System Feasibility Study

A Subset of the Alaska Regional Ports Study

Regional Economic Development (RED) Evaluation

This is an attachment to the Economics Appendix B

January 2015

U.S. Army Corps of Engineers

Alaska District

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Introduction

The regional economic development (RED) account is distinct from the national economic development (NED) account in that it determines the potential impacts to the local or regional economic area, rather than the nation as a whole. Local residents and community leaders request information regarding the potential impacts to the region associated with the construction and/or maintenance of a project.

The Corps of Engineers project evaluation methods provide a structured analysis framework that is focused on the benefits to the nation resulting from the project. The Corps federal interest is based on costs and benefits evaluated under NED guidelines. Recent Corps guidance, however, reiterates the need to assess Regional Economic Development (RED) and Other Social Effects (OSE) as well (EC 1105-2-409).

While the NED account is appropriate for the primary Corps of Engineers project evaluation, the local sponsor often has a more focused concern. The Alaska Deep Draft Arctic Port System Feasibility Study presents a tentatively selected plan that involves project construction and maintenance in the City of Nome. As such, the city needs to assess whether or not the proposed project will be a financial asset for the community. The important questions for the local government sponsor often include:

- Will the project add diversification and stability to employment in the region?
- Will annual revenues cover the annual operations costs for the facility? If not, what will the financial burden be on the city?
- Are there other benefits to the project that would induce the city to take on the financial responsibility in spite of potential losses?

This RED analysis seeks to addresses some of these inquiries.

Regional Economic Development (RED) Methods

RED impacts are often identified and quantified as transfers of economic activity within a geographic region or between regions within the nation, as opposed to NED effects which measure the increase in net value of the national output of goods and services.

Input-Output analysis is at the heart of RED analysis. It measures the interdependence among industries in the regional economy. The matrices and mathematics can be daunting at times, but many customized software programs can assist in computing the regional impacts as a result of a Federal project.

The Regional ECONomic System (RECONS) model is a regional economic impact modeling tool developed by the U.S. Army Corps of Engineers, which in part, provides accurate and defensible estimates of regional economic impacts associated with Corps expenditures. This tool automates calculations and generates estimates of jobs and other economic measures such as income and sales.

RECONS has been certified for use with Corps projects.[1] The RECONS model uses the University of Minnesota IMPLAN database for the sectors and associated spending. The results of modeling expenditures on Corps projects is often useful to local decision-makers in determining the outcome of moving forward with any given project - as it outlines the potential for changes to employment, income, and gross regional product.

There are three main spending categories captured in the RECONS model:

1. **Direct Effects** – represents that proportion of the spending or sales in each industry that flows to material and service providers in the impact area. These are jobs, labor income, and gross regional product associated with the directly affected industry.
2. **Indirect Effects** – represents that proportion of the spending that flows to the support industries. These would be architectural and engineering firms, lumber suppliers, truckers, steel manufacturers, among others. These are considered backward linked industries supporting the construction activity.
3. **Induced Effects** – represents the household expenditures or consumer spending associated with the direct and indirect workers spending their earnings.

Study Area

The Northern Region of Alaska is one of six economic regions as described by the Alaska Department of Labor and Workforce Development. It includes the Nome Census Area, the Northwest Arctic Borough, and the North Slope Borough, as displayed in Figure 1. This region forms the basis of the potential workforce that would be called upon for projects in the study area. For the most part, this RED discussion will focus on the Nome Census Area as the region with the direct impact implications.

Nome plays a key role in the regional economy of Northwest Alaska serving as a strategic hub port for marine transportation of cargo, fuel, gravel, equipment and construction materials. Nome serves about 50 communities along Western and Northern Alaska's coast.[2] Nome is also the nearest community to the Chukchi Sea offshore oil and gas leases offering port facilities, restaurants, hotels, services, and a jet runway for movements of people and cargo.

[1] The RECONS model was certified for use on August 14, 2012. http://www.iwr.usace.army.mil/Media/NewsStories/tabid/11418/Article/480966/iwrs-recons-economic-tool-becomes-certified-model.aspx

[2] The villages that are served through Nome are Ambler, Barrow, Wainwright, Point Lay, Point Hope, Kivilina, Noatak, Kotzebue, Noorvik, Kiana, Selawik, Deering, Buckland, Shishmaref, Little Diomede, Wales, Tin city, Brevig Mission, Gambell, Savoonga, Teller, White Mountain, Golovin, Elim, Koyuk, Shaktoolik, Unalakleet, Shungnak, Stebbins, St. Michael, Kotlik, Emmonak, Alakanuk, Nunam Iqua, Mountain Village, St. Marys, Pilot Station, Marshall, Russian Mission, Scammon Bay, Hooper Bay, Chevak, Tununak, Mekoryuk, Toksook Bay, Nightmute, Chefornak, Kipnuk, Kwigillingok, Kongiganak, Quinhagak, Newtok, Mertarvik, Goodnews Bay, and Platinum. From the Port of Nome Strategic Development Plan – 2013.

Figure 1. Economic Regions Area map

Population

The previous discussion focused on the communities nearest to the project site. (See attachment 1 for a history of the region.) Nome however, is a hub community serving much more than just the immediate city. The following demographic information provides relevant characteristics to the local economy and widens the focus to the Nome Census Area.

Nome Census Area

Workers in Alaska tend to be mobile, so for this analysis, we have expanded the regional component of the workers and wages to the Nome Census Area (See Figure 2) to more accurately capture the potential workforce and the impacts to the region.

Figure 2. Nome Census Area map

Source: Alaska Department of Labor and Workforce Development, US Census 2010 TIGERline

Northern Region Population

The City of Nome has a relatively stable population with a growth rate of less than 1 percent per year over the last 10 years. The City of Nome represents about 39 percent of the total population of the Nome Census Area. The Nome Census Area contains just less than 40 percent of the total Northern Region[3] population. Workers for the expanded port at Nome are expected to be drawn primarily from the Nome Census Area but the balance of the Northern Region will also form part of this pool of workers.

[3] The Northern Region includes the North Slope Borough, the Northwest Arctic Borough, and the Nome Census Area.

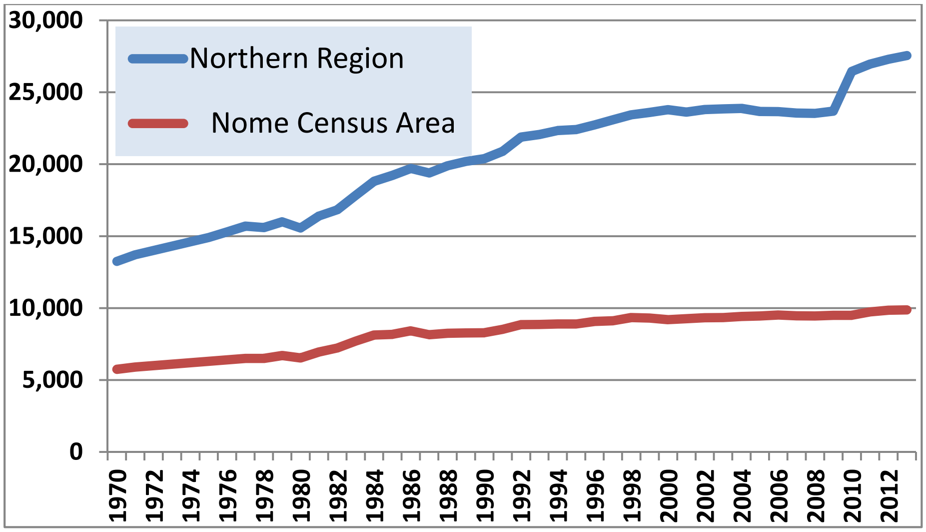

Figure 3. Northern Region Population

Source: State of Alaska Department of Labor and Workforce Development – Demographics Section.

Wage Employment

In 2013, the Alaska Department of Labor and Workforce Development reported 355 employers in the Nome Census Area with an employment level of approximately 3,877 (see Table 1). Government employers make up 38 percent of the region while government workers make up 44 percent of the total workforce. Local government employment includes schools and road crews and makes up about 82 percent of the total government employment. Governments would normally be a support sector or secondary to other industries in the area. However, in Alaska, many of the work-for-wages opportunities are through the government sector which forms the primary source of employment for the community. Most of the private sector employment opportunities in the Nome Census Area are in the Service Providing sector.

Many Alaska communities have marked seasonal fluctuations in work-for-wages jobs. The Nome Census Area however, demonstrates relatively stable year-round employment with a maximum number of workers in September of 4,119 and a low monthly employment of 3,644 in July of 2013.

Table 1. Nome Census Area Employment and Wages, 2013

Industry/Sector	Number of employers	Average Annual Employment	Total Wages	Average Monthly Wages
TOTAL INDUSTRIES	355	3,877	$173,172,397	$3,722
TOTAL GOVERNMENT	134	1,702	$72,858,285	$3,567
FEDERAL GOVERNMENT	23	57	$2,925,578	$4,277
STATE GOVERNMENT	46	242	$16,783,235	$5,779
LOCAL GOVERNMENT	65	1,403	$53,149,472	$3,157
PRIVATE OWNERSHIP	221	2,174	$100,314,112	$3,845
GOODS-PRODUCING	24	204	$14,112,588	$5,765
NATURAL RESOURCES AND MINING	8	0	$0	$0
CONSTRUCTION	14	53	$4,578,473	$7,199
MANUFACTURING	2	0	$0	$0
SERVICE-PROVIDING	197	1,971	$86,201,524	$3,645
TRADE, TRANSPORTATION AND UTILITIES	49	555	$20,608,924	$3,094
Retail Trade	37	328	$9,687,732	$2,461
Transportation and Warehousing	7	200	$10,288,242	$4,287
Utilities	5	27	$632,950	$1,954
INFORMATION	4	39	$1,384,765	$2,959
FINANCIAL ACTIVITIES	12	89	$4,630,606	$4,336
Finance and Insurance	4	17	$1,162,303	$5,698
Real Estate, Rental and Leasing	8	71	$3,468,303	$4,071
PROFESSIONAL AND BUSINESS SERVICES	30	150	$5,506,050	$3,059
Professional, Scientific, Tech.	11	18	$798,460	$3,697
Mgmt. of Companies & Enterprises	9	103	$3,398,674	$2,750
Administrative and Waste Services	10	29	$1,308,916	$3,761
EDUCATIONAL AND HEALTH SERVICES	26	0	$0	$0
Health Care and Social Assistance	26	0	$0	$0
LEISURE AND HOSPITALITY	29	215	$3,661,405	$1,419
Arts, Entertainment and Recreation	12	69	$537,646	$649
Accommodation and Food Services	17	146	$3,123,759	$1,783
OTHER SERVICES	44	308	$12,941,953	$3,502
UNCLASSIFIED ESTABLISHMENTS	3	0	$0	$0

Source: Alaska Department of Labor and Workforce Development, Current Quarterly Census of Employment and Wages, http://labor.alaska.gov/research/qcew/qcew.htm . This table includes workers reported to the U.S. Dept of Labor who are subject to state and federal unemployment laws. This table does not include self-employed individuals, fishers, unpaid family help, domestic laborers, and most individuals engaged in agriculture.

Self-Employed

According to the American Community Survey Data (ACS), in addition to work for wages, there are 233 self-employed persons in the Nome Census Area.[4] There are another 139 self-employed individuals who also worked for wages.

Non-Wage Employment

The ACS also shows a small number of unpaid household workers. All of the communities in the Nome Census Area are remote. The communities are not connected by road or rail to other communities (the seasonal road between Nome and Teller being the one exception). Many residents practice a subsistence way of life hunting and gathering foods being their primary occupation. Subsistence is a communal practice and sharing of the harvest is regarded highly. These occupations do not garner wages and are therefore unreported.

Transfer Payments

Other forms of income for the Nome Census Area include interest/dividends, Social Security Income, public assistance, retirement, and of course, the Alaska Permanent Fund Dividend (other income) as shown in Table 2.

Table 2. Other Income for Nome Census Area

Transfer payments	
Universe: Households	
Total:	2,772
With interest, dividends, or net rental income	1,278
With Social Security income	584
With Supplemental Security Income (SSI)	153
With public assistance income	290
With cash public assistance or Food Stamps/SNAP	865
With retirement income	431
With other types of income	2,520

Source: American Community Survey

Poverty Status

More than 26 percent of the total households in the Nome Census Area are below the poverty level as defined by the U.S. Census Bureau (2,466 households out of 9,318 total). This percentage exemplifies the non-wage subsistence way of life enjoyed by many Alaska residents in remote communities.

