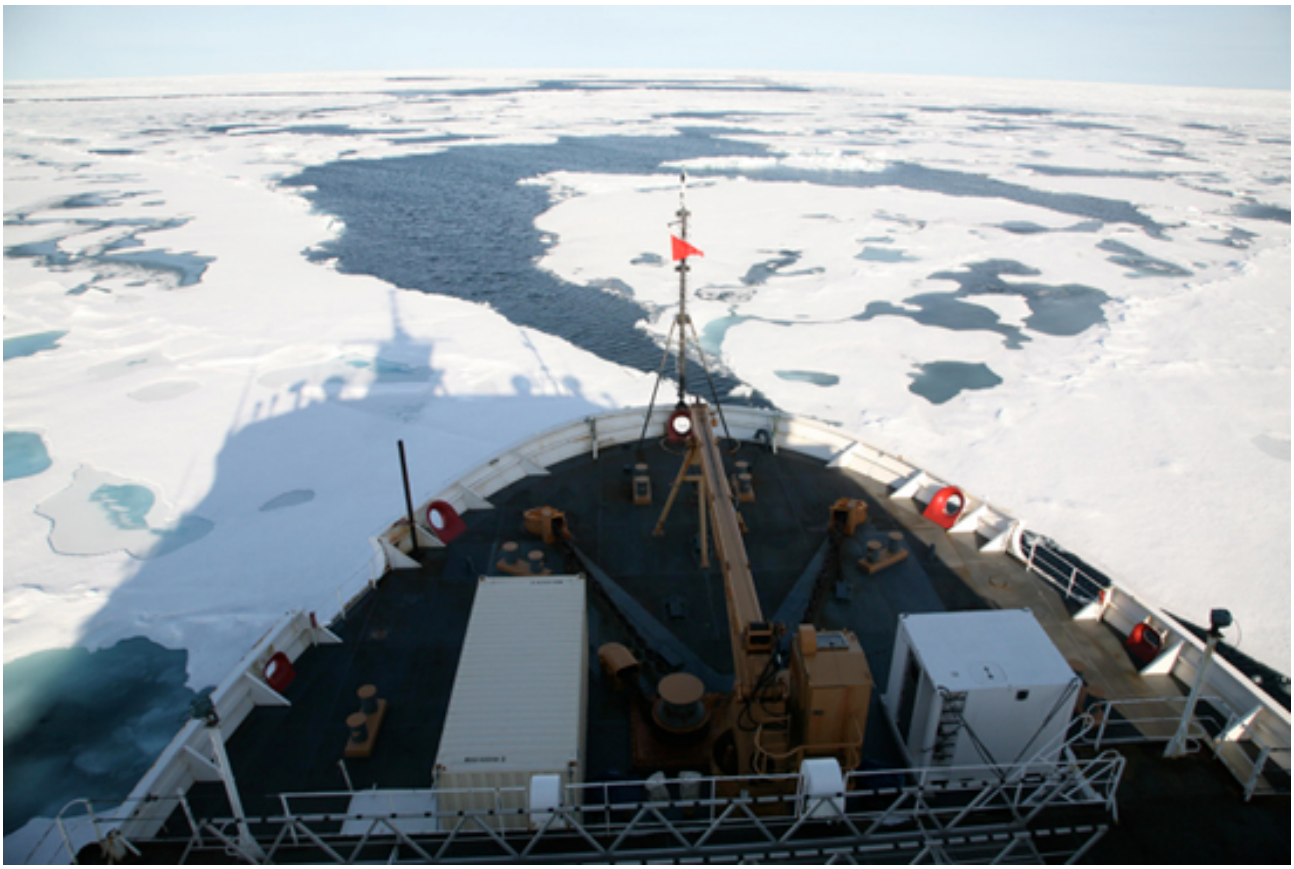


Arctic Nautical Charting Plan

A Plan to Support Sustainable Marine Transportation in Alaska and the Arctic

Office of Coast Survey
Marine Chart Division

February 15, 2013

Record of Changes

Page	Change
3	Added information about feedback on the Arctic Nautical Charting Plan.
6	Added "Planned New Arctic Charts" map with list of planned and recently published charts.
8	Updated mining employment and fishery landings information.
9	Updated cruise and tourist industry information.
9, 27	Updated Northern Routes section and added new map showing possible routing measures
10-12	Updated information and map about the national Continuously Operating Reference Station (CORS) network.
10, 13	Updated information and map about progress on the collection of gravity data for the NGS Gravity for the Redefinition of the American Vertical Datum (GRAV-D) program.
15	Updated "Age of Shoreline and Planned Survey Areas" map
16-17	Updated information and map about the National Water Level Observation Network (NWLON) and sea level data.
19-20	Updated Hydrographic Surveys section and map of recent and planned surveys, including Hydrographic Survey Division plans for surveys to be conducted from 2013 through 2018 (shown in dark green), depiction of hydrographic surveys completed from 2008 through 2012 (shown in light green) and depiction of planned reconnaissance survey areas (green diagonal stripes) and completed survey track lines (dark green lines). Note that changes in the hydrographic survey footprints shown on the overview map have not been incorporated into the individual planned Arctic chart graphics on pages 24-54.
19, 21	Added Automated Information System section and map.
24-57	Added chart numbers, national stock numbers and NGA reference numbers for all planned new charts.
26, 37-38	Modified specification for Kotzebue Harbor & Approaches • Added chart number of 16161 • Extended footprint southward and westward • Changed scale from 1:30K to 1:50K • Added 1:25K Kotzebue Harbor inset • Planned for future 1:25K Cape Blossom inset • Updated sources • Noted 1st edition publication date of April 2012
6, 12, 13, 15, 20, 21	Updated the base map used on many of the graphics showing various charting related information. Changes include: • Differentiated between planned new chart coverage and newly published charts. • Added the Arctic Circle. • Added the Arctic definition from the Marine Mammal Protection Act (Above 60°N).

Commenting on the Arctic Nautical Charting Plan

Submitting Comments

You are invited to comment on the Arctic Nautical Charting Plan through the NOAA Office of Coast Survey (OCS) Inquiry and Discrepancy System at http://ocsdata.ncd.noaa.gov/idrs/discrepancy.aspx.

In the on-line form, enter "Arctic Nautical Charting Plan" in the "OTHER PRODUCTS" box and enter comments or questions in the "DESCRIPTION OF DISCREPANCY" box.

Feedback may also be sent to:

National Ocean Service, NOAA (N/CS2)
Attention: Arctic Nautical Charting Plan
1315 East West Highway
Silver Spring, MD 20910-3282

Contacts from Previous Edition

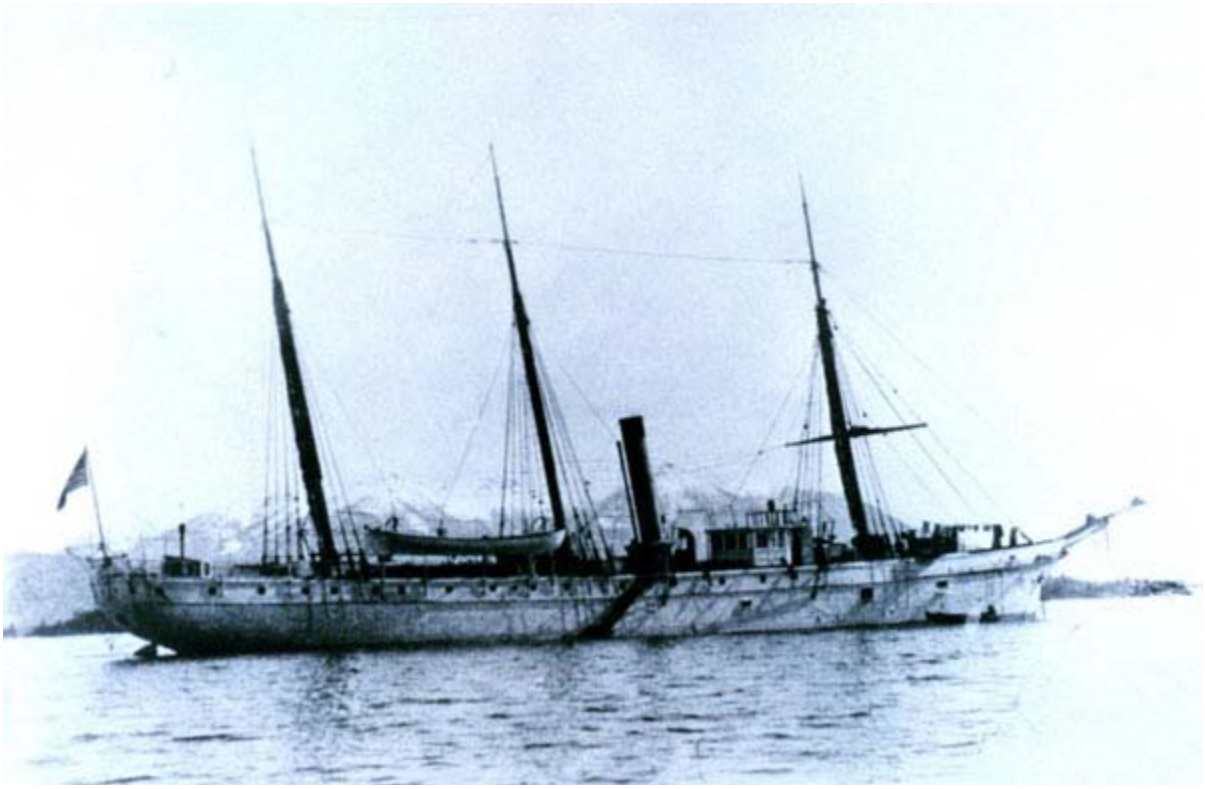
As is this edition, the previous edition (June 1, 2011) of the Arctic Nautical Charting Plan was available for review on the OCS website. Specific outreach was also made to individuals from the organizations listed below.

The Director of the NOAA Office of Coast Survey and the Chief of the Marine Chart Division meet with individuals from the following organizations:

- City of Kotzebue, Capital Projects Department
- Marine Exchange of Alaska
- NOAA, National Marine Fisheries Service, Alaska Fisheries Science Center
- NOAA, National Weather Service, Environmental & Scientific Services Division
- NOAA, National Weather Service, Marine, Public & Fire Weather Programs
- Shell Exploration and Production Company
- U.S. Army Corps of Engineers, Alaska District Operations Branch
- U.S. Coast Guard, District 17 Prevention Division
- U.S. Coast Guard, District 17 Waterways Management
- UMIAQ, subsidiary of Ukpeaġvik Iñupiat Corporation

The NOAA Alaska Navigation Manager made the following contacts:

- Met with citizens in the villages of:
  - Barrow
  - Kotzebue
  - Nome
- E-mail correspondence with:
  - Cully Corporation
  - Kawerak Corporation
  - NANA Corporation
- Following a presentation at an Alaska Harbormasters meeting, met with harbormasters from:
  - Bristol Bay, AK
  - Dutch Harbor, AK
  - Nome, AK
- Distributed copies and discussed the Plan with maritime industry personnel from:
  - Crowley
  - Vitus Marine



Coast Survey Steamer *Hassler*

CONTENTS

On the cover: US Coast Guard icebreaker *Healy*. NOAA photo, published in the Polar Field Services newsletter, *Field Notes,* "Breaking the Ice" at http://polarfieldservice.wordpress.com/category/geological-sciences

Arctic Nautical Charting Plan

January 2013

150°W

CHUKCHI SEA

16079
1:20,000
Barrow

47943 48149 48767 48973 49177 49590 49794

Point Barrow

50000

Planned New Arctic Charts and Existing 1:400,000 and Larger Scale Charts

Chart Label Key
Chart Number
Scale
Chart Title

Legend
- New Arctic Charts
- Planned Arctic Charts
- New NOAA, Former NGA Chart
- Existing 1:400 K & Larger Charts

Cape Lisburne

Point Hope

16140
1:200,000
Point Hope

16145
1:40,000
Delong Mountain Terminal
(Red Dog Mine)

16161
1:50,000
Kotzebue Harbor and Approaches
Published April 2012

KOTZEBUE SOUND

16160
1:200,000
Kotzebue Sound

16190
1:100,000
Bering Strait North

Kotzebue Harbor
1:25,000 Inset

Cape Blossom
1:25,000 Inset

Arctic Circle 66°33' N

Cape Dezhneva

Chukotskiy Peninsula

Little Diomede Island
1:40,000 Inset

Cape Prince of Wales

ALASKA

16210
1:100,000
Bering Strait

16220
1:313,350
St Lawrence Island to Bering Strait

NORTON SOUND

St Lawrence Island

RUSSIA

UNITED STATES

16260
1:300,000
West Yukon Delta,
Nunivak Island to Norton Sound

Cape Romanzof

BERING SEA

16282
1:100,000
East Nunivak Island,
Etolin Strait

St Matthew Island

16281
1:100,000
West Nunivak Island

Nunivak Island

16280
1:300,000
Nunivak Island

16301
1:100,000
Northern
Kuskoswim Bay

Boundary of the Arctic as defined by the Marine Mammal Protection Act
"Marine and estuarine waters north of 60° N latitude."

60°N

16320
1:300,000
East Bristol Bay

BRISTOL BAY

16310
1:300,000
West Bristol Bay

Pribilof Islands

Kodiak Island

GULF OF ALASKA

Boundary of the Arctic as defined by the Arctic Research and Policy Act
"All United States and foreign territory north of the Arctic Circle and all United States territory north and west of the boundary formed by the Porcupine, Yukon, and Kuskokwim Rivers; all contiguous seas, including the Arctic Ocean and the Beaufort, Bering and Chukchi Seas; and the Aleutian chain."

New Arctic Chart		
16161	1:50,000	Kotzebue Harbor and Approaches
New NOAA, Former NGA Chart		
16220	1:313,350	St Lawrence Island to Bering Strait
Planned Arctic Charts		
16079	1:20,000	Barrow
16145	1:40,000	Delong Mountain Terminal (Red Dog Mine)
16190	1:100,000	Bering Strait North
16210	1:100,000	Bering Strait
16281	1:100,000	West Nunivak Island
16282	1:100,000	East Nunival Island - Etolin Strait
16301	1:100,000	Northern Kuskoswim Bay
16140	1:200,000	Point Hope
16160	1:200,000	Kotzebue Sound
16260	1:300,000	West Yukon Delta - Nunivak Island to Norton Sound
16280	1:300,000	Nunivak Island
16310	1:300,000	West Bristol Bay
16320	1:300,000	East Bristol Bay

Introduction

The Arctic's wealth in natural resources is matched only by its inherent beauty. Alaska has 6,640 miles of coastline,[1] much of which lies north of the Alaska Peninsula. It is a treasure that contains considerable economic resources, including oil, natural gas, and minerals. Off the Alaskan coast, the Bering and Chukchi Seas lead to the Northwest Passage past Canada and the Northern Sea Route past Russia, routes that could significantly reduce the time and cost of transiting between the Pacific and Atlantic Oceans.

To ensure sustainable marine transportation throughout the Arctic, the infrastructure that supports safety, environmental protection, and commercial efficiency must be enhanced. Modern nautical charts of the appropriate scale can provide the foundation for improving transportation in the area. They will also supply the base geospatial data used by federal, state, and local entities in fishery stock assessments, coastal zone management, energy exploration and other uses.

Additional NOAA nautical chart coverage will enhance the American Arctic Marine Transportation System by depicting shoreline, depths, hazards and recommended routes throughout the region. Currently, charting data in much of the Arctic is inadequate or nonexistent. According to the *U.S. Coast Pilot*, much of the Bering Sea area is "only partially surveyed, and the charts must not be relied upon too closely, especially near shore. The currents are much influenced by the winds and are difficult to predict; dead reckoning is uncertain, and safety depends upon constant vigilance."[2]

It is time to build the foundation for the increasing marine transportation in the Arctic.

This Office of Coast Survey nautical charting plan devoted exclusively to the Arctic. It presents an overview of the many drivers that have brought the need for a more robust maritime transportation infrastructure to the forefront. It provides detailed plans for the layout of additional nautical chart coverage (shown on page 6) and describes the requisite activities needed to build and maintain these charts. It supports the recommendations of the Interagency Ocean Policy Task Force[3] and NOAA's *Arctic Vision & Strategy.*[4]

Office of Coast Survey

The Office of Coast Survey is the nation's oldest federal science agency, established as the "Survey of the Coast" by President Thomas Jefferson in 1807. Coast Survey has the responsibility for charting U.S. and territorial waters to the limits of the Exclusive Economic Zone, an area of about 3.4 million square nautical miles. Throughout that vast expanse, Coast Survey and its sister navigation services offices provide the navigation products and assistance that reduce the risk of marine accidents and support the nation's economy.[5]

Coast Survey has three operational divisions with distinct, complementary roles in its navigation mission.

The Marine Charting Division compiles and maintains nautical charts for navigation in the coastal areas of the United States and the Great Lakes. The suite of products includes over 1,000 paper nautical charts and more than 800 electronic navigational charts. The charting division also documents critical chart corrections that are then published by the U.S. Coast Guard.

The Hydrographic Surveys Division coordinates overall hydrographic, bathymetric, and oceanographic survey activities, including data acquisition and processing. It sets standards and priorities for survey projects and programs conducted by NOAA survey ships or private contractors.

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[1] State of Alaska, "Alaska Information," at http://www.commerce.state.ak.us/ded/dev/student_info/learn/facts.htm
[2] NOAA, "Bering Sea: Chart 16006," *U.S. Coast Pilot, Alaska: Cape Spencer to Beaufort Sea*, (NOAA, Washington: 2010), Chapter 8, paragraph 3.
[3] White House Council on Environmental Quality, *Final Recommendations of the Interagency Ocean Policy Task Force, July 19, 2010* at http://www.whitehouse.gov/files/documents/OPTF_FinalRecs.pdf
[4] NOAA, NOAA's Arctic Vision & Strategy, at www.arctic.noaa.gov/docs/arctic_strat_2010.pdf
[5] NOAA, *Office of Coast Survey, 2010 - 2015 Strategic Plan*, "OCS Purpose and Past," page 4.

The Navigation Services Division interacts with nautical product customers through navigation managers who are located throughout the country. The division's navigation response teams are mobile, quick-response, hydrographic survey parties that respond to emergency survey needs, such as locating submerged debris after hurricanes. The division also maintains the *U.S. Coast Pilot*, a nine-volume series of supplemental information for navigation that includes federal regulations, channel descriptions, and weather information.

Customers

The waterways are vitally important to Alaskan communities for transportation, recreation and the resources they contain. Ships are the primary transportation mode for importing the goods necessary to keep society functioning and to export crude oil, timber, fish, and other raw materials. Tourism is a major factor in the Alaskan economy; approximately one million tourists visit the state each year via cruise ships.

People and organizations involved in sea commerce include deep draft commercial ships such as container ships, tank vessels, and bulk carriers; tug and barges, ferries, cruise ships, tour boats, military vessels, Coast Guard cutters, excursion boats and fishing vessels. Recreational vessels round out the list of users of Alaskan waters. Many of the commercial vessels require the services of a pilot to make safe passage into and out of a port. They depend upon NOAA to provide charts and publications that are current with the latest depth information, aids to navigation, accurate shoreline, and the other features necessary for safe navigation.

Ports of Call

Energy and Mineral Resources

Mining is a historic cornerstone of Alaska's economy. Many roads, docks, and other infrastructure throughout the state were built to serve the mining industry. Major communities like Fairbanks, Juneau, and Nome were founded on mining activity. Today, a rejuvenated mining industry brings a broad range of benefits, offering some of the highest paying jobs in both urban and rural Alaska, as well as generating significant local government tax payments and royalties to Native corporations for activity on their land.

Alaska's mining industry includes exploration, mine development, and mineral production. The industry produces zinc, lead, gold, silver, and coal, as well as construction minerals such as sand, gravel, and rock. Alaska's seven large operating mines (Fort Knox, Greens Creek, Red Dog, Usibelli, Pogo, Kensington, and Nixon Fork) provided more than 2,250 full-time jobs of the nearly 9,500 mining industry jobs in Alaska last year.[6]

Fishing

Thirteen of the top 30 ports for fishery landings, by value, are in Alaska. Dutch Harbor-Unalaska is the busiest fishing port in the country, bringing in 705.6 million pounds of fish in 2011 (the last year for which statistics are available). Naknek-King Salmon, another major Arctic fishing port, received 99.1 million pounds of fish in 2011. The combined catch brought into both of these harbors was valued at over $293 million.[7]

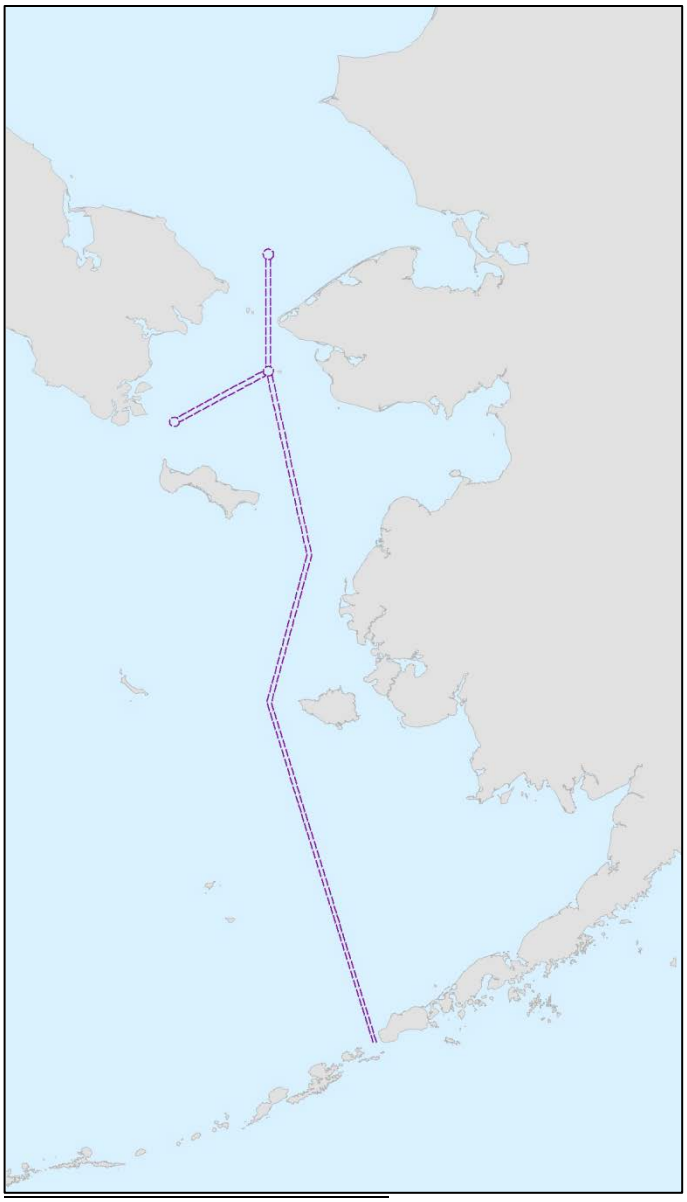
[6] Resource Development Council for Alaska, "Alaska's Mining Industry: Background," at www.akrdc.org/issues/mining/overview.html#Anchor-Background-14210

[7] NOAA, National Marine Fisheries Service, "Total Commercial Fishery Landings At Major U. S. Ports," at http://www.st.nmfs.noaa.gov/st1/commercial/landings/lport_yeard.html

Cruise Industry

In 2010, 58% of Alaska's 1.5 million visitors were cruise ship passengers. Direct visitor industry spending is more than $2 billion annually.[8] Though the total cruise capacity in Alaska is down by more than 10% from 2009 to 2010, the industry has experienced overall growth over the last ten years.[9]

Northern Routes



Arctic sea ice has been observed to be decreasing in extent and thickness during the second half of the 20th century and early 21st century. Global Climate Model simulations indicate a continuing retreat of sea ice, but also show that the winter sea ice cover will remain. There is a possibility of an ice-free Arctic Ocean for a short period in summer perhaps as early as 2015. This would mean the disappearance of multi-year ice, as no sea ice would survive the summer melt season.[10]

A transit between Vladivostok and Rotterdam, using the northern route, can save approximately 10 days and $300,000 per ship. Alternately, the voyage is nearly 11,000 nautical miles through the Pacific, Indian, and Atlantic Oceans – with transits through the Suez Canal and the Mediterranean Sea.

The U.S. Coast Guard is conducting a Port Access Route Study to evaluate: The continued applicability of and the need for modifications to current vessel routing measures; and the need for creation of new vessel routing measures in the Bering Strait. The goal of the study is to help reduce the risk of marine casualties and increase the efficiency of vessel traffic in the study area.[11]

The map at left shows some possible paths that are being considered for routing measures. If it is determined that new vessel routing measures are required, the final configuration may be different than the ones shown here.

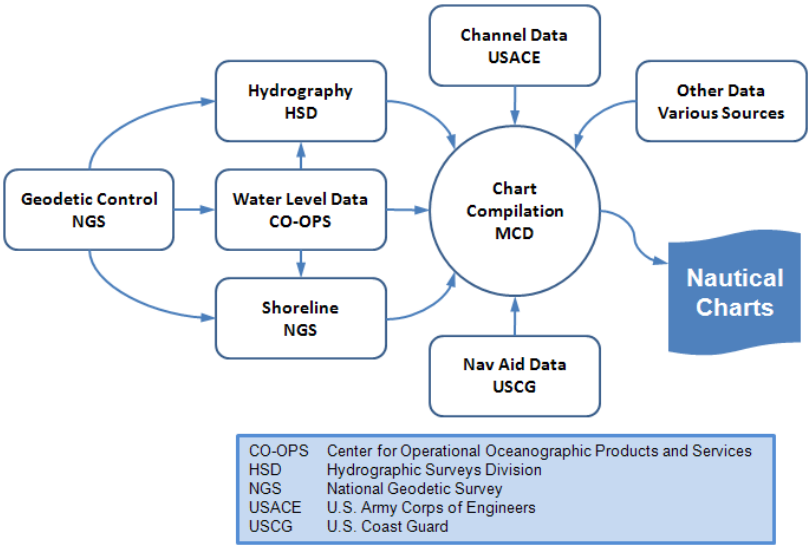
[8] Resource Development Council for Alaska, "Alaska Tourism Industry," at www.akrdc.org/issues/tourism/overview.html

[9] Gene Sloan, "New Alaska law brings steep drop to taxes on Cruise Ship Passengers," USA Today, at http://travel.usatoday.com/cruises/post/2010/06/new-alaska-law-brings-steep-drop-to-tax-on-cruise-ship-passengers/97927

[10] Arctic Council, *Arctic Marine Shipping Assessment 2009 Report*, "Arctic Marine Geography, Climate and Sea Ice:," page 4, at http://www.arctic.gov/publications/AMSA_2009_Report_2nd_print.pdf

[11] GPO, "Port Access Route Study: In the Bering Strait," Federal Register Vol 75, No. 215, Monday, Nov. 8, 2010, Proposed Rules, Pages 68568-68570, at http://www.gpo.gov/fdsys/pkg/FR-2010-11-08/html/2010-28115.htm

Building a Nautical Chart: A Partnership



The Marine Chart Division compiles and updates nautical charts, but it depends on several partners to provide the data used to build and maintain each chart.