[4] The American Community Survey (ACS) is a part of the U.S. Census Bureau's Decennial Census Program and is designed to provide more current demographic, social, economic, and housing estimates throughout the decade. The ACS provides information on more than 40 topics, including education, language ability, the foreign-born, marital status, migration and many more. Each year the survey randomly samples around 3.5 million addresses and produces statistics that cover 1-year, 3-year, and 5-year periods for geographic areas in the United States and Puerto Rico. For more information about the ACS, visit: www.census.gov/acs.

Local Businesses

As of 2013, there are 329 active business licenses in Nome, 8 in Teller, and 5 in Brevig Mission.[5] Businesses by industry type are listed below for the communities of Nome, Teller, and Brevig Mission. Nome is the only community with Construction and Manufacturing employers. However, skilled labor may be found in the nearby communities of Teller and Brevig Mission.

Nome

The businesses in Nome are varied and include several restaurants, hotels and bed and breakfasts, grocery stores, medical facilities, marine supply, mining supply, automotive supply, local and regional native governmental entities. Table 3 presents the number of workers by industry for Nome in 2012.

Table 3. Workers by Industry for Nome, Alaska (2012)

Industry	Number of workers	Percent of total employed
Natural Resources and Mining	32	1.8
Construction	122	6.8
Manufacturing	54	3.0
Trade, Transportation and Utilities	351	19.5
Information	21	1.2
Financial Activities	66	3.7
Professional and Business Services	45	2.5
Educational and Health Services	402	22.3
Leisure and Hospitality	101	5.6
State Government	208	11.5
Local Government	235	13.0
Other	166	9.2
Total	1803	

Source: State of Alaska Department of Labor and Workforce Development, Research and Analysis Section, Alaska Local and Regional Information, Nome city.

Teller

The majority of businesses in Teller are child day care services. There are also two stores in the community. Table 4 lists the 2013 business licenses in Teller by their primary line of business as reported to the State of Alaska.

[5] 2010 US Census

Table 4. Teller Business License by Line of Business (2013)

Line of Business (Primary NAICS)	Number of Business Licenses
Child Day Care Services	4
General Line Grocery Merchant Wholesalers	1
Independent Artists, Writers, and Performers	1
Petroleum Bulk Stations and Terminals	1
Supermarkets and Other Grocery (Except Convenience) Stores	1

Source: State of Alaska, Department of Commerce, Community and Economic Development

Brevig Mission

Two of the five current business licenses in Brevig Mission are for tax preparation services. Two others are for stores. Table 5 lists the 2013 business licenses in Brevig Mission by their primary line of business as reported to the State of Alaska.

Table 5. Brevig Mission Business Licenses by Line of Business (2013)

Line of Business (Primary NAICS)	Number of Business Licenses
General Line Grocery Merchant Wholesalers	1
Other Support Activities for Air Transportation	1
Supermarkets and Other Grocery (Except Convenience) Stores	1
Tax Preparation Services	2

Source: State of Alaska, Department of Commerce, Community and Economic Development

Municipal Government

All of the communities located in the geographic region under consideration are located in the Nome Census Area. This entire region is in the unorganized borough[6] of the State of Alaska. Boroughs and cities with the State of Alaska may choose to levy property tax. The City of Nome is the only one of the three cities evaluated in this report to levy a property tax. The following sections provide a brief description of the taxing authority for each of the cities evaluated and their revenues from 2012 taxes.

Nome

Nome is a first class city in the Nome Census Area. The City of Nome levies property taxes, a 5 percent sales tax, and a 6 percent bed tax. Tax revenues to the City of Nome from these three sources were $7.7 million in 2012.[7]

Teller

Teller is a second class city in the Nome Census Area. Teller has a 3 percent sales tax, and no property or other taxes. Sales tax revenue to the City of Teller was $38,847 in 2012.[8]

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[6] Boroughs are similar to counties.

[7] http://commerce.alaska.gov/DNN/Portals/4/Repository/Taxable/2012-Full.pdf

Brevig Mission

Brevig Mission is a second class city in the Nome Census Area. Brevig Mission has a 3 percent sales tax, and no property or other taxes. Sales tax revenues to Brevig Mission were $42,017 in 2012.[9]

Port of Nome Revenues

Table 6 shows the historical revenues to the City of Nome from the Port. Revenues from cargo and gravel have been combined and revenues from Petroleum products are shown separately. The last column in the table shows the historical revenues in 2013 dollars. While there are some year-to-year variations, the overall trend has been increased activity at the port.

Table 6. Port of Nome Historical Revenues

Year	From Cargo/Gravel	From Petroleum	Nominal Total	Nominal Total Adjusted to FY2013 dollars
1996	$ 131,492	$ 292,827	$ 424,319	$ 631,516
1997	$ 148,674	$ 262,956	$ 411,630	$ 603,745
1998	$ 201,855	$ 328,716	$ 530,571	$ 767,075
1999	$ 232,476	$ 279,292	$ 511,768	$ 732,411
2000	$ 216,815	$ 304,073	$ 520,887	$ 733,112
2001	$ 164,807	$ 302,883	$ 467,690	$ 640,003
2002	$ 236,043	$ 374,797	$ 610,840	$ 820,042
2003	$ 322,716	$ 260,041	$ 582,758	$ 761,641
2004	$ 203,672	$ 269,525	$ 473,198	$ 602,869
2005	$ 247,604	$ 373,476	$ 621,080	$ 767,785
2006	$ 206,508	$ 300,013	$ 506,521	$ 606,742
2007	$ 288,332	$ 396,912	$ 685,244	$ 802,998
2008	$ 328,529	$ 448,748	$ 777,276	$ 871,142
2009	$ 388,807	$ 404,532	$ 793,338	$ 878,724
2010	$ 509,004	$ 302,304	$ 811,308	$ 882,971
2011	$ 403,560	$ 244,876	$ 648,436	$ 683,699
2012	$ 526,650	$ 421,940	$ 948,590	$ 978,373
2013	$ 412,501	$ 331,441	$ 743,942	$ 743,942

If we assume that the increased cargo, gravel, and petroleum commodity forecast is representative of the increases in revenue, then revenues from the Port of Nome to the City will approach $1.2 million by the year 2040. This is a simplistic assumption as the invoicing for customers using the Port of Nome is not that straightforward. The assumptions for the NED evaluation held the commodity forecast constant at 2040 and this projection mirrors those same assumptions, as displayed in Figure 4.

[8] Ibid.
[9] Ibid.

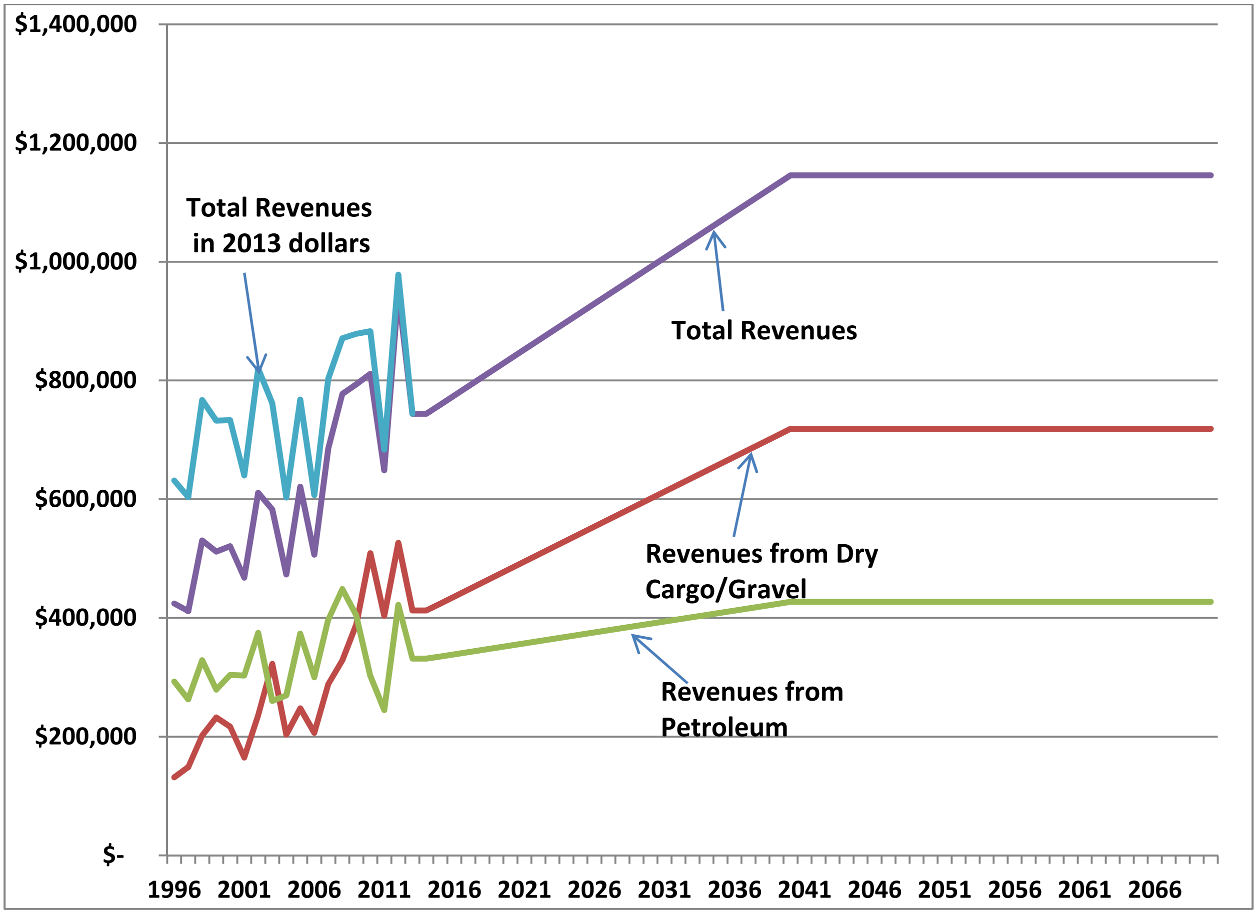

Figure 4. Expected Port of Nome Revenues

RECONS

The Regional Economic System (RECONS)[10] model was designed, in part, to measure the economic impact or contribution of direct expenditures by USACE on Civil Works projects. The model was initially developed to capture the employment and income impacts as a result of the American Recovery and Reinvestment Act (ARRA) of 2009. Model enhancement allows the Corps to evaluate the Regional Economic Development impacts on a variety of projects.

RECONS is a regional economic impact modeling tool that currently contains IMPLAN's 440 sectors, which are based on the U.S. Department of Commerce Bureau of Economic Analysis's latest Benchmark Input-Output Study (2002). The sector scheme is consistent with the 6-digit North American Industry Classification System (NAICS) code for manufacturing, although the service sectors, including the retail sectors, are more aggregated.

[10] For more information, visit the Corps Institute of Water Resources website at http://www.iwr.usace.army.mil/Missions/Economics/RegionalEconomicSystem(RECONS).aspx .

The following sections describe the employment and income potential at the local, state, and national level as a result of construction of an expanded harbor at Nome, periodic maintenance of the harbor, and increased throughput at the Port of Nome from the project. The timing of each of these activities is different so the analysis is displayed here as three separate activities.

Existing Employment and Earnings

The RECONS model shows existing employment in the Nome Census Area of 4,269 jobs.[11] This includes both work for wages employment and self-employed but does not count those engaged in subsistence activity (Table 7). This table provides a base from which to compare the construction impacts from the enhanced marine infrastructure at Port of Nome.

Table 7. Impact Region Profile (Nome Census Area)

Section	Output (millions)	Labor Income (millions)	GRP (millions)	Employment
Accommodations and Food Service	$11	$4	$6	187
Administrative and Waste Management Services	$4	$2	$2	32
Agriculture, Forestry, Fishing and Hunting	$1	$0	$0	32
Arts, Entertainment, and Recreation	$9	$1	$2	132
Construction	$21	$9	$10	135
Education	$42	$37	$42	782
Finance, Insurance, Real Estate, Rental and Leasing	$61	$10	$44	277
Government	$102	$56	$67	1,032
Health Care and Social Assistance	$57	$37	$41	593
Imputed Rents	$44	$4	$27	170
Information	$5	$1	$2	14
Management of Companies and Enterprises	$0	$0	$0	0
Manufacturing	$1	$0	$0	2
Mining	$73	$15	$44	117
Professional, Scientific, and Technical Services	$16	$4	$8	74
Retail Trade	$30	$10	$21	360
Transportation and Warehousing	$73	$17	$23	291
Utilities	$3	$1	$3	36
Wholesale Trade	$0	$0	$0	2
Total	**$552**	**$210**	**$342**	**4,269**

Note: Output, Labor Income, and Gross Regional Product all in millions of dollars. Rows and columns may not sum due to rounding.

[11] Employment shown in this table is greater than that shown in Table 1 because it includes self-employed individuals.

Construction Spending Patterns

Construction of the expanded harbor at Nome is expected to take place over 2 years.[12] The Tentatively Selected Plan is an extension of the existing causeway with a 450-foot caisson dock dredged to minus 28 feet at a total cost of $207,686,889 (October 2014 price level). $170,033,200 is construction of the breakwater, $29,620,340 is construction of the docks and associated utilities, and $8,033,380 is dredging to the desired depth. In the RECONS model, these are three separate activities (see Table 8).

Regional Impacts

Of the $103.8 million in Federal spending in the first year of construction, $54 million is captured within the local impact area resulting in total economic output within the region of $73.4 million. In the first year of construction, this project will retain or create 595 jobs in the directly affected industries, with an associated $28 million in labor income and $32.7 million in gross regional product. An additional 132.5 jobs are supported by indirect and induced economic activity in the first year of construction resulting in almost 728 total jobs within the impact area. This project will support total labor income of $33.5 million and gross regional product of $43.7 million.

Table 8. Regional Construction Impacts (represents one year of construction)

IMPLAN No.	Industry Sector	Sales	Jobs	Labor Income	GRP
	Direct Effects				
26	Mining and quarrying sand, gravel, clay, and ceramic and refractory minerals	$22,624,389	119.9	$13,545,306	$14,813,741
319	Wholesale trade businesses	$78,569	1.0	$17,140	$43,016
323	Retail Stores - Building material and garden supply	$94,451	1.0	$42,364	$63,983
324	Retail Stores - Food and beverage	$40,183	0.6	$19,899	$29,184
332	Transport by air	$32,415	0.1	$7,182	$13,991
334	Transport by water	$1,542,961	3.6	$203,514	$581,007
335	Transport by truck	$23,636,864	209.7	$7,830,934	$10,732,231
36	Construction of other new nonresidential structures	$679,701	3.8	$302,816	$355,859
39	Maintenance and repair construction of nonresidential structures	$135,436	0.8	$63,680	$79,609
413	Food services and drinking places	$44,184	0.7	$14,924	$24,211
5001	Labor	$5,983,460	254.1	$5,983,460	$5,983,460
	Total Direct Effects	$54,892,612	595.5	$28,031,215	$32,720,290
	Secondary Effects	$18,492,477	132.5	$5,420,118	$10,949,377
	Total Effects	**$73,385,089**	**727.9**	**$33,451,333**	**$43,669,667**

[12] Since the construction is presumed to take place over a 2-year period, all employment and income estimates are half of the total projections assuming that the construction spending is fairly even over time.

Statewide Impacts

Of the $103.8 million in Federal spending in the first year of construction, $80 million is captured within the state impact area resulting in total economic output within the state of $141.4 million. In the first year of construction, this project will retain or create 966 jobs in the directly affected industries, with an associated $44 million in labor income and $51.4 million in gross state product. An additional 380.5 jobs are indirect and induced economic activity in the first year of construction resulting in almost 1,347 total jobs supported within the state. This project will support total labor income of $64.5 million and gross state product of $87.5 million (gross state product is inclusive of the gross regional product depicted in Table 8

Table 9. Statewide Construction Impacts (represents one year of construction)

IMPLAN No.	Industry Sector	Sales	Jobs	Labor Income	GSP
	Direct Effects				
115	Petroleum refineries	$1,196,138	0.1	$35,728	$163,699
141	All other chemical product and preparation manufacturing	$25,274	0.1	$2,365	$3,428
171	Steel product manufacturing from purchased steel	$102,846	0.2	$34,927	$42,230
198	Valve and fittings other than plumbing manufacturing	$0	-	$0	$0
201	Fabricated pipe and pipe fitting manufacturing	$192,804	0.8	$40,384	$70,279
26	Mining and quarrying sand, gravel, clay, and ceramic and refractory minerals	$32,810,627	202.8	$19,643,845	$21,483,370
268	Switchgear and switchboard apparatus manufacturing	$0	-	$0	$0
290	Ship building and repairing	$873	0.0	$224	$269
319	Wholesale trade businesses	$763,861	10.0	$316,007	$576,613
322	Retail Stores - Electronics and appliances	$810	0.0	$350	$456
323	Retail Stores - Building material and garden supply	$121,723	1.3	$55,489	$82,979
324	Retail Stores - Food and beverage	$40,183	0.6	$19,899	$29,184
326	Retail Stores - Gasoline stations	$24,092	0.2	$9,931	$16,864
332	Transport by air	$32,415	0.1	$7,182	$13,991
333	Transport by rail	$36,943	0.2	$6,888	$11,381
334	Transport by water	$719,782	1.7	$48,791	$242,096
335	Transport by truck	$20,685,364	183.6	$6,444,675	$9,059,086
337	Transport by pipeline	$14,225	0.0	$5,544	$5,328

IMPLAN No.	Industry Sector	Sales	Jobs	Labor Income	GSP
36	Construction of other new nonresidential structures	$2,542,128	14.2	$1,149,863	$1,345,812
365	Commercial and industrial machinery and equipment rental and leasing	$3,435,822	8.3	$859,401	$1,978,961
375	Environmental and other technical consulting services	$426,722	3.9	$292,287	$293,374
386	Business support services	$729,443	17.8	$425,486	$421,084
39	Maintenance and repair construction of nonresidential structures	$497,699	2.9	$235,678	$293,845
413	Food services and drinking places	$44,184	0.7	$14,924	$24,211
417	Commercial and industrial machinery and equipment repair and maintenance	$2,421,585	14.0	$1,427,585	$1,798,367
439	* Employment and payroll only (federal govt, non-military)	$1,967,781	16.3	$1,789,252	$1,967,781
5001	Labor	$11,454,279	486.5	$11,454,279	$11,454,279
69	All other food manufacturing	$62,665	0.2	$5,401	$9,436
	Total Direct Effects	$80,350,262	966.4	$44,326,375	$51,388,396
	Secondary Effects	$61,036,054	380.5	$20,128,908	$36,119,838
	Total Effects	**$141,386,316**	**1,346.9**	**$64,455,283**	**$87,508,235**

Impacts to the Nation

Of the $103.8 million in Federal spending in the first year of construction, $100 million is captured within the national impact area resulting in total economic output within the nation of $276 million. In the first year of construction, this project will retain or create 1,262.5 jobs in the directly affected industries, with an associated $54.7 million in labor income and $63.6 million in gross national product. An additional 1,051 jobs are supported by this economic activity in the first year of construction resulting in almost 2,314 total jobs supported in the nation. This project will support total labor income of $111.8 million and gross national product of $162.5 million. See Table 10.

Table 10. Nationwide Construction Impacts (represents one year of construction)

IMPLAN No.	Industry Sector	Sales	Jobs	Labor Income	GNP
	Direct Effects				
115	Petroleum refineries	$1,281,053	0.2	$51,725	$234,504
141	All other chemical product and preparation manufacturing	$2,814,524	5.5	$473,257	$686,671
171	Steel product manufacturing from purchased steel	$707,659	1.5	$240,324	$290,570
198	Valve and fittings other than plumbing manufacturing	$286,777	0.9	$71,233	$138,261
201	Fabricated pipe and pipe fitting manufacturing	$608,209	2.4	$146,738	$255,443
26	Mining and quarrying sand, gravel, clay, and ceramic and refractory minerals	$35,416,745	224.0	$21,204,136	$23,189,773
268	Switchgear and switchboard apparatus manufacturing	$27,780	0.1	$6,579	$13,566
290	Ship building and repairing	$269,199	1.3	$91,493	$109,866
319	Wholesale trade businesses	$1,789,766	23.4	$767,409	$1,375,428
322	Retail Stores - Electronics and appliances	$1,414	0.0	$651	$852
323	Retail Stores - Building material and garden supply	$121,723	1.4	$55,489	$82,979
324	Retail Stores - Food and beverage	$40,183	0.6	$19,899	$29,184
326	Retail Stores - Gasoline stations	$24,290	0.3	$10,014	$17,003
332	Transport by air	$32,415	0.1	$7,182	$13,991
333	Transport by rail	$1,698,882	9.6	$542,358	$917,848
334	Transport by water	$719,782	1.7	$34,895	$212,041
335	Transport by truck	$23,010,650	204.2	$7,536,814	$10,377,242
337	Transport by pipeline	$14,635	0.0	$6,460	$6,214
36	Construction of other new nonresidential structures	$3,714,515	24.4	$1,683,074	$1,968,982
365	Commercial and industrial machinery and equipment rental and leasing	$4,279,439	13.8	$1,121,249	$2,464,866
375	Environmental and other technical consulting services	$675,997	6.2	$468,874	$470,627
386	Business support services	$977,163	23.8	$619,241	$612,813
39	Maintenance and repair construction of nonresidential structures	$607,044	4.4	$287,593	$358,509
413	Food services and drinking places	$44,184	0.7	$14,924	$24,211

IMPLAN No.	Industry Sector	Sales	Jobs	Labor Income	GNP
417	Commercial and industrial machinery and equipment repair and maintenance	$2,558,374	22.4	$1,571,115	$1,899,952
439	* Employment and payroll only (federal govt, non-military)	$1,969,753	16.3	$1,791,045	$1,969,753
5001	Labor	$15,829,172	672.3	$15,829,172	$15,829,172
69	All other food manufacturing	$367,499	1.2	$52,390	$91,487
	Total Direct Effects	$99,888,820	1,262.5	$54,705,324	$63,641,803
	Secondary Effects	$176,076,000	1,051.3	$57,133,504	$98,880,826
	Total Effects	**$275,964,820**	**2,313.9**	**$111,838,828**	**$162,522,629**

OMRR&R Spending Patterns

Maintenance at the harbor is expected to occur periodically:

- Maintenance dredging at 10-year intervals (this is dredging for the newly expanded harbor and does not include the ongoing dredging nearshore at Port of Nome)
- Armor rock repair on the causeway at 25-year intervals
- Caisson dock repair at 20-year intervals
- Dolphin anode repair at 15 year intervals

Each of these activities will be evaluated in turn to determine the impact to the community when these maintenance activities take place. Impacts from the individual items are presented first and then a summary of the output and earnings over the project period of analysis.

Maintenance Dredging

Maintenance dredging is projected at 10-year intervals. Over the 50-year project period of analysis, there should be about 5 occasions when maintenance dredging is needed at the expanded causeway. Each dredging event is estimated at $2,065,850 in 2014 dollars.

Table 11. OMRR&R Dredging Impacts (represents single dredging event)

Impacts		Regional	State	National
Total Spending		$2,065,850	$2,065,850	$2,065,850
Direct Impact				
	Output	$160,484	$954,429	$1,864,689
	Job	2.96	5.77	37.58
	Labor Income	$80,848	$369,720	$1,133,950
	GRP/GSP/GNP	$104,609	$504,926	$1,311,402
Total Impact				
	Output	$213,945	$1,577,170	$4,761,722
	Job	3.37	9.3	54.96
	Labor Income	$96,433	$575,707	$2,068,930
	GRP/GSP/GNP	$136,645	$886,476	$2,962,401

Note: Direct impacts are the outcomes from the direct construction spending for the project. Total impacts include indirect and induced spending as a result of the project.

Armor Rock Replacement

The armor rock on the expanded causeway can be damaged over time and may need repair. It is estimated that the armor rock periodic repair will occur at 25 year intervals, twice over the project period of analysis. Each armor rock repair event is estimated at $3,232,246 in 2014 dollars.

Table 12. OMRR&R Armor Rock Replacement Impacts (represents single replacement event)

Impacts		Regional	State	National
Total Spending		$3,232,246	$3,232,246	$3,232,246
Direct Impact				
	Output	$760,903	$2,386,360	$3,112,879
	Job	26.78	30.92	42.63
	Labor Income	$675,357	$1,094,692	$1,453,108
	GRP	$689,878	$1,628,438	$2,097,328
Total Impact				
	Output	$1,021,570	$4,047,846	$8,225,985
	Job	29.12	42.55	74.99
	Labor Income	$749,202	$1,659,264	$3,190,879
	GRP	$843,858	$2,627,442	$5,065,969

Note: Direct impacts are the outcomes from the direct construction spending for the project. Total impacts include indirect and induced spending as a result of the project.