A nautical chart shows water depth, shoreline, prominent topographic features, aids to navigation, and other information pertinent to marine transportation.[12] Producing a nautical chart requires accurate sea level information, hydrographic surveys, geodetic control, shoreline and channel delineation, and aids to navigation data.

Several different NOAA and non-NOAA organizations provide this information to the Marine Chart Division in various formats. The production of some of these data sources depend on the input from still other organizations.

Much of the data needed for building charts for the Arctic still needs to be produced, and execution of this *Arctic Nautical Charting Plan* will require close coordination among several federal agencies. The following sections provide descriptions of four principal chart production inputs.

Geodetic Controls

NOAA's National Geodetic Survey (NGS) defines, manages, and provides public access to the National Spatial Reference System (NSRS), the coordinate system that provides the geodetic foundation for mapping and charting as well as all other positioning activities in the United States. NOAA's geodesy program has grown out of a 200-year old requirement to provide the nation with geodetic and geographic positioning services. A 2009 socioeconomic study estimated that the NSRS provides more than $2.4 billion in potential annual benefits to the U.S. economy (*Socio-Economic Benefits Study: Scoping the Value of CORS and GRAV-D*, Levenson 2009).

The Arctic currently has limited geodetic infrastructure for accurate positioning and elevations; in particular, the region lacks the gravity data necessary for a modern vertical reference system. Overhauling the Arctic geospatial framework of geodetic control and water levels will correct meters-level positioning errors in the region and enable centimeter-level measurements. These corrections will support critical needs, including marine transportation, sea level rise monitoring, understanding of erosion and permafrost thaw impacts to infrastructure, oil and gas resource exploration, and storm surge modeling.

NGS manages a national Continuously Operating Reference Station (CORS) network of highly accurate GPS receivers that continuously collects radio signals broadcast by Global Navigation Satellite System (GNSS) satellites. (NGS provides access to GPS data from this network free of charge via the Internet.) The CORS system enables positioning accuracies that approach a few centimeters relative to the National Spatial Reference System. CORS are used to monitor 3-D land movement over time and are critical for activities requiring precise positioning. NGS is working with partners to add CORS stations to fill some critical gaps in coverage for the region. In 2010, for example, NGS added over 20 stations owned and operated by partners such as the Plate Boundary Observatory to the NOAA CORS Network in Alaska.

[12] NGA, *American Practical Navigator (Bowditch),* Chapter 3, "Nautical Charts," page 23.

Gaps remain, however. In addition to enhancing CORS coverage in the region, NOAA needs to expand the number of co-located CORS and National Water Level Observation Network stations to improve measurement of local sea level change and land movement in the region.

Furthermore, installation of a small subset of foundation CORS in the region is needed to supplement the network. The foundation CORS will improve the accuracy of the International Terrestrial Reference Frame to a level capable of measuring absolute global sea level rise on the order of millimeters per year. These foundation CORS must be extraordinarily stable and co-located with other space geodetic techniques, such as Very Long Baseline Imterferometry, Satellite Laser Ranging, and Doppler Orbitography and Radiopositioning Integrated by Satellite. A map of CORS receivers as of January 2013 is on page 12. The latest CORS information is maintained at www.ngs.noaa.gov/CORS.

The Gravity for the Redefinition of the American Vertical Datum, or GRAV-D, is an ambitious program initiated by NGS to redefine the vertical datum of the United States. NGS is working to collect airborne gravity data in Alaska as a priority. This is the most cost-effective way to establish geodetic control in these areas and will allow the increase of elevation measurement accuracy from one meter (or worse) to two centimeters. Recent collection efforts are shown on the map found on page 13.

Arctic Nautical Charting Plan

January 2013

150°W

CHUKCHI SEA

Point Barrow

20000

Continuously Operating Reference Station (CORS) Receivers

Legend

- CORS
- New Arctic Charts
- Planned Arctic Charts
- New NOAA, Former NGA Chart

Number within or next to chart outline indicates chart scale

Cape Lisburne

Point Hope

200000

40000

KOTZEBUE SOUND

Arctic Circle 66°33' N

Kotzebue Harbor
1:25,000 Inset

Cape Blossom
1:25,000 Inset

313350

Cape Dezhneva

Chukotskiy Peninsula

Little Diomede Island
1:40,000 Inset

200000

Cape Prince of Wales

100000

100000

ALASKA

NORTON SOUND

St Lawrence Island

RUSSIA

UNITED STATES

Boundary of the Arctic as defined by the Arctic Research and Policy Act

"All United States and foreign territory north of the Arctic Circle and all United States territory north and west of the boundary formed by the Porcupine, Yukon, and Kuskokwim Rivers; all contiguous seas, including the Arctic Ocean and the Beaufort, Bering and Chukchi Seas; and the Aleutian chain."

300000

Cape Romanzof

BERING SEA

St Matthew Island

60°N

100000

100000

Nunivak Island

100000

300000

Boundary of the Arctic as defined by the Marine Mammal Protection Act

"Marine and estuarine waters north of 60° N latitude."

BRISTOL BAY

300000

300000

Kodiak Island

Pribilof Islands

GULF OF ALASKA

60°N

Arctic Nautical Charting Plan

January 2013

150°W

60°N

CHUKCHI SEA

2011

20000

Point Barrow

2011

Airborne
GRAV-D Collection

Legend
- New Arctic Charts
- Planned Arctic Charts
- New NOAA, Former NGA Chart
- 2012 GRAV-D
- 2011 GRAV-D
- 2010 GRAV-D
- Pre-2010 GRAV-D

Number within or next to chart outline indicates chart scale

Cape Lisburne

Point Hope

40000

200000

KOTZEBUE SOUND

25000
50000

Kotzebue Harbor
1:25,000 Inset

Cape Blossom
1:25,000 Inset

2012

Arctic Circle 66°33' N

313350

Cape Dezhneva

Chukotskiy Peninsula

Little Diomede Island
1:40,000 Inset

Cape Prince of Wales

200000

100000

100000

ALASKA

2009

NORTON SOUND

Boundary of the Arctic as defined
by the Arctic Research and Policy Act

"All United States and foreign territory north of the Arctic Circle and all United States territory north and west of the boundary formed by the Porcupine, Yukon, and Kuskokwim Rivers; all contiguous seas, including the Arctic Ocean and the Beaufort, Bering and Chukchi Seas; and the Aleutian chain."

St Lawrence Island

RUSSIA

UNITED STATES

2010

300000

Cape Romanzof

BERING SEA

Boundary of the Arctic as defined
by the Marine Mammal Protection Act

"Marine and estuarine waters north of 60° N latitude."

St Matthew Island

100000

100000

Nunivak Island

2008

100000

300000

BRISTOL BAY

300000

300000

Kodiak Island

Pribilof Islands

GULF OF ALASKA

60°N

Shoreline Surveys

The National Geodetic Survey provides shoreline data that Coast Survey uses to compile nautical charts. National shoreline data also provides critical baseline information to manage coastal resources and to define America's territorial limits, including the Exclusive Economic Zone. The National Shoreline is fundamental to the growth of the nation's shipping, manufacturing, export, coastal development, and insurance industries.

NGS uses various technologies to delineate the shoreline, including airborne imagery, high-resolution satellite imagery, and lidar. This also requires accurate sea level information (water levels and datum references) provided by CO-OPS.

NOAA's goal is to update 10% of the National Shoreline, and 20% of the nation's critical ports, every year. This update frequency would provide contemporary shoreline that is no older than 10 years. Currently, the NGS Remote Sensing Division is only able to update approximately 3 to 5% of the National Shoreline annually. This leaves many regions with outdated, and often inaccurate, shoreline. Less than 10% of Alaska has contemporary shoreline data, and less than 1% is mapped annually. The map showing the age of the shoreline surveys conducted in Arctic Alaska is on page 15.

NOAA is limited in its ability to meet mission goals in coastal Alaska due to a lack of historical datasets and integrated frameworks for the physical, chemical, biological and socioeconomic parameters that support coastal management needs. Most of the shoreline along Alaska's northern and western coasts has not been mapped since 1960, if ever, and confidence in the shoreline depicted on the region's nautical charts is extremely low.

The 2008 Alaska Climate Impact Assessment Commission observed that "accurate shoreline maps are essential to develop accurate coastal erosion and storm surge forecasts, and address land-use issues." The commission went on to state: "updates to technical maps requires an accurate vertical datum—airborne sensors and topographic lidar technology would produce accurate shoreline measurements to address sea level rise and coastal erosion issues." Further, according to the January 2009 *Climate Change Science Project Synthesis Report 4.1*, NOAA "lacks crucial pieces of information at the right resolution and detail to deliver a comprehensive understanding of how coastal landforms will actually respond to sea level rise, given the coupling with storm impacts and the interaction with threshold events or tipping points."

Arctic Nautical Charting Plan

January 2013

150°W

CHUKCHI SEA

20000

Point Barrow

Age of Shoreline Surveys and Planned Survey Areas

Legend

- New Arctic Charts
- Planned Arctic Charts
- New NOAA, Former NGA Chart
- 2000-2012 Shoreline
- 1960-1999 Shoreline
- 1927-1959 Shoreline
- 1886-1926 Shoreline
- No Shoreline Survey
- 2013 Planned Shoreline Surveys

Number within or next to chart outline indicates chart scale

Cape Lisburne

Point Hope

40000

200000

KOTZEBUE SOUND

25000

50000

Kotzebue Harbor
1:25,000 Inset

Arctic Circle 66°33' N

Cape Blossom
1:25,000 Inset

313350

Cape Dezhneva

Chukotskiy Peninsula

Little Diomede Island
1:40,000 Inset

200000

Cape Prince of Wales

100000

100000

ALASKA

Boundary of the Arctic as defined by the Arctic Research and Policy Act

"All United States and foreign territory north of the Arctic Circle and all United States territory north and west of the boundary formed by the Porcupine, Yukon, and Kuskokwim Rivers; all contiguous seas, including the Arctic Ocean and the Beaufort, Bering and Chukchi Seas; and the Aleutian chain."

NORTON SOUND

St Lawrence Island

RUSSIA

UNITED STATES

300000

Cape Romanzof

BERING SEA

Boundary of the Arctic as defined by the Marine Mammal Protection Act

"Marine and estuarine waters north of 60° N latitude."

St Matthew Island

100000

100000

Nunivak Island

100000

300000

BRISTOL BAY

300000

300000

Kodiak Island

Pribilof Islands

GULF OF ALASKA

60°N

60°N

Sea Level Data

NOAA's Center for Operational Oceanographic Products and Services (CO-OPS) National Water Level Observation Network (NWLON) provides the reference system of tidal and water level datums for the U.S. Tidal and water level datums derived from the NWLON have been important primarily for navigation and shoreline boundary purposes. Water level time series data from long-term NWLON and short-term subordinate water level stations, relative to the applicable chart datum, are a critical hydrographic component, used for reducing bathymetric data acquired for the production of nautical charts.

For example, the tidal datum of Mean Lower Low Water (MLLW) is the reference datum, or chart datum, for bathymetry on U.S. nautical charts in tidal waters. The International Great Lake Datum is the chart datum for the Great Lakes. Similarly, Mean High Water (MHW) is the reference datum for the National Shoreline and bridge clearances on nautical charts. The NWLON also supports the CO-OPS Physical Oceanographic Real-Time System (PORTS®), which gives mariners real-time data to transit into and out of seaports. The network also supports other monitoring networks, including the National Weather Service's Tsunami Warning Centers.