Caisson Dock Repair

Periodic repairs to the caisson dock are expected at 20-year intervals at a cost of $1,035,891 in 2014 dollars.

Table 13. OMRR&R Caisson Dock Repair Impacts (represents single repair event)

Impacts		Regional	State	National
Total Spending		$1,035,891	$1,035,891	$1,035,891
Direct Impact				
	Output	$343,689	$748,657	$1,008,724
	Job	8.46	10.57	13.45
	Labor Income	$288,585	$474,453	$589,560
	GRP	$305,561	$549,383	$690,635
Total Impact				
	Output	$466,888	$1,272,625	$2,692,231
	Job	9.45	14.18	23.79
	Labor Income	$323,148	$648,905	$1,138,963
	GRP	$379,820	$863,856	$1,642,231

Note: Direct impacts are the outcomes from the direct construction spending for the project. Total impacts include indirect and induced spending as a result of the project.

Dolphin Anode Repair

Periodic repairs to the dolphin anodes are expected at 15-year intervals at a cost of $1,033,729 in 2014 dollars.

Table 14. OMRR&R Dolphin Anode Repair Impacts (represents single repair event)

Impacts		Regional	State	National
Total Spending		$1,033,729	$1,033,729	$1,033,729
Direct Impact				
	Output	$331,963	$747,139	$1,006,664
	Job	8.36	10.56	13.43
	Labor Income	$283,009	$474,233	$589,106
	GRP	$298,717	$548,860	$689,828
Total Impact				
	Output	$451,127	$1,270,014	$2,686,657
	Job	9.32	14.17	23.76
	Labor Income	$316,396	$648,321	$1,137,363
	GRP	$370,571	$862,677	$1,639,438

Note: Direct impacts are the outcomes from the direct construction spending for the project. Total impacts include indirect and induced spending as a result of the project.

OMRR&R Summary Impacts

The following summarizes the employment and earnings for the periodic maintenance of the expanded causeway at the Port of Nome. This summary is an evaluation of the various OMRR&R activities over the 50-year project period of analysis displayed in 2014 dollars. The jobs displayed in the previous impact tables would remain the same. For simplicity, this table shows output, labor income, and gross regional product from direct impacts to the region, state, and nation, indirect and induced impacts, and then the total impacts for those same categories.

Table 15. OMRR&R Summary Impacts over Period of Analysis

Regional Summary	Direct Impacts	Indirect/Induced Impacts	Total Impacts
Output	$ 1,473,718	$ 512,537	$ 1,986,255
Labor Income	1,154,507	145,393	1,299,900
GRP	1,244,599	306,615	1,551,214
Statewide Summary			
Output	4,939,835	3,358,741	58,291,153
Labor Income	2,386,170	1,122,628	49,992,577
GSP	3,146,733	2,033,012	46,483,780
National Summary			
Output	7,782,119	12,494,065	20,276,184
Labor Income	4,410,597	4,099,174	8,509,771
GNP	5,379,011	7,139,069	12,518,080

Note: Values depicted here are summaries of the periodic Operations Maintenance, Repair, Replacement and Rehabilitation over the project period of analysis of 50 years based on the FY15 discount rate of 3.375 percent.

Resource Extraction Spending Patterns

The employment and income depicted here in the previous paragraphs show changes to the regional, state, and national economies as a result of the initial construction and periodic maintenance for the Port of Nome enhanced marine infrastructure. Not depicted is the increased activity as a result of offshore oil and gas and mining activity in the region. This is not included in the Regional Economic Development analysis for this project, as the specific industry, revenue, and employment expansion estimates are not quantified with significant certainty.

However, it is important to note that the assumptions used in the NED evaluation - of three oil and gas companies exploring in the Chukchi Sea and using Nome as a base in 2020, then these three companies increasing fleets in 2030 as they move into production and begin new exploration, and then again in 2040 as the companies move into production and begin a third exploration platform - are likely to have an effect on employment and incomes in the region. The Graphite Creek Mine is presumed in production by the base year 2020 and moves a level amount of product through backhaul barges over the period of analysis. Graphite Creek Mine anticipates more than 100 year-round workers at the mine most of whom will use Nome travel to and from the area. Since these are year-round high paying positions, it can be reasonably expected that these workers will choose to live close to their place of employment and bring their families with them. The spending patterns displayed in this RED analysis do not attempt to capture the changes to the Nome Census Area or the State of Alaska from a change in the resource extraction activity in the area.

Summary

Employment and income changes due to project construction in Nome are shown in Table 16. Regional output is estimated at $73.4 million; statewide output is $141.4 million, and national output is $276 million. Jobs created or retained on the regional level are estimated at 728, statewide is 1,347, and nationally is 2,314. Labor income impacts for the region are approximated at $33.5 million, statewide is $64.5 million, and nationally is $111.8 million. Impacts to gross regional product are $43.7 million, gross state product are $87.5 million, and gross national product are $162.5 million for the initial year of construction.

Table 16. Annual Impacts from Construction

Impact Areas	Regional	State	National
Output	$73,385,089	$141,386,316	$275,964,820
Job	727.9	1,346.9	2,313.9
Labor Income	$33,451,333	$64,455,283	$111,838,828
GRP/GSP/GNP	$43,669,667	$87,508,235	$162,522,629

Note: Impacts shown in this table are for one year of what is presumed to be a 2-year project construction season.

Repair and maintenance of the expanded marine infrastructure at Port of Nome will continue to provide employment and income to the region at various years during the project period of analysis.

Attachment 1

History of the Study Area

Malemiut, Kauweramiut, and Unalikmiut Eskimos have occupied the Seward Peninsula historically, with a well-developed culture adapted to the environment. Around 1870 to 1880, the caribou declined on the peninsula and the Eskimos changed their diets. The following histories of the communities in the region are taken from the State of Alaska Division of Community and Regional Affairs, Community Database Online.[13]

Nome

Gold discoveries in the Nome area were reported as far back as 1865 by Western Union surveyors seeking a route across Alaska and the Bering Sea. But it was a $1,500-to-the-pan gold strike on tiny Anvil Creek in 1898 by three Scandinavians, Jafet Lindeberge, Erik Lindblom, and John Brynteson, that brought thousands of miners to the “Eldorado”. Almost overnight an isolated stretch of tundra fronting the beach was transformed into a tent-and-log cabin city of 20,000 prospectors, gamblers, claim jumpers, saloon keepers, and prostitutes. The gold-bearing creeks had been almost completely staked, when an entrepreneur discovered the “golden sands of Nome”. With nothing more than shovels, buckets, rockers, and wheel barrows, thousands of idle miners descended upon the beaches. Two months later the golden sands had yielded one million dollars in gold (at $16 an ounce).

A narrow-gauge railroad and telephone line from Nome to Anvil Creek was built in 1900. The City of Nome was formed in 1901. By 1902 the more easily reached claims were exhausted and large mining companies with better equipment took over the mining operations. Since the first strike on tiny Anvil Creek, Nome’s gold fields have yielded $136 million. The gradual depletion of gold, a major influenza epidemic in 1918, the Great Depression, and World War II each influenced Nome’s population. A disastrous fire in 1934 destroyed most of the city. In recent years, gold dredges returned to Nome as the price of gold approached $1,800 an ounce. Gold dredges continue to operate offshore.

The population of Nome is a mixture of Inupiat Eskimos and non-Natives. Although some employment opportunities are available, subsistence activities are prevalent in the community. Former villagers from King Island also live in Nome. Nome is the finish line for the 1,100-mile Iditarod Trail Sled Dog Race from Anchorage, held each March.

Port Clarence

The 1893 U.S. Census listed a collective village at Point Spencer with a population of 485, of which 236 were native and 249 were foreign. Their descendants are the residents of nearby Brevig Mission, Teller, and Wales. The Port Clarence Coast Guard LORAN station was operational from 1961 - 2010. The LORAN program was terminated February 8, 2010. The US Census 2010 showed 24 people living at the station.

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[13] State of Alaska Division of Community and Regional Affairs, Community Database Online. http://www.commerce.state.ak.us/cra/DCRAExternal

Brevig Mission

Brevig Mission is comprised predominantly of Inupiat Eskimos leading a subsistence way of life. The Kawerak Eskimos in this area lived in migratory communities in pursuit of hunting and fishing grounds and traded furs with Siberia, Little Diomede, and King Island. They formed alliances with Wales, Little Diomede, and others for protection. The "Teller Reindeer Station" opened near this site in 1892; it was operated by the U.S. Government until 1900. The Norwegian Rev. Tollef L. Brevig, a pioneer Lutheran missionary, began serving the reindeer station on August 1, 1894, as pastor and teacher to the Laplanders and Eskimos. Rev. Brevig traveled between villages by dog team along the beach and often performed services in Nome. A Lutheran mission was constructed at the present site in 1900, and the village became known as "Teller Mission." The mission was given 100 reindeer on a five-year loan from the government. By 1906, the government's role had diminished, and the mission became dominant. In 1963, the Brevig Mission post office was established. The city was incorporated in 1969. Reindeer were the economic base of this community until 1974, but the industry has since declined.

Teller

Teller is a traditional Kawerak Eskimo village relying upon a subsistence way of life. Many of today's residents were originally from Mary's Igloo, another western Alaska community north of Nome. Seals, beluga whales, fish, reindeer, and other local resources are utilized. A herd of reindeer roam the area.

The Eskimo fishing camp called "Nook" was reported 20 miles south of Teller in 1827. A Western Union Telegraph expedition wintered at the present site in 1866 and 1867; it was then called "Libbyville" or "Libby Station". The Teller Reindeer Station was operated by the US government at a nearby site from 1892 to 1900. The station was named in 1892 by Sheldon Jackson for US Senator and Secretary of the Interior Henry Moore Teller. Teller Mission, a Norwegian Evangelical Lutheran mission, was built in 1900 across the harbor at the current site of Brevig Mission. Present-day Teller was established in 1900 after the Bluestone Placer Mine discovery 15 miles to the south. During these boom years, Teller had a population of about 5,000 and was a major regional trading center, attracting Natives from Diomede, Wales, Mary's Igloo, and King Island. In May 1926, bad weather caused the dirigible "Norge" to detour to Teller on its first flight over the North Pole from Norway to Nome. A city was formed in 1963.

ATTACHMENT 5 – OTHER SOCIAL EFFECTS EVALUATION

Alaska Deep Draft Arctic Port System Feasibility Study

A Subset of the Alaska Regional Ports Study

Other Social Effects (OSE) Evaluation

This is an attachment to the Economics Appendix B

January 2015

U.S. Army Corps of Engineers

Alaska District

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Introduction

Engineering Regulation ER 1105-2-100 establishes the principles to be followed for Water Resource Development projects. These principles are intended to ensure proper and consistent planning by Federal agencies in the formulation and evaluation of water and related land resources implementation studies. There are four accounts established to facilitate evaluation and display of effects of alternative plans: National Economic Development (NED), Regional Economic Development (RED), environmental quality (EQ), and the Other Social Effects.

The focus of this appendix is the Other Social Effects (OSE) account, which registers plan effects from perspectives that are relevant to the planning process.

Other Social Effects Methodology

Most water and land resource plans have beneficial and adverse effects on social well-being. These effects reflect a highly complex set of relationships and interactions between inputs and outputs of a plan and the social and cultural setting in which these are received and acted upon. The Other Social Effects (OSE) account is a means of displaying and integrating into water resource planning information on alternative plan effects from perspectives that are not reflected in the other three accounts.[1] The categories of effects in the OSE account include urban and community impacts; life, health, and safety factors; displacement; long-term productivity, energy requirements, and energy conservation.

This analysis uses the guidance developed in the publications "*Handbook on Applying Other Social Effects Factors in Corps of Engineers Water Resources Planning*"[2] and "*Applying Other Social Effects in Alternatives Analysis*" from the Institute of Water Resources.[3]

This document describes seven social factors that should be considered in water resource planning documents as described in Table 1:

[1] U.S. Army Corps of Engineers Planning Guidance Notebook, Engineering Regulation 1105-2-100 Appendix D, dated 30 June 2004.
[2] IWR publication 09-R-4, Handbook on Applying "Other Social Effects" Factors in Corps of Engineers Water Resources Planning, dated December 2009.
[3] Applying Other Social Effects in Alternatives Analysis developed by Jason Weiss, URS Group Inc., Jagadish Prakash, URS Group Inc., and Shanika Amarakoon, Abt Associates Inc, May 13, 2011, Task Order 4 of Contract W912HQ-10-D-0005.