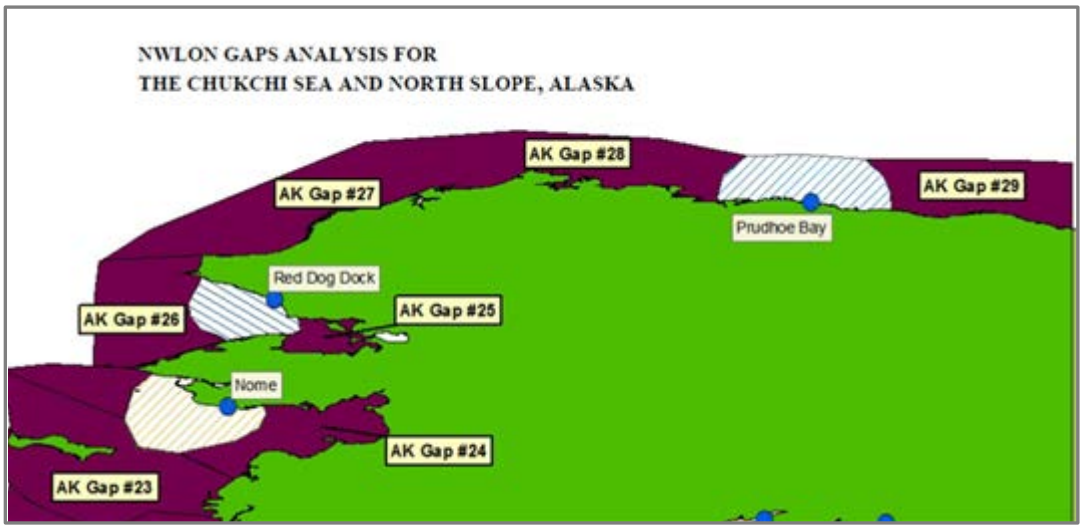
National Water Level Observation Network (NWLON)

CO-OPS operates 26 long-term NWLON tide stations in Alaska, as shown below.[13]

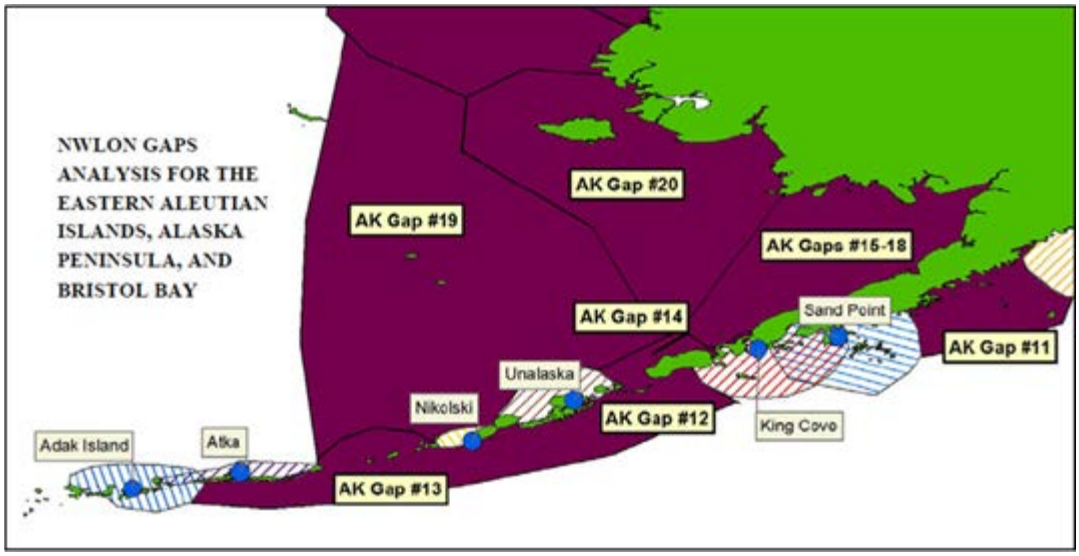
[13] NOAA, CO-OPS, "ODIN MAP" at http://tidesandcurrents.noaa.gov/gmap3

CO-OPS has identified 27 gaps in NWLON coverage in Alaska, and 19 of those are located in western and northern Alaska. Long-term plans envision establishing new NWLON stations in these gap locations. An effort will be made to co-locate NGS CORS stations and new NWLON stations to provide measurements of local sea level change and land movement from the same position. However, funding has not yet been identified and technology for installations in these gap locations has not yet been approved for operations. The following gaps are areas that have inadequate control to determine tidal datums, and also have inadequate knowledge of relative sea level variations and trends.

Aleutian Islands	Attu Island	Bering Strait	Chukchi Sea	Kuskokwim Bay
Amchitka Island	Beaufort Sea	Bristol Bay	Kotzebue Sound	Kvichak Bay



NWLON gap analysis for the Chukchi Sea and North Slope, Alaska



NWLON gap analysis for the eastern Aleutian Islands, Alaska Peninsula, and Bristol Bay

The NWLON gaps in north and western Alaska remain quite large, as shown in the figures above. Unless tide reduction capabilities are increased within specification the data in this region will remain limited.

Coast Survey Charting Support

To support Coast Survey hydrographic surveying for nautical charts, CO-OPS determines the tidal control necessary to provide accurate final tide reducers for bathymetric soundings. The tidal control includes tidal

zoning and time and height offsets, and short term water level gauges required for installation during an OCS survey, if an existing NWLON station does not provide the necessary information. CO-OPS has a relatively sparse collection of historical and present day water level information in the remote western and northern parts of Alaska and determining simple tidal zoning parameters is often quite challenging. Additional gauge installations at multiple locations are needed to support hydrographic surveys in the Arctic. Water level data should be collected and analyzed prior to bathymetric data collection when feasible and locations and priorities will depend upon hydrographic survey requirements.

Datum control in the Arctic is limited, due to the difficulties of maintaining long-term water level stations. Even if NWLON stations are installed in designated "gap areas", they will not provide full datum control until 19 years of data is collected. Therefore, datums computed on less than 19 years of data will have a higher uncertainty. Short-term datums computed at proposed NWLON "gap" stations will be necessary until a 19-year epoch datum becomes available. This process will improve charts available to mariners sooner than would otherwise be the case. Nevertheless, when possible, it is advantageous to collect tidal data well before survey operations commence so a survey can be controlled by a known, more accurate tidal datum.

Emerging Technology

CO-OPS has successfully tested an innovative system to collect water level data in remote cold climate regions that experience problems with ice accumulation. In August 2008, two specially designed bottom-mounted water level gauges were deployed off the coast of Barrow, Alaska, in approximately 100 feet of water. The systems were equipped with a high stability pressure sensor, acoustic modem, disposable ballast, and a pop-up buoy for recovery. The two systems were used to collect water level, temperature, and conductivity data for two years, resulting in a two-year continuous time series and datum determination. It is envisioned that water level data using similar technology will support NOAA applications, such as hydrographic surveys, remotely sensed data acquisitions, marine boundary determination, dredging activities, habitat restoration, and safe, efficient and environmentally sound maritime commerce. CO-OPS is beginning a multi-year project to transition this technology into operations.

VDatum Support

VDatum is a software tool developed and supported by NGS, CO-OPS, and Coast Survey. It transforms geospatial data among a variety of tidal, orthometric, and ellipsoidal vertical datums, allowing for a common reference system. For the model to run accurately, it is necessary to update tidal datums in some areas. CO-OPS has installed several short-term water level gauges for this purpose. To support development of a VDatum model for the region, CO-OPS has identified an additional 86 sites in the Arctic either for installing new short-term water level stations or re-occupying historic stations. CO-OPS will also use the data collected from these stations to develop the tidal zoning necessary to support Coast Survey and NGS planned hydrographic surveys and shoreline mapping activities, as well as other marine transportation services in Arctic. VDatum requires static GPS surveys to determine the relation of tidal datums to both geodetic and ellipsoidal elevations.

Due to the lack of tidal datum control and limited geodetic data in the Arctic the creation of the VDatum product is not expected for a number of years. The completion of the GRAV-D Geoid model will facilitate geodetic control. CO-OPS anticipates installing water level stations throughout Alaska in FY14 to FY18, as part of the VDatum tri-office (CO-OPS, NGS & OCS) operations plan. The lack of datum control in the Arctic will require additional data collection over a number of years to facilitate accurate VDatum development. Any additional short term water level stations installed for hydrographic support in the Arctic will support future VDatum development.

Tidal Current Predictions

CO-OPS has the requirement to update and maintain the U.S. Tidal Current Tables, containing predictions of times and speeds of tidal currents at particular locations. Tidal current predictions assist mariners with making decisions about traveling through an area, using increased current speeds to decrease travel time and using the knowledge of slack water times to best maneuver through a port or harbor. Knowledge of tidal currents also assists with dispersion models such as those necessary for predicting oil spill trajectories. Tidal

currents in the Arctic region of Alaska have not been measured since the early 1950s when only a few days of data were collected, thus tidal current predictions have high uncertainty and are sparsely located. Accurate predictions need at least 35 days of data. CO-OPS plans to deploy current meters and calculate predictions in the Arctic area and approaches of Alaska to support navigation in the western Aleutians, Bristol Bay, Bering Strait, Norton Sound, Kotzebue, Chukchi Sea, and Barrow. Deployments of current meters will require much advanced planning to ensure the proper equipment is deployed with the proper vessels that can withstand the harsh Arctic environment to ensure successful data acquisition. Logistic requirements will increase as vessels, personnel and equipment have to travel to these remote areas where many supplies are limited.

Summary

CO-OPS is actively engaged in expanding its operational capabilities in the Arctic by collecting new observations and exploring new technologies. Funding constraints limit the pace of the expansion, leading to higher product uncertainties in the near term. However, the data will be useful for charting in Alaska and a variety of other applications. The data collected from new water level stations will be used to fill gaps in NWLON, calculate tide predictions and update tidal control stations for OCS hydrographic surveys and NGS shoreline mapping activities. NOAA will also share the updated tidal datums with other federal agencies, such as the U.S. Geological Survey and the U.S. Army Corps of Engineers. The Army Corps of Engineers can use this information to protect the villages from coastal erosion and sea level rise on the western part of Alaska. Coastal managers can use the data in inundation analysis. The NWLON data will also be used to derive long-term local relative sea level change and to perform sea-level trend analyses. Lastly, tidal current data collected will update tidal current predictions, as well as information in the *U.S. Coast Pilot*.

Hydrographic Surveys

Data collection and compilation for nautical charts are the principle objectives of a hydrographic survey. Survey data also support a variety of maritime functions including safe navigation, port and harbor maintenance (dredging), coastal engineering (beach erosion and replenishment studies), coastal zone management, and offshore resource development.

The primary data collected from hydrographic surveys are water depth (bathymetry) and object detection. There is also significant interest in seafloor texture and composition, such as sand, mud, rocks, because of implications for anchoring, dredging, marine construction, pipeline and cable routing, tsunamis, and storm surge modeling. Bathymetric, backscatter and side scan sonar data also supports other NOAA missions, such as fish habitat characterization, bottom type classification and submerged cultural resources management.[14]

The Office of Coast Survey's Hydrographic Surveys Division undertook hydrographic survey projects during the 2011 and 2012 field seasons in Kotzebue Sound, Kuskokwim River and Bay, Unimak and Akutan Passes, as well as reconasance surveys in Bristol Bay and from Unimak Pass through the Bering Strait to Barrow and back. This is only a small portion of the overall Arctic hydrographic survey requirement identified by HSD, which amounts to nearly 40,000 square nautical miles.[15] The division will set the priorities for future operations as the nature of changing requirements are refined. Recent and planned hydrographic surveys are shown on the map on page 20.

Automatic Information System (AIS) Data

Ships using the Automatic Information System transmit their position and other information several times per minute. MCD has found these position reports useful in determining ship transit patterns and uses this data as one of many inputs when considering where to create new nautical charts. A map of recent AIS data is shown on page 21.

[14] NOAA, "Hydrographic Surveying is the Foundation of Nautical Charts," *NOAA Hydrographic Survey Priorities, 2012 Edition*, at http://www.nauticalcharts.noaa.gov/hsd/docs/NHSP-full%20document_2012.pdf, page 5.
[15] NOAA, "Hydrographic Surveying is the Foundation of Nautical Charts," *NOAA Hydrographic Survey Priorities, 2012 Edition*, at http://www.nauticalcharts.noaa.gov/hsd/docs/NHSP-full%20document_2012.pdf, page 12.

Arctic Nautical Charting Plan

January 2013

150°W

CHUKCHI SEA

20000

Point Barrow

Recent Hydrographic Surveys and Plans for Future Surveys

Legend

- New Arctic Charts
- Planned Arctic Charts
- New NOAA, Former NGA Chart
- 2008-2012 Hydro Surveys
- 2013-2018 Hydro Survey Plans
- Hydro Recon Survey Plans

Number within or next to chart outline indicates chart scale

Cape Lisburne

Point Hope

40000

200000

KOTZEBUE SOUND

25000

Kotzebue Harbor
1:25,000 Inset

Arctic Circle 66°33' N

Cape Blossom
1:25,000 Inset

313350

Cape Dezhneva

Chukotskiy Peninsula

Little Diomede Island
1:40,000 Inset

Cape Prince of Wales

100000

ALASKA

Boundary of the Arctic as defined by the Arctic Research and Policy Act

"All United States and foreign territory north of the Arctic Circle and all United States territory north and west of the boundary formed by the Porcupine, Yukon, and Kuskokwim Rivers; all contiguous seas, including the Arctic Ocean and the Beaufort, Bering and Chukchi Seas; and the Aleutian chain."

NORTON SOUND

St Lawrence Island

RUSSIA

UNITED STATES

300000

Cape Romanzof

BERING SEA

St Matthew Island

Boundary of the Arctic as defined by the Marine Mammal Protection Act

"Marine and estuarine waters north of 60° N latitude."