Table 1 Social Factors Used to Describe Other Social Effects

Social Factor	Description
1. Health and Safety	Perceptions of personal and group safety and freedom from risks
2. Economic Vitality	Personal and group definitions of quality of life, which is influenced by the local economy's ability to provide a good standard of living
3. Social Connectedness	Community's social networks within which individuals interact; these networks provide significant meaning and structure to life
4. Identity	Community member's sense of self as a member of a group, in that they have a sense of definition and grounding
5. Social Vulnerability and Resiliency	Probability of community being damaged or negatively affected by hazards and its ability to recover from a traumatic event
6. Participation	Ability of community members to interact with others to influence social outcomes
7. Leisure and Recreation	Amount of personal leisure time available and whether community members are able to spend it in preferred recreational pursuits

OSE are measured as "beneficial" or "adverse" as they relate to the impacts on real income and employment and to other social opportunities. Effects on income, employment, and population distribution, fiscal condition, energy requirements, and energy conservation may be reported on a "positive" or "negative" basis. Effects on life, health, and safety may be reported as either beneficial or adverse.

For purposes of this evaluation, we use a "+" sign to indicate beneficial or positive effects and a "-" sign for adverse or negative effects. And rather than evaluate each of the alternatives contained in the planning document, we summarize the effects to the Nome alone Tentatively Selected Plan. Point Spencer and Cape Riley are mentioned in this document but have not been carried forward in the evaluation. This is for ease of evaluating and because the combination plans do not alter the Other Social Effects evaluation. The OSE evaluation does not vary for the various Nome alone alternatives.

Table 2 Key to Social Factors Scoring

Score	Effects resulting from a project
++	Significant positive/beneficial effects
+	Moderate positive/beneficial effects
0	Negligible effects (no impacts)
-	Moderate negative/adverse effects
- -	Significant negative/adverse effects

The social factors, metric, and more detailed descriptions are found in Table 3.

Table 3 Social Factors Metrics

Social Factor	Metric	Description
Health and Safety	Mental health	Issues affecting the mental health of a person such as anxiety and stress (e.g. threat of large vessel grounding that destroys ability to harvest food)
	Physical health	Issues affecting a person's physical health (e.g. air quality, diseases)
	Physical safety	Safety issues that could cause bodily harm to a person (e.g. need to conduct crew transfers in open water)
	Special issues	Special concerns pertaining to increased vessel traffic from increased open water periods in the Arctic.
Economic Vitality	Business climate	Issues affecting the ability of a community to retain and attract businesses
	Employment opportunities	Issues affecting the availability to provide employment opportunities for residents
	Financial impacts	Issues affecting a person or group's standard of living (e.g. taxes, property values)
	Municipal services	Issues affecting the local tax base and the ability to provide municipal services
	Special issues	Special concerns of issues of ability to conduct subsistence activity which is a substitute for work-for-wages in rural/remote regions of Alaska
Social Connectedness	Community cohesion	Issue affecting local social networks, including personal networks
	Community Facilities	Issues affecting access to local community related facilities (e.g. community center, post office, tribal meets)
	Special issues	Special concerns associated with honoring Alaska Native traditional knowledge
Identity	Cultural identity	Issues affecting sense of cultural identity within a community (e.g. historical significance, cultural significance)
	Community identity	Issues affecting sense of community identity (e.g. potlatches, harvests)
	Special issues	Special concerns such as empowerment of Alaska Native cultures to continue their traditional way of life.

Social Factor	Metric	Description
Social Vulnerability and Resiliency	Residents of study area	Issues affecting the overall risk to the population within the study area
	Socially vulnerable groups	Issues affecting socially vulnerable groups (e.g. low income, minority, elderly, children, disabled)
	Special issues	Special concerns identified during baseline assessment
Participation	Public participation	Issues affecting overall public involvement in community matters (e.g. trust in government officials, public interest in the community)
	Special issues	Special concerns identified during baseline assessment.
Leisure and Recreation	Recreational activities	Issues affecting access to, or availability of, recreational activities (e.g. participation in ball games, potlatches)
	Special issues	Special concerns identified during baseline assessment.

Source: Taken from *Applying Other Social Effects in Alternatives Analysis* by Abt Associates Inc. May 13, 2011.

No evaluation of remote Alaska projects would be complete without a general understanding of subsistence. Following is a discussion of subsistence and where possible, we have pulled from previous study efforts for the Nome and Port Clarence area. The Other Social Effects evaluation is concerned mostly with impacts to the subsistence way of life, given its prominence in Alaska Native culture.

Subsistence Way of Life

There is a large body of work written on the culture for the subsistence way of life.[4] Subsistence in Alaska generally refers to the hunting, fishing, and collecting of wild animals and plants as the primary source of food. This type of production and consumption is common in remote Alaska communities and is differentiated from commercial purchases. There is a great deal more to Alaskan Native subsistence practices than merely harvesting and consuming resources. Of particular importance are the social and religious components of the subsistence practices of many Alaskan Native villagers.[5]

The food production and cultural values for the subsistence way of life are not easily quantified. Proteins such as seal, walrus, and caribou are not available for retail purchase. Furthermore, the nutritional value of harvested animals and plants cannot be duplicated with typical store bought goods

[4] This is sometimes inaccurately referred to as the "subsistence lifestyle" which is not correct. A "lifestyle" implies a choice an individual makes, whereas the subsistence way of life is of necessity for survival.

[5] *Distribution and Exchange of Subsistence Resources in Alaska* by Steve Langdon and Rosita Worl, Technical Paper Number 55 prepared for the U.S. Department of Fish and Game by the University of Alaska Arctic Environmental Information and Data Center, April 1981. This research was partially funded by ANILCA Federal Aid Funds, administered through the U.S. Fish and Wildlife Service, Anchorage, AK.

in the region. There are complicated patterns of giving, sharing, caring, trading, partnership, and commercial exchange that contribute to the survival of the group. Of special interest to the Alaska Deep-Draft Arctic Port System study is when, how, and if impacts to the subsistence way of life can be identified and then avoided and/or minimized.

In many ways, the Nome/Port Clarence region is a fragile resource-rich environment. Uncertainty for the subsistence way of life is introduced from negative impacts to the resource and abilities of hunter/gatherers in the group to be successful.

Conventional economic theory is built on the pricing mechanism which sets the value of goods and services through the forces of supply and demand. It is only in the exchange of one commodity for another that prices, and more importantly, values are established.[6] A subsistence way of life, however, is not a cash economy. There is an obligation to share and ownership of the resources is by the group or community or village. This obligation is understood as the exchange of equivalent return and establishes a bond between donor and recipient. Exchanges that occur in the subsistence way of life can increase a person's social status if the repayment of a debt, for instance, has a percent increase from the original debt. There are complicated patterns of sharing that are dependent on the relationship: immediate family, kinship relationships, elder care, and group dynamics.

The subsistence way of life relies on the recreation of the resources needed for living. Steve Langdon describes subsistence as having the following characteristics:[7]

1. **Production**, whether from naturally occurring biological or domesticated resources, primarily for personal or household consumption.
2. **Distribution** carried out through traditional noncommercial channels.
3. **Consumption** of the overwhelming majority of items produced takes place within the household or community.
4. **Resources** used are derived from local and regional areas in the vicinity of the community.
5. **Production and Distribution** are not organized to obtain the greatest possible return given available labor and technology, but are organized for security and continued existence.

It's important to note that production of naturally occurring resources in remote Alaska villages result in items that cannot be purchased in a commercial market. The production of many foods are found in limited areas or processed in special ways and highly valued. Lack of information on the customary patterns of trade was an issue recognized in the Federal Subsistence Fisheries Implementation Plan in 2002.[8] Trade in wild, renewable resources has a long history in Alaska. Long before contact with

[6] *Ibid.*
[7] *Ibid.*
[8] *Customary Trade and Barter in Fish in the Seward Peninsula Area, Alaska* by James S. Magdanz, Sandra Tahbone, Austin Ahmasuk, Davis S. Koster, and Brian L. Davis, Technical Paper No. 328 prepared by the division of Subsistence Alaska Department of Fish and Game, August 2007.

Europeans in the 18th century, thousands of indigenous Alaskans gathered each year at specific sites to trade including Point Spencer at Port Clarence.[9]

According to Rosita Worl, circulation of the resource products in Alaska are classified under the following general headings:[10]

1. **Ceremonial distribution** – takes place for birth, death, marriage, and seasonal hunts as examples
2. **Sharing** – goods and services are exchanged without the expectation of receiving in return
3. **Partnership** – voluntary relationships between individuals who are not related – partnerships generally last a lifetime.
4. **Trade** – can occur intervillage, intertribal, and intercontinental in order to obtain goods not available locally. This trade could include bargaining.
5. **Commercial exchange** – is more of a market economy where the village store enables the transaction.

A 2011 study of the economic value of subsistence activity at Little Diomede Alaska examined more than 200 previous studies of subsistence in Alaska.[11] The results of the literature review and in-depth discussions by the study team identified four primary elements of subsistence as follows:

1. **Economic** – procurement and exchange of resources and production in a non-market system.
2. **Social** – relationships from one individual with a special role, to groups of people, to whole communities which govern access to resources, organization of work, distribution and consumption of goods and services, and celebration and enjoyment of life.
3. **Organization** – the systematic practice of subsistence and organizational structure that designates the relationships.
4. **Celebrations and Ceremonies** – a critical part of the Alaska Native culture and communities that serve a variety of purposes including giving thanks to the resource, the captain and crew perhaps of a whaling vessel, and honoring elders. The celebrations and ceremonies are as important as Christmas or other holidays in western society and are irreplaceable. [12]

These days, the subsistence way of life is tempered somewhat with a limited cash economy. It is important to note that residents electing to take jobs for wages are in the difficult position of having to choose between a paycheck and their traditional gathering activities. These workers will often rely on family members and other village residents to supply them with their traditional foods. Bartering and trading for traditional foods is also a common practice. And while the true subsistence way of life is rarely practiced anymore, the cultural traditions associated with this way of life continue.

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[9] *Ibid.*
[10] *Distribution and Exchange of Subsistence Resources in Alaska* by Steve Landon and Rosita Worl, Technical Paper Number 55 prepared for the U.S. Department of Fish and Game by the University of Alaska Arctic Environmental Information and Data Center, April 1981.
[11] *Economic Value of Subsistence Activity, Little Diomede, Alaska* prepared by ResourcEcon, Stephen R. Braund & Associates, Dr. Steve J. Langdon, and Tetra Tech, Inc., December 2011.
[12] *Ibid.*

The State of Alaska recognizes that subsistence hunting and fishing are economically and culturally important for many Alaskans. Alaska state law directs the Board of Game and Board of Fisheries to provide a reasonable opportunity for subsistence uses first, before providing for other uses of any harvestable surplus of a fish or game population [AS 16.05.258 (b)]. This is often referred to as the "subsistence preference" or sometimes the "subsistence priority." [13] For the most part, the sale of subsistence harvests is prohibited by State law – these would be considered commercial transactions and subject to different rules and regulations.

The following social factors, with particular emphasis on the impacts to the subsistence way of life, are discussed in turn for the without-project condition followed by anticipated changes in the with-project condition. The resulting metrics is the change from the without-project condition to the with-project condition. The definition for each of the metrics following is provided for Nome Alone but since the definition does not change, the Point Spencer and Cape Riley sections just list the metric title without definition.

Public/Environmental Safety

The reach of the Deep-Draft Arctic Port System study is much farther than the Nome, Point Spencer, and Cape Riley areas. This will be the nearest port(s) to the Bering Strait, the chokepoint from which all vessels traveling the Northern Sea Route or the Northwest Passage must pass. Oil and gas leases are already in place in the Chukchi and Beaufort Seas and this project would provide the nearest deep water port for vessels supporting those operations. The next nearest deep water port is located at Dutch Harbor, more than 800 miles away.

The U.S. Coast Guard and Department of Homeland Security recently released it *Feasibility of Establishing an Arctic Deep-draft Seaport* report to Congress dated February 11, 2014. The report calls out the Nome/Port Clarence region as an optimum location for a deep-draft seaport. The report says:

> *"A deep-draft seaport that advances national strategic interests in the Arctic region must be in a location suitable to provide a base of operations for a variety of industrial activities, transportation requirements, SAR requirements, marine scientific research efforts, staging for disaster response, logistics support, and as a place of refuge for vessels in distress. It must be located near the shipping lanes passing through the Bering Strait." (page 4)*

In this report to Congress, the authors suggest that resources and funding are challenges facing this nation and that building a seaport "would reasonably take 10 to 20 years."

In 2013, the tanker Nordvik was struck by ice while sailing in the Matsien Strait to the north of the Taimyr Peninsula off the coast of Russia. The vessel was fully loaded with diesel fuel, and started taking on water after striking the ice floe. Russian icebreakers responded to the vessel. The 1,800 tons of diesel fuel was reloaded to another vessel. After plugging the hole with a cement plug the Nordvik was towed through the remainder of its Northern Sea Route voyage. It was 10 days from the ice floe strike

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[13] State of Alaska Department of Fish and Game, http://www.adfg.alaska.gov/index.cfm?adfg=subsistence.main

to when the vessel was able to clear the Russian waters of the Northern Sea Route.[14] This accident could have easily happened in Alaska waters.

Arctic waters and in particular, the waters of Port Clarence are the food source for the people living in the region. A recent article in the Huffington Post reports that "oil spill cleanup" is a myth".[15] Once the oil is spilled the battle is lost. Exxon spent more than $2 billion to "clean up" Prince William Sound after the grounding of the Exxon/Valdez in 1989. They managed to recover less than 7 percent. BP spent $14 billion to "clean up" after the 2010 Deepwater Horizon spill and it recovered only 3 percent of the spilled oil.[16] An oil spill in the Arctic region will have long-term effects on the people living there and may be catastrophic for those communities relying on the water for their food source.

Changing Arctic

The National Oceanic and Atmospheric Administration recently released its Arctic Report Card 2014 in which NOAA documents the changes in air temperature, snow cover, sea ice, Arctic Ocean temperatures, Greenland ice sheet, Arctic Ocean productivity, and vegetation. NOAA's findings on sea ice are summarized as follows:

> *"The extent of sea ice in September 2014 was the sixth lowest since satellite observations began in 1979. The eight lowest sea ice extents since 1979 have occurred in the last eight years (2007-2014). At the time of maximum ice extent in March 2014, there had been a modest increase in ice thickness and age relative to the same time in 2013. Despite this, there is still much less of the oldest, thickest (greater than 13 feet or 4 meters) and most resilient ice than in 1988, when the oldest ice made up 26 percent of the ice pack compared to 10 percent this year."* [17]

Craig McLean from NOAA's office of Oceanic and Atmospheric Research said "Arctic warming is setting off changes that affect people and the environment in this fragile region, and has broader effects beyond the Arctic on global security, trade, and climate". This is the broader context within which the communities in the Nome Census Area operate.

A recent policy brief from the Center for a New American Security makes five recommendations that apply to the U.S. national Arctic policy as well as actions for leading the Arctic Council which begins in March 2015. The recommendations are summarized as follows:

1. **Elevate U.S. Arctic Commitments and Engagement – Time, Attention, Money, and Leadership** by expanding government resources dedicate to the Arctic, fostering stronger U.S. federal government interagency coordination, implementing a realistic and funded plan to expand the icebreaker fleet to build credibility, establish capability in all manner of Arctic maritime operations, and enable the United States to be a responsible Arctic partner.

[14] http://www.arctic-lio.com/node/206
[15] http://www.huffingtonpost.com/richard-steiner/exxon-valdez-25th-anniver_b_4869118.html March 7, 2014.
[16] Ibid.
[17] http://www.noaanews.noaa/gov/stories2014/20141217_arctic_report_card_2014.html

2. **Build foundations for sustainable, Responsible Economic Expansion** by expanding infrastructure, particularly temporary and shore capacity equipment (such as ports communications, refueling stations, vehicles, roads, floating platforms, undersea and aerial autonomous vehicle), direct the Arctic council to expand research and engagement on Arctic environmental effects, and build technical, public-private partnerships for developing shared infrastructure.
3. **Ensure Safety and Security of Arctic Oceans and Borders** by implementing traffic separation schemes to prevent maritime collisions and promote standardization of Arctic maritime regulation, procure, deploy and lead an international effort to ensure adequate monitoring and predictions of changing weather, ocean and ice conditions, and initiate and lead an international partnership of nations, and elevate border security to reduce the rising possibility of illegal border entry through Alaska as Arctic traffic increases.
4. **Develop Broad Cooperation with Russian on Arctic Resource Use** by recognizing and leveraging Russia as the current pre-eminent Arctic power, and actively coordinate on specific policy prerogatives, such as maritime traffic management, data-sharing, environmental protections, oil spill response, search and rescue activities and border and customs affairs, to leverage the strong technical and infrastructural capabilities that Russia has and the United States does not.
5. **Forge Long-Term Partnerships and New Coordinating Mechanisms** by establishing a sustained public-private dialogue bringing together government and industry to discuss stakeholder priorities and responsible resource management in the Arctic, work with the public, private, and indigenous Alaskan stakeholders to integrate and leverage the state's assets and capacity in to support Arctic Alaskan economic development in a broad and sustainable manner.

Subsistence, environmental safety, and the changing Arctic all form the overarching conditions under which the Other Social Effects must be considered.

Nome Alone

Life, health, and safety factors

A basic human need is for personal and group safety. Conditions that are seen as unsafe or unhealthy create personal stress and dissatisfaction among those affected. The level of perceived risk associated with conditions or alternatives is also a factor in determining satisfaction.

Without-project:

In the without-project condition, the residents of Nome and the surrounding communities recognize the level of marine traffic passing their shores is increasing. Traffic at the Port of Nome saw significant increases in recent years and many vessels draft too deep to enter the harbor resulting in open water transfer of crew and supplies. Some perceive the increased Arctic traffic going “up over the top” to be happening at an exponential rate. These factors make some residents uneasy as there is limited marine infrastructure in the area. Provision of search and rescue operations or response to oil spills falls to local residents ill-equipped for the large scale responses needed.

In addition, the surrounding areas are rural communities reliant on a subsistence way of life.   Residents report that they worry about seal and fish harvests. The perception is that without a project in the area, the interactions between vessels and the environment will increase and be detrimental to their subsistence way of life.

Figure 1 -US Coast Guard Cutter Healy Icebreaker off the coast of Nome, Alaska

In the event a search and rescue operation is needed in the Arctic, the closest vessels with ability to respond may be the subsistence vessels, generally 20-foot skiffs. If this were the case, not only would the vessel in distress be at risk for loss of life and damage to the environment but the responding skiffs would be unable to accommodate the rescue operation needed. The nearest Coast Guard vessels could be days away. Rescue operations in Arctic waters are only successful when the rescue occurs within minutes. Rescue operations past a few hours become "recovery" missions.

With-project:

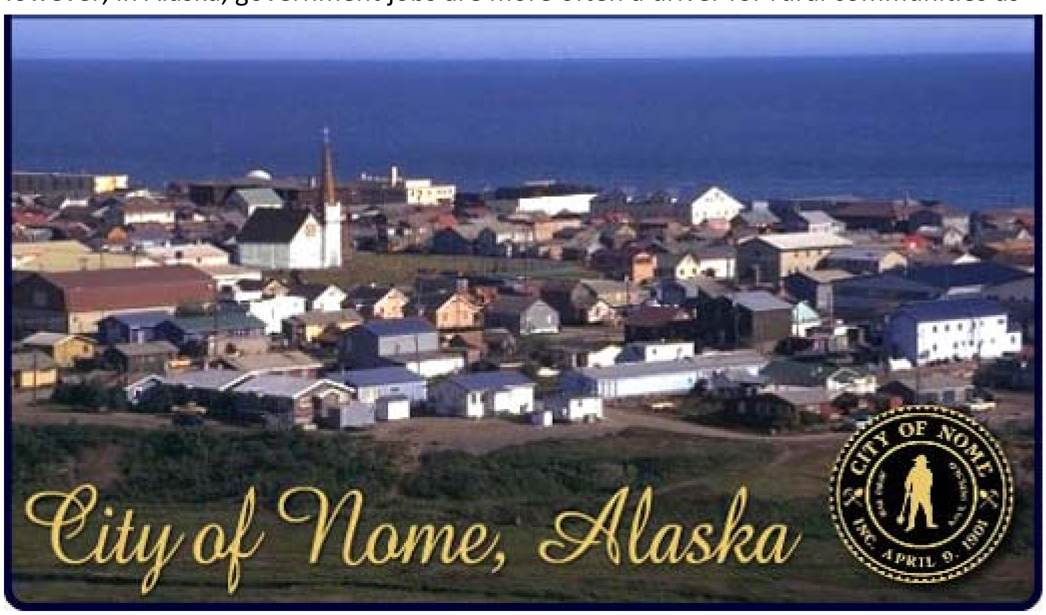
The perception is that with a project in the region the risks of damage from catastrophic events can be minimized. There is an additional perception that with adequate infrastructure in place, there would be increased oversight for fuel spills and additional protection for residents leading a subsistence way of life. This project will become the northernmost deep water port and could also address the stated needs of the Coast Guard, Navy, and other government's vessels for enhanced marine infrastructure in the Arctic.

Economic Vitality

Personal and group definitions of quality of life are influenced by an economy's ability to provide a good standard of living for residents now and into the future. Factors such as employment opportunities, income mix, poverty and unemployment dynamics, educational opportunities, and access to markets affect economic vitality and may be affected by a water resources issue or by solutions offered.

Without-project:

Nome has a comparatively larger population for an Alaskan community and more diversified economy than the more remote villages in the region. Nome serves as a hub for about 50 communities along Western Alaska's coast. About 20 percent of Nome workers are in the Trade, Transportation, and Utilities sector, with 22 percent in Education and Health Services, and another 24 percent in state and local government. State and local government sector jobs are generally considered support for other industry sectors. However, in Alaska, government jobs are more often a driver for rural communities as opposed to being support jobs. Nome is expected to continue to expand its economic base in the future. The Port of Nome is already experiencing delays and damage to infrastructure as a result of increased Arctic activity. The City is pursuing an additional 240-foot of dock space in the outer harbor to better accommodate the many barges calling at the Port. The City has no plans for



deepening the outer harbor however, so deeper draft vessels would still need to lighter their operations in open water.

With-project:

In the with-project condition, Nome is expected to expand its economic base even further. There will be opportunities for surrounding communities such as Teller and Brevig Mission to participate in the expanded workforce if they desire. Some jobs will require training and provided residents have the ability to avail themselves of this training, there will be additional work for wages opportunities. New jobs will increase the employment opportunities in the region and provide expanded tax revenues to the City of Nome.

Social Connectedness

Social connectedness refers to the pattern of social networks within which individuals interact, which largely provides meaning and structure to life. Social networks are composed of horizontal associations that are generally focused on community and family levels of interaction and also of vertical associations that bridge across communities and levels of society. Social capital theorists generally focus on the benefit to be gained by cultivating an array of diverse voluntary associations in communities to build “civic infrastructure” that can provide individuals with greater opportunities for connectedness.

Without-project:

The City of Nome is large by rural Alaska standards with more than 3,600 people. The community is the terminus for the annual 1,100 mile Iditarod Sled Dog Race held each March. The City has also been in the spotlight in recent years as gold dredges operate just offshore from the beach and television crews document the action. Nome has a jet runway and several charter companies operate from the airport serving the smaller communities along the coast. The size of the community and the many connections to the surrounding villages has lead to a strong civic infrastructure. Even though Nome is large by rural Alaska standards, there are no road connections (other than a seasonal road to Teller) so there is probably more of a connection to family, neighbors, friends, and community groups than in the more urban areas.

With-project:

Social connectedness is not expected to change with a project as the civic infrastructure for the Nome area is already quite strong. One caveat would be the importance of using traditional knowledge in the decision-making process as there are strong Alaska Native connections that may be impacted.

Identity

Identity is the sense of self as a member of a group, distinct from and distinguished from other groups by values, beliefs, norms, roles, and culture. Related to the concept of identity is the concept of cultural security: the need for the recognition and honoring of one's language, traditions, and values. Identity and cultural security are factors in well-being and satisfaction in that they are seen to confer a core sense of definition and grounding. In circumstances where basic identity needs are threatened, dishonored, or violated, dissatisfaction and conflict are likely to develop.

Without-project:

Nome is proud of its colorful gold rush history set within the framework of 10,000 years of Inupiaq Eskimo history. Their tourism website boasts that there is "No Place Like Nome". [18] In the late 1800s, Wyatt Earp operated a saloon in town. [19] The community is also a popular destination for birders. The Port of Nome recognizes its strategic proximity to the Bering Strait entryway to the Arctic. The Port updated its strategic plan in March 2013 with the intent of communicating to the public the changes about to take place and as a marketing tool for potential users in the area. The Port plans to expand its capabilities to meet the growing needs for Arctic infrastructure and is working closely with the community, the Village Corporation, and the Regional Native Corporation to expand its holdings in a reasonable way while honoring long Alaska Native traditions.