60°N

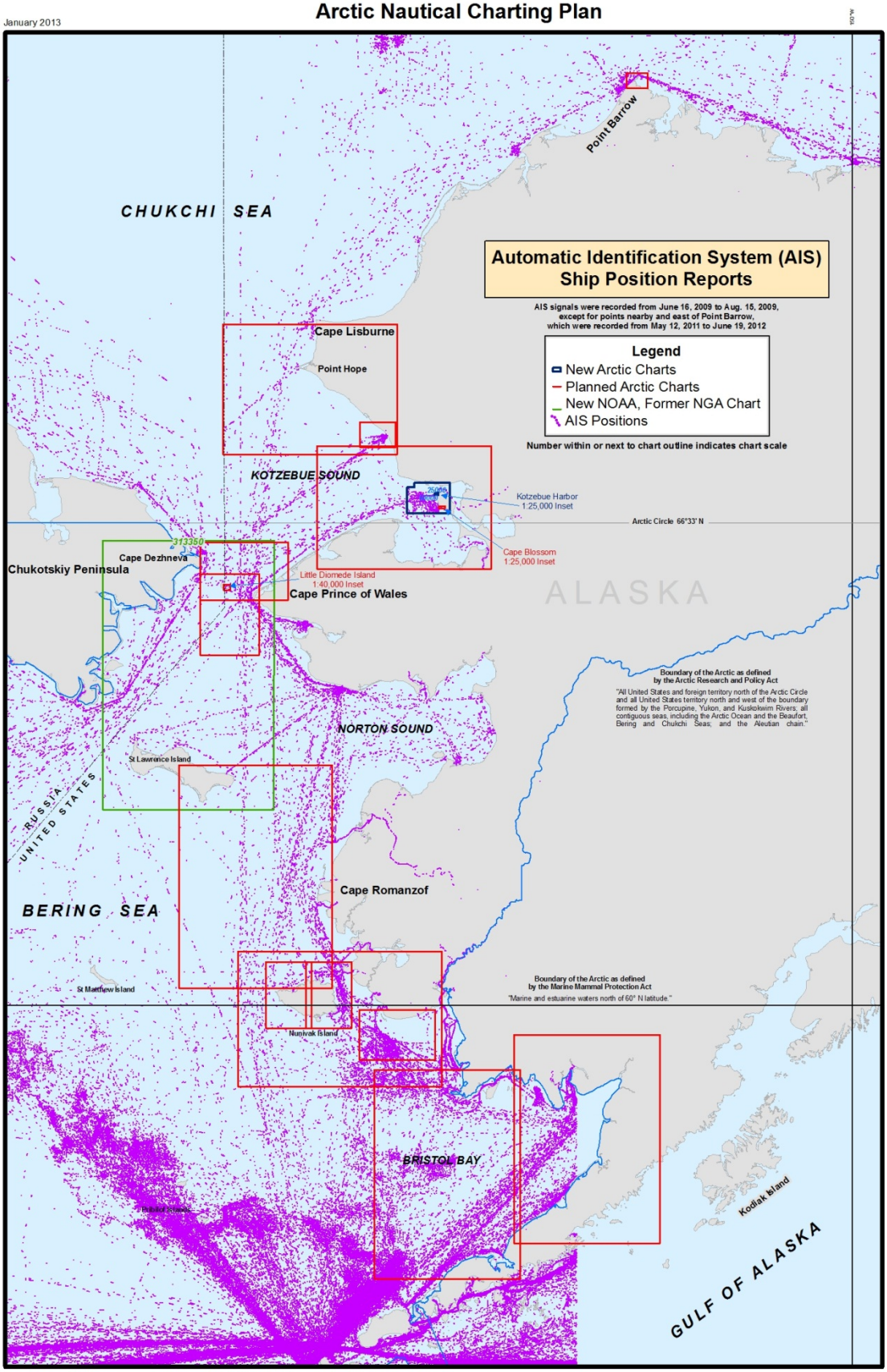
Nunivak Island

BRISTOL BAY

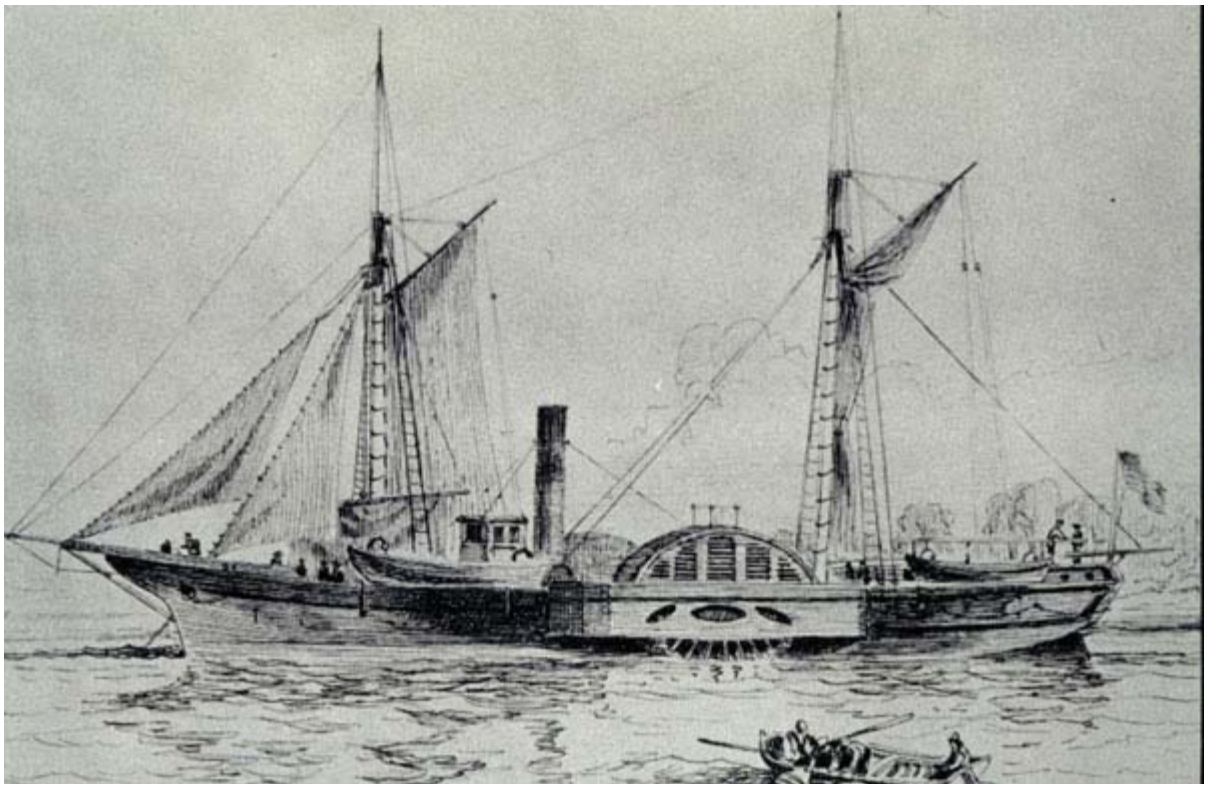
Pribilof Islands

Kodiak Island

GULF OF ALASKA



A higher resolution image of this map may be obtained at:
www.nauticalcharts.noaa.gov/mcd/docs/Arctic_Nautical_Charting_Plan_AIS.pdf.



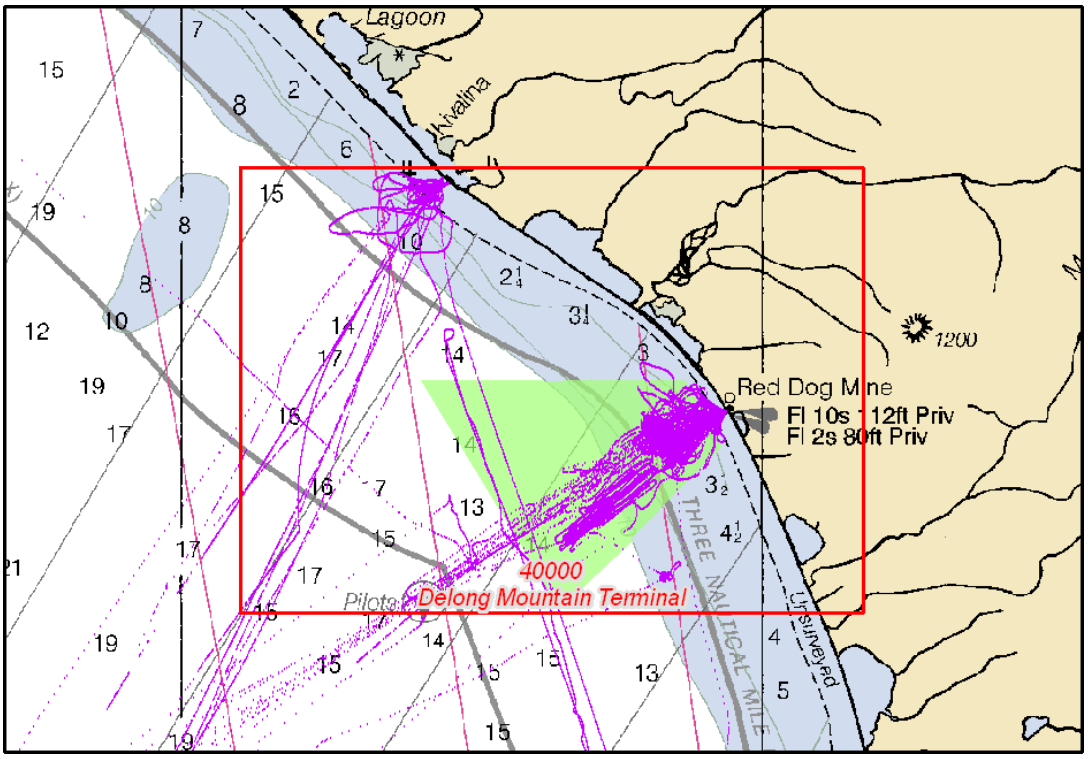
Coast Survey Steamer *Bibb*

Proposed New Large and Medium Scale Charts

Each of the new chart proposals describe the area to be covered and the rationale for creating the chart. A graphic shows an image of the largest scale chart covering the area. The images also show chart footprint options (in red), as well as the footprints for any existing charts (in gray) and hydrographic surveys planned for the near future (in green).

Magenta dots show ship positions reported from Automatic Identification System (AIS) signals recorded during the two months from June 16 to August 15, 2009. AIS is a coastal tracking system that identifies ships and their position, course, and speed. This window is within the Arctic's busy summer ship season and is thought to show typical vessel traffic patterns.

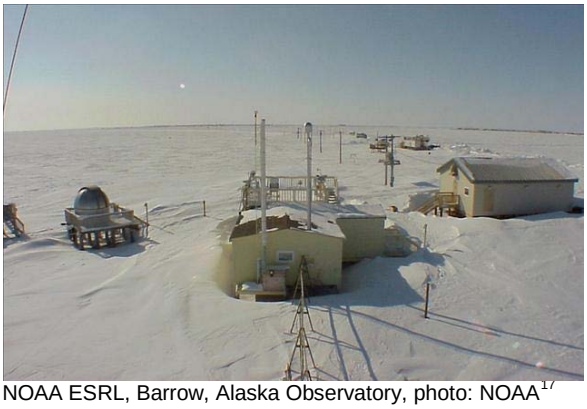
	Proposed New Chart Footprint
	Planned Hydro Survey Footprint
	AIS Position Reports
	Existing Chart Footprint



Barrow: 16079 1:20,000

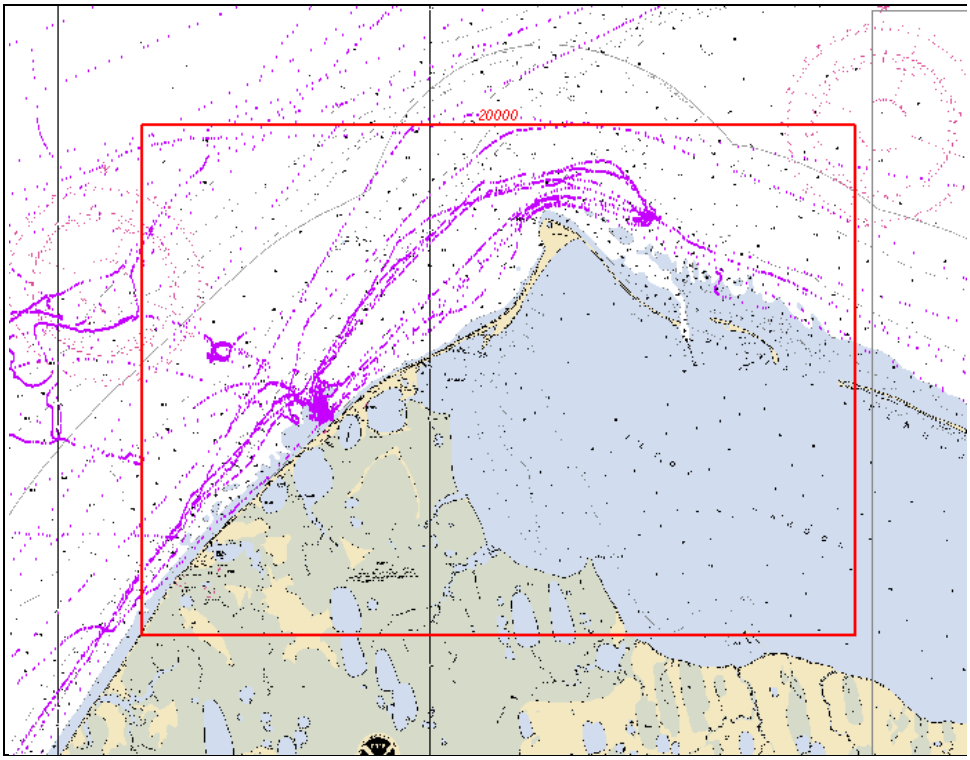
Largest scale chart currently: 16082, 1:47,943

City of Barrow, photo: Dave Cohoe[16]



NOAA ESRL, Barrow, Alaska Observatory, photo: NOAA[17]

Barrow is the northernmost community in the U.S. and is the "economic, transportation and administrative center for the North Slope Borough."[18] Vessel traffic, heaviest during the summer after the subsistence whaling season ends, consists of tugs carrying fuel and supply barges. Barrow has no pier facilities. Marine cargo bound for Barrow is lightered from barges to landing craft. Anchorage can be had 1200 yards off Barrow in 30 feet of water to receive supplies and to transfer personnel by small boat. The anchorage is exposed to weather from all directions. Barrow is a destination for small cruise ships carrying as many as 400 passengers. A seasonal U.S. Coast Guard station is active from July to August.[19] NOAA's Earth System Research Laboratory, Global Monitoring Division observatory is located about a mile northeast of the City of Barrow.