Nome has seen significant increased traffic to its port in recent years as research vessels, cruiseships, government vessels, and resource extraction companies all use the port for resupply and crew changes. Much of his activity takes place in a brief 4-month ice-free summer. As ice develops later in the year, the port's operating season is expanding and companies in the region are realizing a longer season for their services.

With-project:

An expanded Port project will bring the perceived growth to Nome sooner. Given the community's close ties with the Village and Regional Native Corporations, it is expected that Nome's identity and cultural conditions will continue unharmed. There may be small pockets of individuals who feel threatened by the changes but conflicts are expected to be infrequent. There is potential for community residents leading a subsistence way of life to instead pursue one of the new employment opportunities that comes with the expansion. This could be a conflict for individuals torn between work for wages and a more traditional way of life.

The with-project condition also offers a sense of security, however, as the enhanced marine infrastructure will allow faster response times for search and rescue and oil spill response, thereby reducing the risk of harm from catastrophic events.

[18] http://www.visitnomealaska.com/nome-history-culture.html
[19] http://www.visitnomealaska.com/PDF's/WYATT%20EARP.pdf

Social Vulnerability and Resiliency

Social vulnerability refers to the capacity for being damaged or negatively affected by hazards or impacts. Vulnerability is associated with characteristics of the population. Certain groups are generally more vulnerable than other parts of the populations (e.g. the aged, the poor, minorities). Such groups may lack the resources and capacities to resist the hazard. Resiliency is the capability to cope with and recover from a traumatic event. Studies show that social institutions such as families and public and private organizations play an important role in mitigating the effects of disasters. Individuals who have strong social ties and communities that have strong civic infrastructure are likely to be more resilient.

Without-project:

The City of Nome and the entire western and northern coast of Alaska are vulnerable as they lack the basic infrastructure common in other areas to respond to search and rescue or oil spill responses when a marine accident occurs. Residents in these communities can see the large vessels passing their shore on their way to the Northern Sea Route or the Northwest Passage. These communities have witnessed the erosion of their communities as permafrost melts and their shores previously protected by ice are unprotected for longer and longer periods of the year. Subsistence harvesters rely on the fish and mammals for their family's survival. More and more, the fish smell of fuel and the mammals have scars from vessel interactions. These conditions are expected to continue and increase in intensity in the future.

With-project:

A Federal project at Nome would enhance search and rescue and oil spill response and relieve congestion at the Port. A port project at Nome would increase oversight of vessels in the area so that inappropriate releases from vessels can be recognized and responded to sooner. Mammal /vessel interactions will continue as in the without-project condition unless operating restrictions are put in place. Vessel operating restrictions are outside the Corps purview but could become recommendations within the report for Coast Guard or Port of Nome action.

Participation

Participation means being able to interact with others to influence social outcomes. It is critical to recognize the role of participation in legitimizing group action and building group cohesion. Public participation is an indispensable element of all planning strategies.

Without-project:

Public meetings (planning charette in April 2013) and community visits (Nome, Teller, and Brevig Mission in June 2013) have already taken place and more are scheduled as part of the planning process for this feasibility study. Now that a Tentatively Selected Plan is identified, additional meetings are being coordinated to keep stakeholders informed of the progress. In addition, personal interviews were conducted with potential users of expanded facilities at Nome including the US Coast Guard, the US Navy, and oil and gas support companies for the offshore oil and gas leases in the Chukchi and Beaufort Seas. Communication with users and affected communities will continue as the feasibility study proceeds. The Corps and the State have dedicated websites and email address for this project in order to manage document releases and comments received.

With-project:
Local input is an important decision criterion in determining the ultimate Federal action at Nome. Once a project is constructed, it will be up to the Port operator to maintain communication with the public. The Port of Nome has developed strategic plans for the Port in the past and is expected to continue its public outreach with a project.

Leisure and Recreation
Having leisure time and being able to spend it in preferred recreational pursuits is an important aspect of well-being for most people. To the extent that water resources problems or solutions affect leisure time and/or recreational opportunities, they are likely to be perceived as important considerations.

Without-project:
The Port of Nome is a working harbor with commercial fishing vessels, gold dredges, support vessels, cargo, fuel, and gravel barges. Given the short open water season at Nome, there is very little in the way of recreational activity happening at the Port though sailing vessels and cruise ships have increased presence at Port of Nome in recent years. The summer season in Alaska is short with very long periods of daylight so companies operating in this environment tend to work long hours and double shifts to pack as much as possible into the day. Large cruise ships are unable to enter the Port of Nome so must lighter their guests to shore for excursions and smaller cruise ships must compete for dock space with the barges. These conditions are expected to continue for the foreseeable future.

With-project:
There is the potential for increased cruise ship traffic with a project at Nome. More and more cruise ships are taking advantage of the open water season in the Arctic and ecotourism has been on the rise for several years now. The expanded harbor will provide protection and adequate depths for larger guide and cruiseships to enter the harbor. This will alleviate the need to lighter passengers to shore as the vessel will be able to pull alongside the dockface.

Summary of Nome Alone OSE

Following is a summary of the positive/beneficial effects and the negative/adverse effects from the changed condition with a Federal project at Nome.

Table 4 Nome Alone Social Factors Metrics Evaluation

Social Factors	Metrics	Without-Project	Nome Alone
Health and Safety	Mental Health	0	+
	Physical Health	0	++
	Physical Safety	0	++
	Special Issues - Arctic	0	+
Economic Vitality	Business Climate	0	+
	Employment Opportunities	0	++
	Financial Impacts	0	+
	Tax Revenues	0	+
	Special Issues - Subsistence	0	0
Social Connectedness	Community Cohesion	0	0
	Community Facilities	0	0
	Special Issues – Traditional Knowledge	0	0
Identity	Cultural Identity	0	-
	Community Identity	0	0
	Special Issues – Alaska Native Way of Life	0	0
Social Vulnerability and Resiliency	Residents of Study Area	0	+
	Socially Vulnerable Groups	0	+
	Special Issues	0	0
Participation	Public Participation	0	+
	Special Issues	0	0
Leisure and Recreation	Recreational Activities	0	+
	Special Issues	0	0

Note: See Table 2 for key to scoring metrics. Zeros in the Without-Project column indicate that this is the starting condition.

Point Spencer Alone

Point Spencer is on the western edge of Port Clarence, a naturally deep harbor that is about 75 miles northwest of Nome. There is no road connection to this site. Point Spencer is a previous US Coast Guard LoRan station which was shut down in 2010. There are currently no residents at Point Spencer though there is a runway, some shuttered buildings, and formerly used fuel tanks.   The runway can be used for emergencies.

A project at Point Spencer is delayed at this point until others move forward with site development.

The US Coast Guard, the Bering Straits Native Corporation, and the State of Alaska are in negotiations with Bureau of Land Management for transfer of the property. It is expected that all three entities will acquire or retain a portion of the property.

Figure 2 - Point Spencer – former US Coast Guard Loran Station

Cape Riley Alone

Cape Riley is an uninhabited site on the western edge of Port Clarence about 4 miles south of Teller and about 7 miles south of Brevig Mission. See Figure 3. Cape Riley is not being considered further at this time.

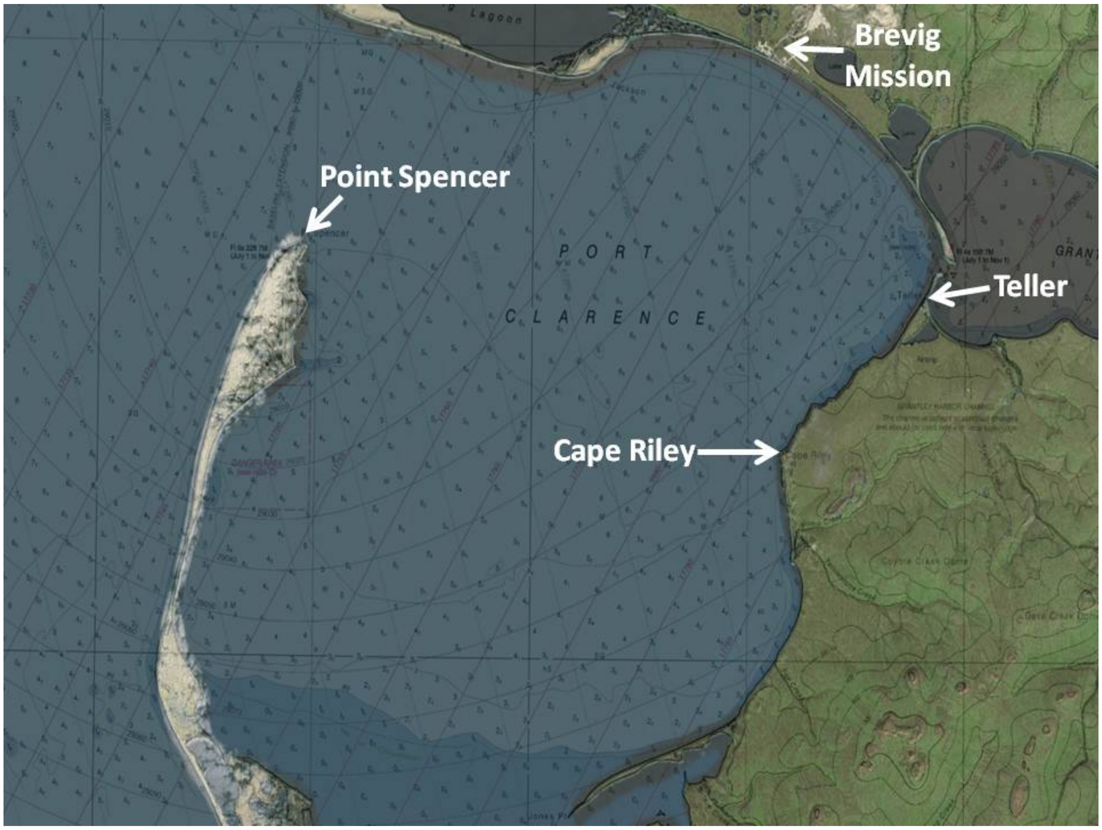


Figure 3 – Port Clarence and nearby communities

Summary of Other Social Effects

Of greatest concern for the Other Social Effects evaluation is the lack of infrastructure in the region which reveals itself in the Health and Safety factors with a project at Nome. Mental and physical health and physical safety are all seen as improved with the Tentatively Selected Plan. Many see this port development as the stepping stone to increased economic development in the region with the promise of additional work-for-wages employment. One potential negative social factor is the loss of cultural identity as the Alaska Native way of life and individuals may be faced with the difficult choice of balancing a subsistence way of life with wage employment or having to choose between the two.

See the Attachment for a glossary of Arctic oil spill response research.

List of Studies Concerning Oil Spill Response in Arctic Waters

All studies listed in the following tables are from the Alaska Department of Environmental Conservation Division of Spill Prevention and Response Research and Development Projects (2000-2013) received via email on June 10, 2014 from Crystal Smith, Scientific Support Coordinator for ADEC.

YEAR	PROJECT TITLE	PROJECT DESCRIPTION
1997–2005	Environmental Sensitivity Index (ESI) Mapping	Series of seasonal maps intended to provide a regional overview of the environmentally sensitive resources that would receive priority protection during oil spill planning and response. The resources depicted on the maps are selected on the basis of their high sensitivity and/or vulnerability to spilled oil or their special management status. The following is a summary of the ESI mapping status by subarea: • Aleutians (2002) • Bristol Bay (2004) • Cook Inlet (2002) • Kodiak (1997) • North Slope (2005) • Northwest Arctic (2002) • Prince William Sound (2000) • Southeast Alaska (2001) • Western Alaska (2003) More information available at: http://response.restoration.noaa.gov/book_shelf/827_ERD_ESI.pdf
2000	International Oil & Ice Workshop, 2000	Workshop on oil spill preparedness and response for cold climates. Provided an opportunity to congregate experts on oil fate and behavior, Arctic oil spill response, ice environments, and Arctic oilfield development in order to present the state of knowledge in a combined classroom and field setting (Anchorage and Prudhoe Bay).
2000	MORICE Phase 5	Mechanical Oil Recovery in Ice Infested Waters (MORICE) was a multiphase Joint Industry Program (JIP) to develop technologies for more effective recovery of oil spills in ice-infested waters. Phase 5, evaluated four different internal oil recovery units for the lifting grated belt at a test tank in Hamburg, Germany, in May 2000. Upon completion of these tests, the prototype skimmer was shipped back to Prudhoe Bay, AK, where it received further equipment modifications, and more powerful hydraulics and a larger power pack were installed. Selected skimmer manufacturers were invited to participate and provide an internal recovery system for evaluation. The complete prototype skimmer was evaluated for ice processing on the Alaskan Beaufort Sea during October 2000.