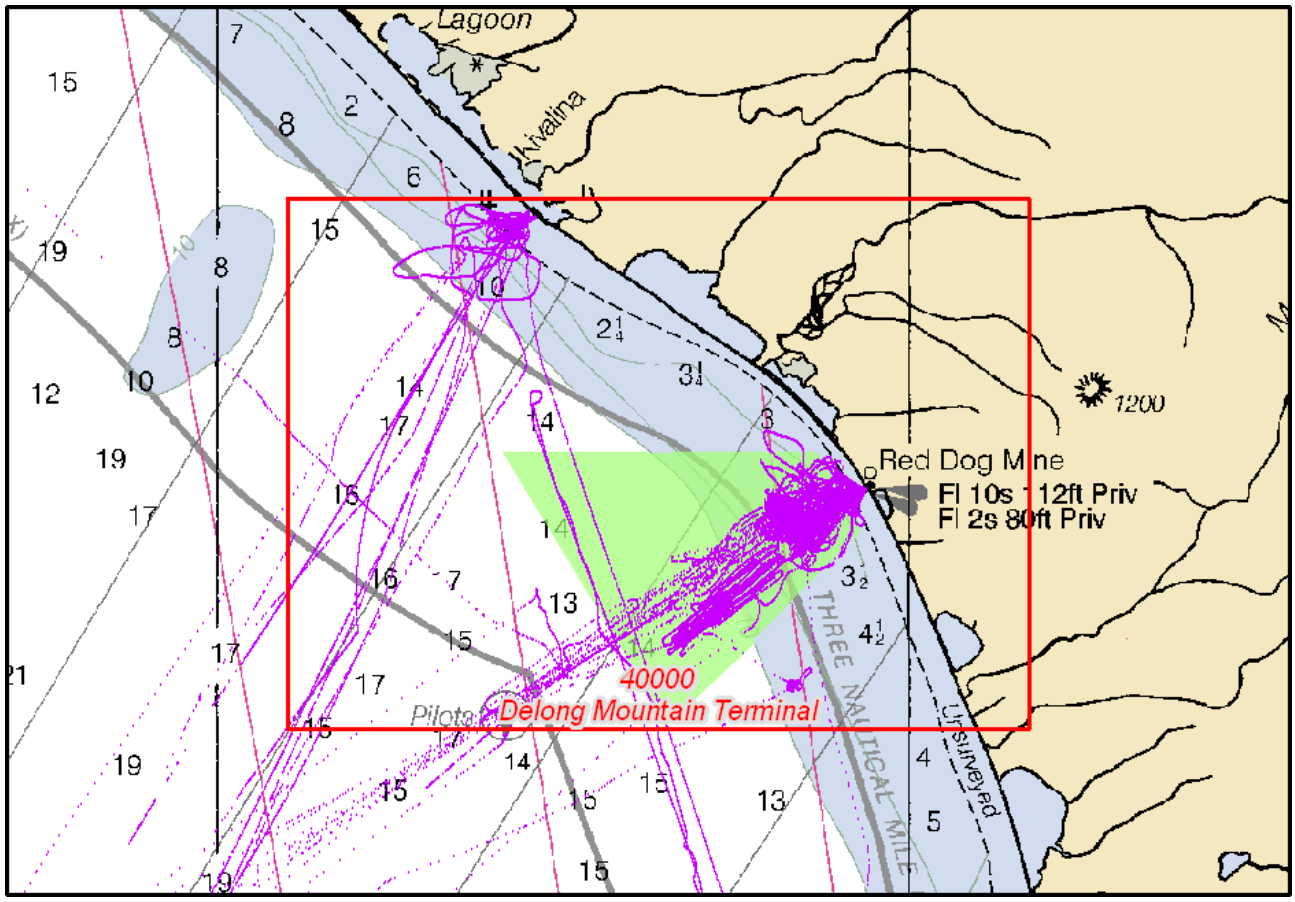
[16] Wikipedia, "Barrow Alaska,: at http://en.wikipedia.org/wiki/Barrow,_Alaska
[17] NOAA, "Barrow, Alaska Observatory," at www.esrl.noaa.gov/gmd/obop/brw/index.html
[18] City of Barrow, "Welcome," at www.cityofbarrow.org
[19] NOAA, "Bering Sea: Chart 16006," *U.S. Coast Pilot, Alaska: Cape Spencer to Beaufort Sea*, (NOAA, Washington: 2010), Chapter 8, paragraphs 127 and 129.

Delong Mountain Terminal (Red Dog Mine): 16145 1:40,000

Largest scale chart currently: 16005, 1:700,000

Delong Mountain Terminal Pier, Photo: Rob Stapleton[22]

The Delong Mountain Terminal is a shallow draft port with an open shipping season of approximately 100 days. It was constructed to service the Red Dog Mine. The mine, in operation since 1989, is the world's largest producer of zinc concentrate, representing 79% of all U.S. zinc mine production. It is also the second largest lead producing mine in the country, accounting for a third of all U.S. production.[20] The mine uses self-loading barges to pick up the ore and lighter it to the ships anchored offshore.[21]



[20] Teck, "Red Dog Operations," web site at http://www.reddogalaska.com.
[21] FOSS, "Creating the World's First Open Lighterage for Alaska's Red Dog," at http://www.foss.com/stories_teck.html
[22] Alaska Journal of Commerce, "Northwest borough makes offer to buy Red Dog road, port," July 2, 2009, at www.alaskajournal.com/stories/070209/loc_10_002.shtml

Kotzebue Harbor and Approaches: 16161 **1:50,000**

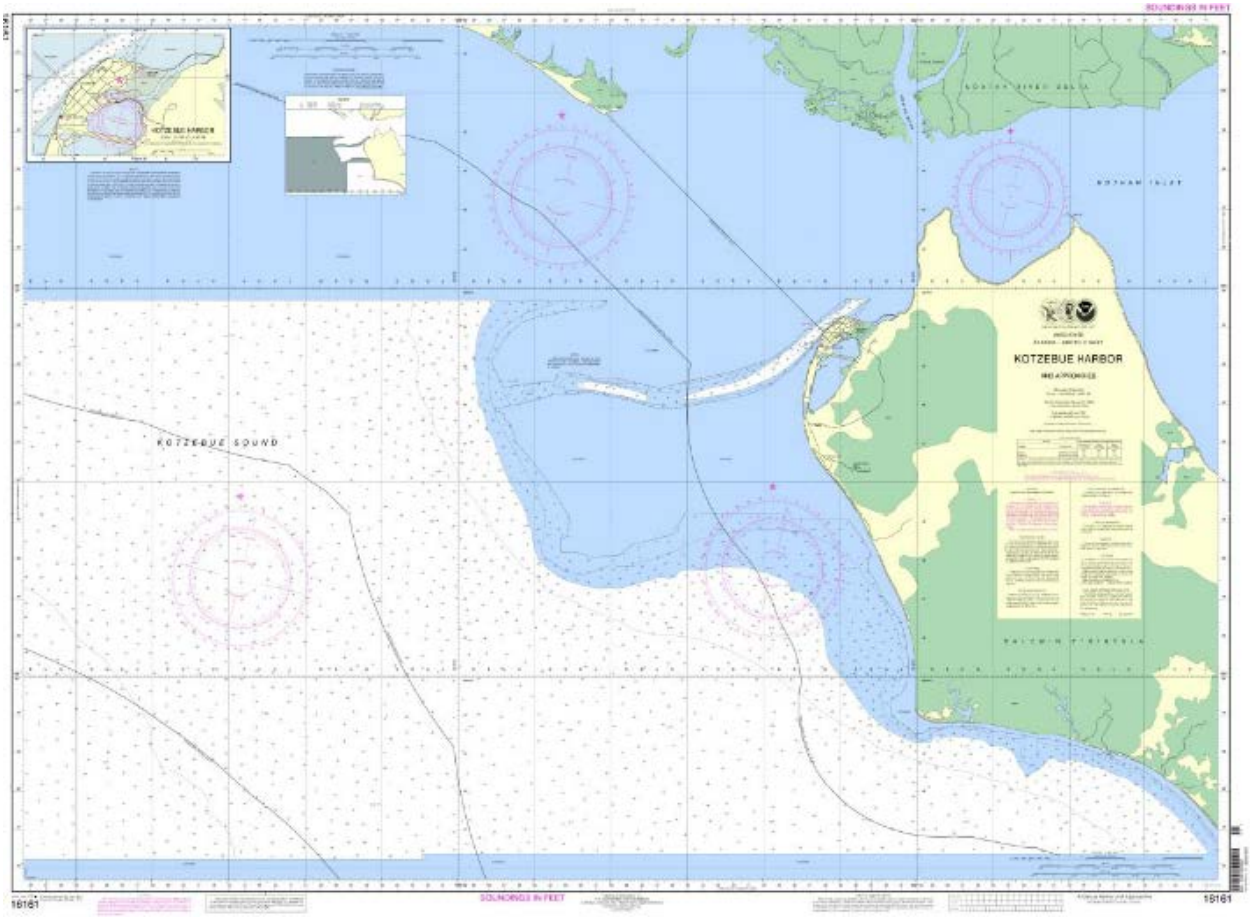
The first edition of 16161 was published in April 2012.

Previously, the largest scale chart available was 16005, 1:700,000.

Kotzebue[23]

Kotzebue lies on a sand spit at the end of the Baldwin Peninsula in the Kotzebue Sound where the Noatak, Kobuk and Selawik rivers end.

"Kotzebue serves as the transportation hub (both air and sea) for the whole of the Northwest Alaska. There are 11 villages that require barge shipments and the large transport ships must be anchored at least 14 miles out in the Kotzebue Sound due to shallow waters, inadequate charts and navigational aids. The transport ship's freight must be lightered by smaller barges to Kotzebue. Our port of call is the second most costly in the world with the exception of Antarctica."[24]



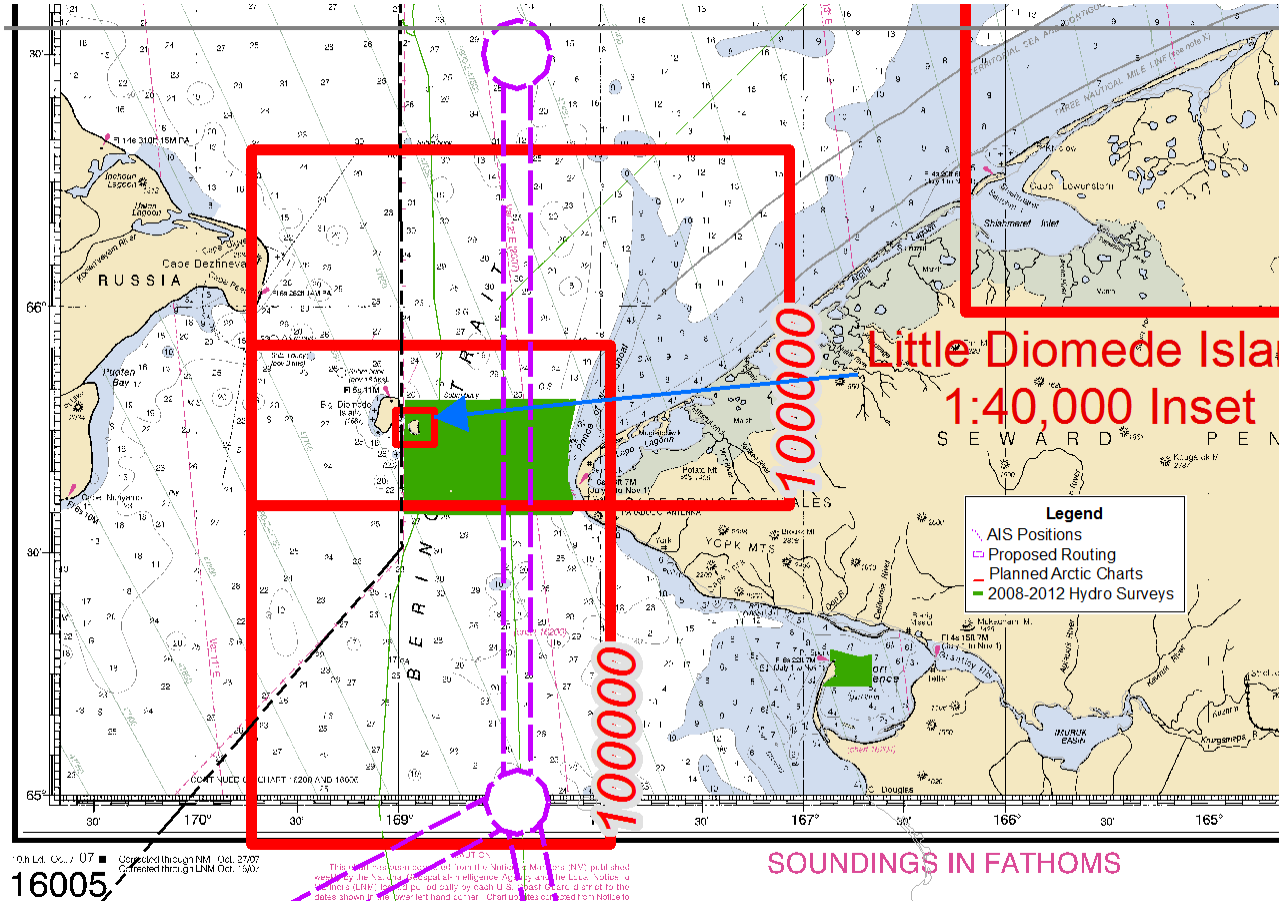
[23] City of Kotzebue, "Photographs of Kotzebue Alaska," http://kotzpdweb.tripod.com/kotzpics11.html
[24] Chuck Greene, Mayor of Northwest Arctic Borough, Letter to NOAA, "Regarding: Survey of Kotzebue Sound," April 13, 1998

Bering Strait: 16210	**1:100,000**
Bering Strait North: 16190	**1:100,000**
Little Diomede Island Inset: 16190	**1:40,000**

Largest scale chart currently: 16005, 1:700,000

.Village of Inalik on Little Diomede Island[26]

The Bering Strait is 44 miles wide between Cape Prince of Wales, Alaska, and Cape Dezhneva, Siberia. It is the gateway from the Bering Sea in the Pacific Ocean to Chukchi Sea in the Arctic Ocean.[25] The Russian island of Big Diomede and the American island of Little Diomede lie just three nautical miles apart. These islands divide the two major passages through the strait, which lie to the east and west of the islands with depths of about 20 to 30 fathoms. Much of the Alaskan vessel traffic clings close to the shore rounding Cape Prince of Wales, as shown by the clustering of AIS returns on the chart graphic below. New chart coverage includes a 1:40,000 scale inset of Little Diomede Island on the Bering Strait North Chart.



[25] NOAA, "Bering Sea: Chart 16006," *U.S. Coast Pilot, Alaska: Cape Spencer to Beaufort Sea*, (NOAA, Washington: 2010), Chapter 8, paragraph 379.

[26] Alaska Department of Commerce, Community, and Economic Development, "Alaska Community Database Photo Index," at www.dced.state.ak.us/dca/commdb/images/diomede_aerial1.jpgwrewf

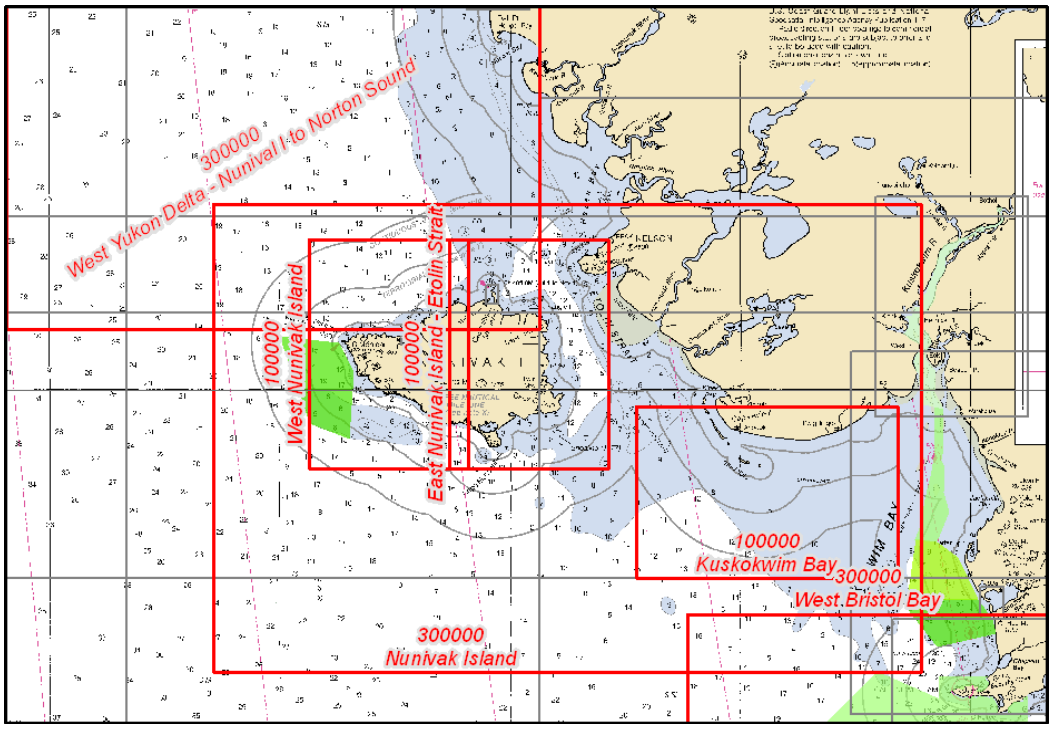
West Nunivak Island: 16281	**1:100,000**
East Nunivak Island – Etolin Strait: 16282	**1:100,000**
Northern Kuskokwim Bay: 16301	**1:100,000**
Nunivak Island: 16280	**1:300,000 (see pages 30 and 28)**

Largest scale chart currently: 16006, 1:1,534,076

Nunivak Cliffs[27]

Nunivak Island is about 330 miles north of Unimak Pass. The latest edition of the *U.S. Coast Pilot* notes that "dangerous shoals and uneven bottom have been reported and are shown on [the 1:1.5 million scale chart 16006]; the island should be approached with extreme caution."[28]

The currency of the navigational information known about Nunivak Island is betrayed by the same edition of the *Coast Pilot* which reports "in 1899 the U.S.S. CORWIN cruised completely around Nunivak Island, following the shore and outlying islands at a distance of about 2 miles, and found general about depths of 7 to 10 fathoms,"[29] and that, "in 1979, the U.S. Coast Guard Cutter IRONWOOD reported possible shoreline charting inaccuracies on the northwest side of Nunivak Island between Cape Mohican and Nash Harbor. Until surveys are made of this area, mariners are advised to use caution when using shoreline features for navigation." The *Coast Pilot* also quotes reports from other ship transits in 1977, 1971, and 1951. Mariners could benefit from more current hydrographic and shoreline information around Nunivak.



[27] Photo: U.S. Fish and Wildlife Service at www.fws.gov/digitalmedia/cdm4/item_viewer.php?CISOROOT=/natdiglib&CISOPTR=696&CISOBOX=1&REC=1

[28] NOAA, "Bering Sea: Chart 16006," *U.S. Coast Pilot, Alaska: Cape Spencer to Beaufort Sea*, (NOAA, Washington: 2010), Chapter 8, paragraph 379.

[29] Ibid, Chapter 8, paragraph 386.

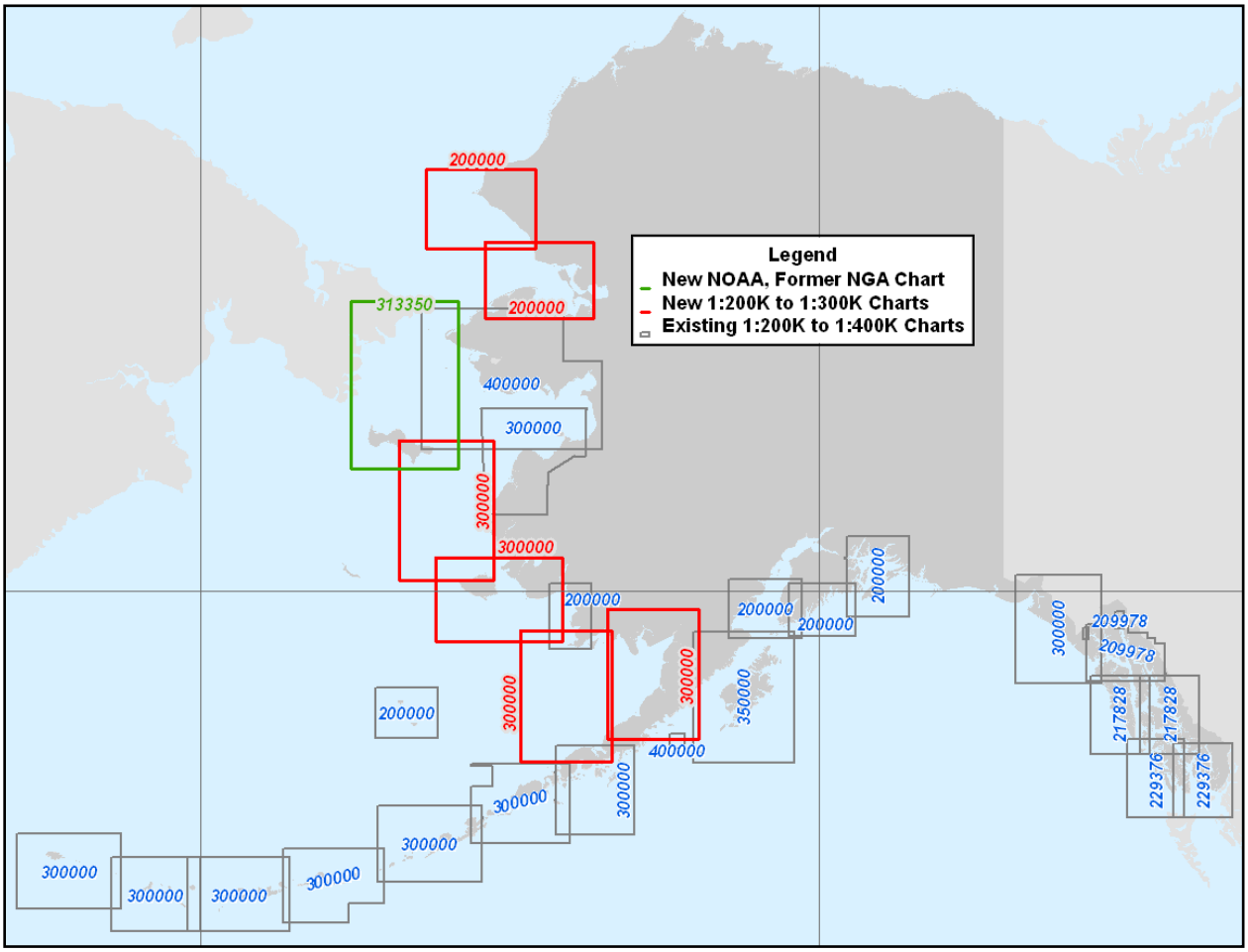
New Medium Scale Chart Coverage

Based on their scale, charts are commonly placed into one of five categories: berthing, harbor, approach, coastal, and general. Charts smaller than 1:150,000, such as the six charts described on the following pages, are usually considered to be general charts. Coastal charts are intended for inshore coastwise navigation, for entering or leaving bays and harbors of considerable width, and for navigating large inland waterways. The scales range from about 1:50,000 to 1:150,000.[30]

Except for Bristol Bay, there are few coastal scale charts in western Alaska. By necessity, therefore, smaller scale charts must be pressed into service for coastal navigation. The largest scale charts available in much of western Alaska are in the 1:700,000 to 1:1.5 million range, and this scale is not very useful (even in a pinch) for coastal navigation.

The addition of six new 1:300,000 scale charts, while not technically considered "coastal charts," will provide a significant improvement in the level of detail for navigational and bathymetric information available to mariners. These charts will close all of the gaps in medium scale chart coverage over western Alaska.

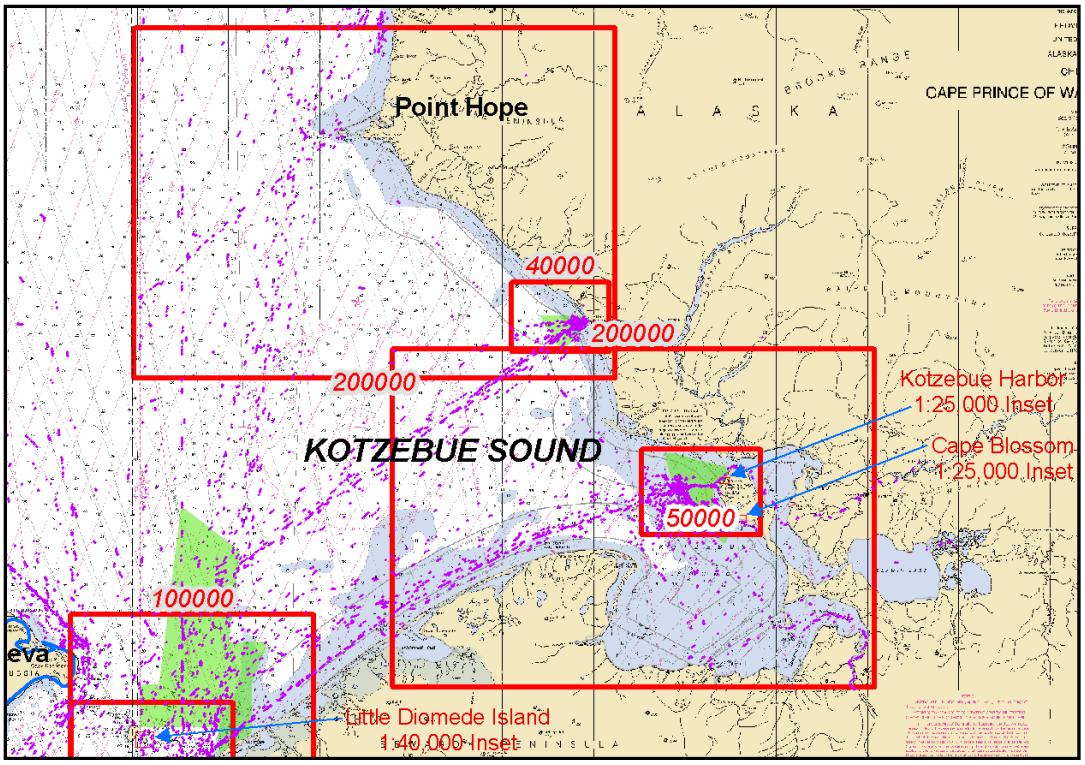
The map below shows the existing 1:200,000 to 1:400,000 scale coastal chart coverage in Alaska. Each chart's scale is shown. Chart 16200 "Norton Sound to Bering Strait," and Chart 16220 "St. Lawrence Island to Bering Strait" (where chart maintenance is transferring from NGA to NOAA), are the only charts in this group that are of a smaller scale than 1:300,000.