YEAR	PROJECT TITLE	PROJECT DESCRIPTION
2000	Oil Detection in Ice	Pangaea Geochemical Technologies demonstrated the potential use of gas-sieve gas chromatograph instrumentation capable of detecting molecular levels of hydrocarbons in ice core samples.
2000	Barge Ice Deflection System	Design and construct a Barge Ice Deflection System (BIDS). The concept, design, fabrication, and testing of BIDS was a direct result of lessons learned from fall 1999 drilling on the North Slope. Spill responders recognized the need to deflect ice away from barge skimming systems in order to maintain a reasonable recovery
2000	Temporary Pipeline Concept	As a result of lessons learned during a barge offloading demonstration on the North Slope, a study was implemented to examine the feasibility, design, process, and rough order-of-magnitude costs for a system capable of handling recovered oil spill fluids consistent with the response planning standard (RPS) requirements from the Northstar C-
2000	Viscous Oil Pumping Demonstration	Previous tests indicated the injection of water through an annular injection flange significantly reduced the discharge hose pressures while pumping viscous fluids. This test investigated the potential to adapt this technology to a cold climate through injection of alternative lubricating fluids.
2000	Emulsion Breaker Study, 1	Determined the effect of small dosages of emulsion-breaking chemical on several North Slope crude oil emulsions at or near freezing temperatures.
2000	Crude Oil Evaporation Study	Study to provide an educated analysis of the potential evaporative losses from an oil and gas surface well blowout from the Northstar and Pt. McIntyre fields on the Alaskan North Slope.
2000–2002	GNOME Oil Trajectory Model for the Alaskan North Slope	In coordination with NOAA, this project worked to develop a regional oil spill trajectory model appropriate for use in the nearshore marine environment of the Alaskan Beaufort Sea. GNOME, the General NOAA Oil Modeling Environment, is a general-purpose oil spill trajectory model used by NOAA/HAZMAT.
2001 and ongoing	Geographic Response Strategies (GRS)	GRS are oil spill response plans tailored to protect a specific sensitive area from oil impacts following a spill. These response plans are map-based strategies that can save time during the critical first few hours of an oil spill response. They show responders where sensitive areas are located and where to place oil spill protection resources. The
2001	Ice Access Guidelines for Spill Responders	Sandwell Engineering Inc. conducted research and developed a manual focused on oil spill response efforts to support both on-ice and under-ice cleanup activities on the North Slope. The manual provides equipment operators, site managers, and project managers the information necessary to understand the factors and requirements to
2001	MORICE Phase 6	The prototype skimmer (from Phase 5) was considered ready for oil in ice testing. The unit was shipped to Svalbard, Norway, in May 2001 for testing, however, due to complications, the unit was not field-tested. The MORICE project concluded after Phase 6A which successfully tested and evaluated the prototype skimmer at Ohmsett in
2001	National Institute of Standards & Technology (NIST) Well Blowout Dispersion Modeling	Contract with NIST to create a 3-D model of a drilling related blowout. The model includes the presence of a rig structure and can account for variations in flow rate, oil properties, gas-to-oil ratios, discharge pressures, wind conditions, and impingement effects of drill rig structure on the oil and gas plume.
2002	Alaska Incident Management System (AIMS) Guide	The AIMS Guide was developed for use by public and private agencies to fully coordinate response efforts during a significant oil or hazardous materials release. While the roles of the government organizations may vary from directing the response, augmenting the response, or providing regulatory oversight, the intent of this document is to

YEAR	PROJECT TITLE	PROJECT DESCRIPTION
2003	NIST, Well Blowout Droplet Size Study	Preliminary study to investigate the drop size distributions created from various pipe diameters under a range of flow rates and GORs.
2003	Viscous Oil Pumping Studies, USCG	Joint Viscous Oil Pumping System (JVOPS) Workshop, headed by representatives of the Canadian and US Coast Guards was held in Houma, LA, Dec 1–15, 2003. The purpose of the workshop was to improve oil spill response systems for heavy viscous oils. The workshop targeted testing in the critical 200,000–500,000+ cSt range and
2003	Viscous Oil Pumping Studies, Mini Barge	In a test, a vacuum truck pumped a 249 bbl mini barge of its cargo of emulsified Northstar crude oil at 32°F in 46 minutes. The pumping confirmed long-standing planning assumptions regarding transfer rates of emulsified oil at ambient sea temperatures stored by on-water spill response systems.
2003	Emulsion Breaker Study, 2	Test to examine the fate of emulsion breaker chemicals that may be used to help decant free water from oil storage barges.
2004	Testing Portable Pumps with Viscous Oil	Demonstrated pumping capability of ACS equipment for recovering oil spilled to tundra in cold conditions. The key elements of this test were to measure the rate at which weathered oil could be recovered with small, portable pumps and to determine the limits of pumping related to pour points of the oil.
2004 – 2006	NIST Well Blowout Model Development	Continue National Institute of Standards and Technology's (NIST) well blowout model development. Develop Alaska- based capability to apply and run NIST's oil dispersion model for cases of rig and no rig and fire and no fire. Compare the results of a no-fire-no-rig case to SL Ross's model results. Develop capability to model the
2004	TAP II Modeling, North Slope	Trajectory Analysis Planner (TAP II) Modeling. GNOME model location files for Alaskan Beaufort Sea provided opportunities to expand spill trajectory modeling to statistically-based projections of potential spill impact areas. The graphical output from TAP II includes threat zone analysis, shoreline impact analysis, site oiling analysis and
2004 – 2005	Testing Emulsion Breakers to Improve Pumping of Viscous Emulsions	Quantify the effectiveness of demulsifier addition in reducing emulsion viscosity, and hence friction-induced backpressures, when pumping emulsions in hoses.
2004 – 2006	North Slope Coastal Ocean Dynamic Applications Radar (CODAR)	Support for a project led by the University of Alaska Fairbanks to develop a land based radar system for measuring the speed and direction of the Beaufort Sea's surface currents.
2004 – 2006	Ground Penetrating Radar (GPR) for Detecting Oil in and Under Ice	Studies of GPR for the detection of oil in and under sea ice: • November 2004 experiments at the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) in
2005	North Slope Nearshore & Offshore Breakup Study	Provides an analysis of ice conditions and the dates associated with seasonal transitions in the nearshore and offshore Beaufort Sea environments including the lagoon areas inside the barrier islands affected by major river overfloods. More information available at: http://dec.alaska.gov/spar/ipp/nscharter.htm

YEAR	PROJECT TITLE	PROJECT DESCRIPTION
2005	Viscous Oil Pumping Studies	Continuation of previous work. Tested a range of North Slope pumps in North Slope liquids to determine their capability. Tested a range of additional annular injection unit types. Measured viscosity and pump rates resulting from treatments of a range of oils with a range of emulsion breakers. Developed pump well and lids
2005	ADEC Tundra Treatment Manual	Updated the manual with new tactics. The purpose of this manual is to provide a menu of tactics which can be used to treat and monitor tundra impacted by spills of crude oil, petroleum products, seawater, and other substances after initial response efforts have eliminated the threat of large-scale spill migration.
2005–2006	Spill Related Analysis of North Slope Crude Oils	Oil characteristics affecting recovery and transfer planning were determined by laboratory tests. The viscosity, emulsification tendency, specific gravity, and evaporation rates of crude oils from 11 North Slope sources were measured.
2005–2009	SINTEF Oil in Ice Joint Industry Program (JIP) Support	Provided support through Alaska Clean Seas. The objective of the JIP Oil-in-Ice project led by the Norwegian research group SINTEF was to "further develop tools and technologies for environmental beneficial oil spill response strategies for ice-infested waters." The project culminated with a large-scale field trial with actual
2006	Alaska Commercial Fisheries - Water Quality Sampling Methods and Procedures Manual	This manual presents scientific water-quality sampling methods to assess potential contamination of commercial fishery resources and gear in Alaska waters during an oil spill. It is intended for oil spill response personnel and fishery managers as they assess and manage the risk to commercial fisheries during spill events. The manual
2006	Spill Tactics for Alaska Responders (STAR) Manual	This project led to the development of a statewide spill response tactics manual for use by the spill response community, including federal, state, local, industry, and spill cooperatives throughout Alaska. The final product is available for general use by the spill response community in Alaska, and also serves as a means for the oil industry
2006	De-Ice Rope Mop Skimmer Studies	Methods of de-icing rope mop skimmers in cold temperatures were examined. The research included a literature review of the state-of-the-art in de-icing technology, and a series of small-scale tests at the SL Ross laboratory to evaluate candidate technologies.
2006	Pour Point Depressants Studies	Measure the affect of pour point depressors on the viscosity and "pump-ability" of cold, viscous recovered and stored oil and oil emulsions. Pour point depressors are introduced in ppm. They are typically used in some oil production processes, but had not yet been examined for spilled oil transfer.
2006 and ongoing	Potential Places of Refuge (PPOR)	PPOR are pre-identified sites that may aid decision-makers in responding to vessels in distress. These plans are tailored to protect sensitive areas from impacts from possible spills and are map-based to save time during the critical first few hours of a vessel response. The following is a summary of the PPOR initiatives thus far by
2007	Vessel Emergency Towing System (ETS)	Develop emergency towing capabilities for disabled vessels using locally available tugboats in conjunction with ETS equipment that may be stationed in strategic locations in Alaska or air deployable via US Coast Guard or other
2007	International Oil & Ice Workshop, 2007	Workshop on advancing spill response in cold water and ice. Provided an opportunity to bring together an international audience with this common interest. The two-day technical program was made up of presentations by recognized experts on a wide range of key topics including:
2007	Mechanical Recovery Systems for Ice-Infested Waters – Examination of Technologies for	A report identifying the existing state-of-technology for mechanical recovery in sea ice, and investigating any new mechanical recovery systems that may be transferable for use in ice-infested waters. More information is available at: http://dec.alaska.gov/spar/ipp/nscharter.htm

YEAR	PROJECT TITLE	PROJECT DESCRIPTION
2007	Beaufort Sea Current Study	A report describing analyses designed to estimate the distance and direction an oceanic oil spill could travel during each of the two primary circulation regimes found in the nearshore Beaufort Sea: (1) under landfast ice during winter and (2) in open water or partial ice cover during summer. More information available at: http://dec.alaska.gov/spar/ipp/nscharter.htm
2008	Alaska In Situ Burning Guidelines	The Alaska in situ burning guidelines are used by the Alaska Department of Environmental Conservation, US Coast Guard, and US Environmental Protection Agency on-scene coordinators to authorize an emergency in situ burn of oil. More information is available at:
2008	Ground Penetrating Radar (GPR) Workshop and Demonstration	A two-day GPR workshop was held on the North Slope to familiarize ADEC, ADNR, BPXA, ConocoPhillips, and ACS spill response personnel in using the GPR. ACS now has an operational GPR system on the North Slope.
2009–2010	Airborne GPR for Detecting Oil In and Under Ice	Continued studies of airborne supported ground penetrating radar (GPR) for detecting oil under sea ice. This project focuses on hardware development that will produce two prototype, higher-powered GPR systems that can be tested in Arctic field environments using commonly available light helicopters. The goal is to significantly expand
2009–2010	ADEC Tundra Treatment Manual	The initial document was produced in 2001. Additional research and studies are warranted to validate the procedures in the document, and documenting results of actual case studies of past spills that have impacted the tundra. Work includes field investigations and revising the guidelines, followed by changes to the manual, then
2009–2010	Oleophillic Skimmer Research	In controlled conditions of cold and broken ice, test the effects on the Crucial disc skimmer’s operation and durability and the skimmer’s oil recovery rate and efficiency including the skimmer’s ice-processing capability. In a test tank, measure the effects and recommend skimmer modifications to reduce ice interference in order to
Ongoing	ShoreZone Mapping	ShoreZone is a mapping and classification system that specializes in the collection and interpretation of low-altitude aerial imagery of the coastal environment. Its objective is to produce an integrated, searchable inventory of geomorphic and biological features of the intertidal and nearshore zones, which can be used as a tool for science,
		For other R&D projects, see: http://dec.alaska.gov/spar/perp/r_d/research_list.htm