[30] NGA, *Bowditch*

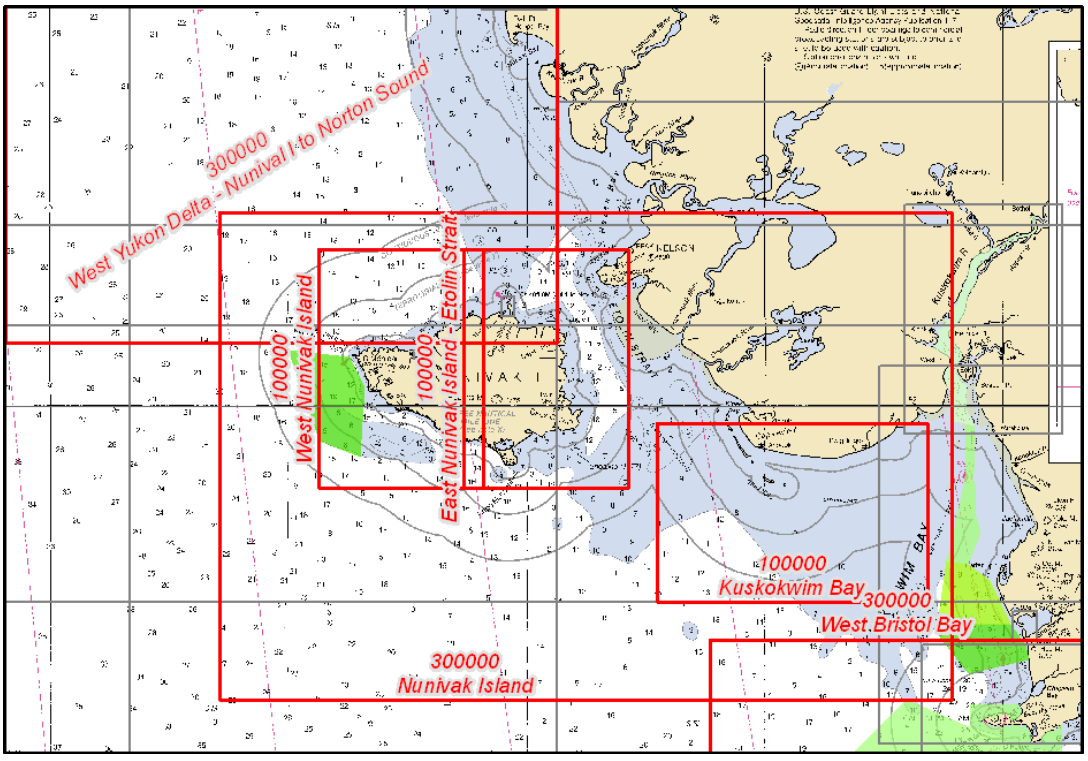
Kotzebue Sound: 16160 **1:200,000**
Point Hope: 16140 **1:200,000**

Largest scale chart currently: 16005, 1:700,000



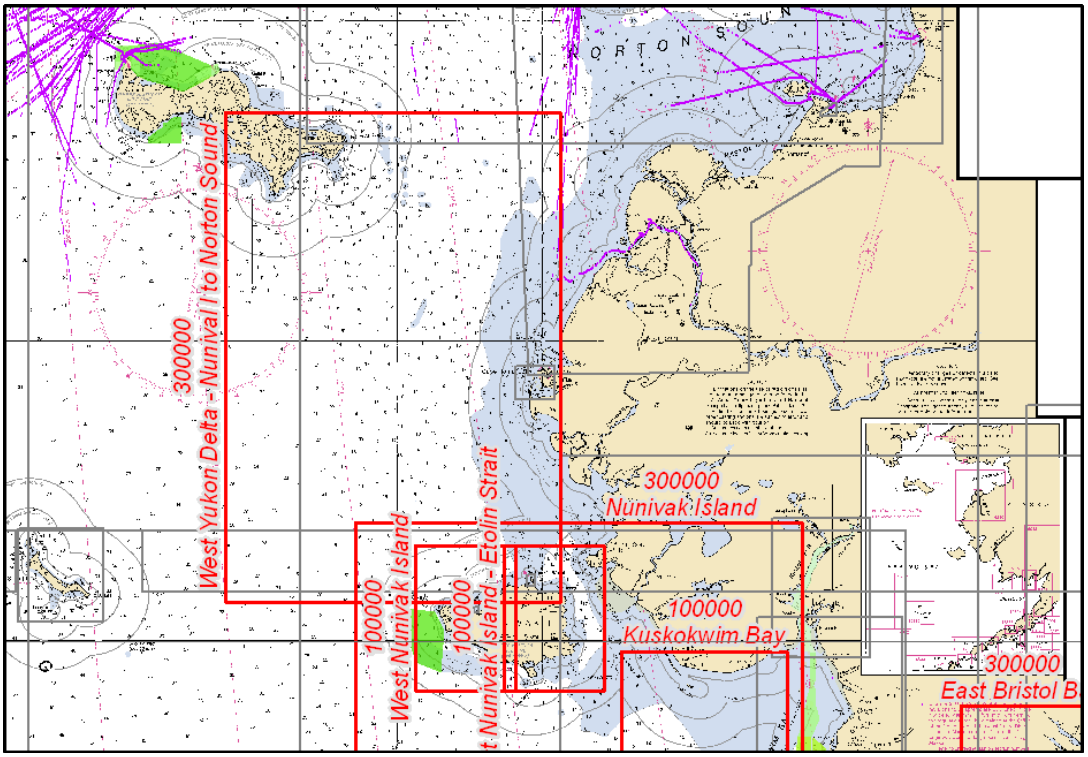
Nunivak Island: 16280 **1:300,000**

Largest scale chart currently: 16006, 1:1,534,076



West Yukon Delta / Nunivak Island to Norton Sound: 16260 **1:300,000**

Largest scale chart currently: 16006, 1:1,534,076



West Bristol Bay: 16310 **1:300,000**

East Bristol Bay: 16320 **1:300,000**

Largest scale chart currently: 16011, 1:1,023,188

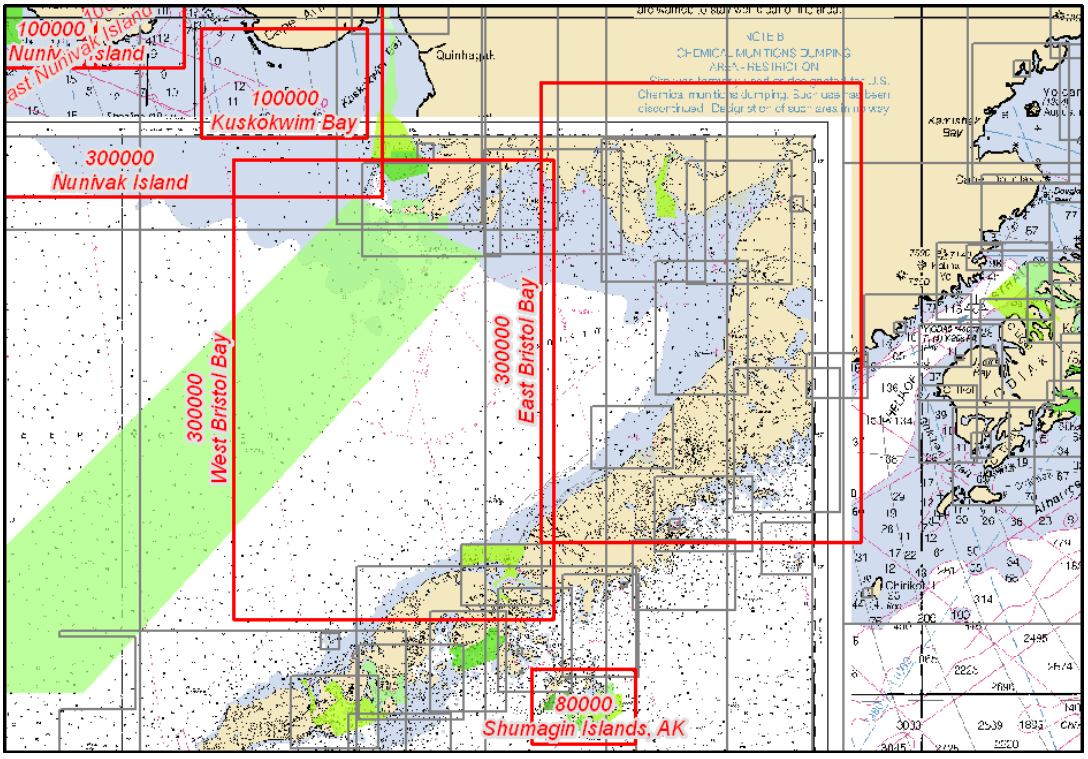


CHART SPECIFICATIONS

The chart specifications and details of source data available for each chart will be updated as plans are refined. The date of the last modification is noted on the bar at the top of each chart specification.

NOAA Ships *Fairweather* and *Rainier*

Barrow **1:20,000**

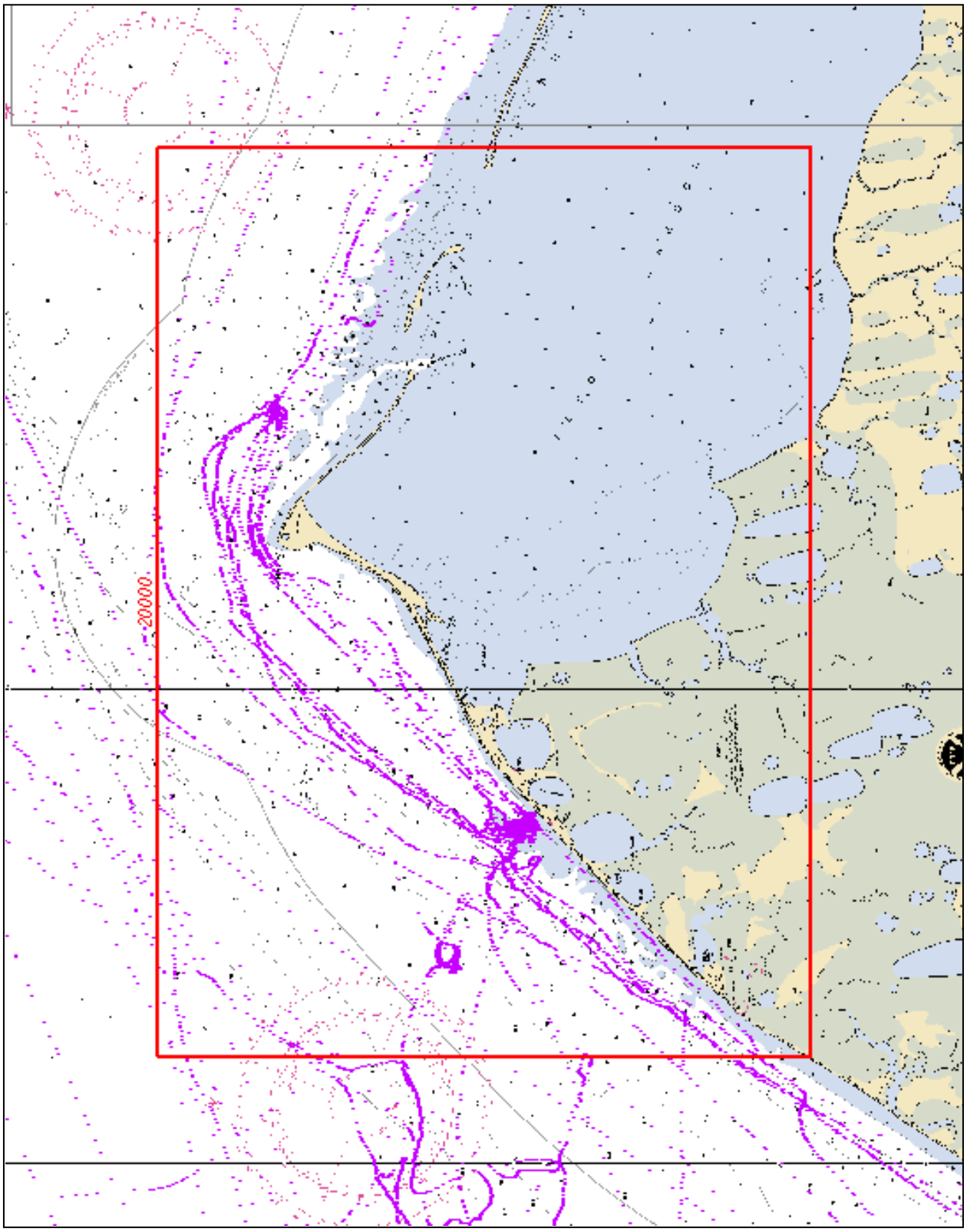


Chart Specification as of February 1, 2013

Chart Number: 16079

National Stock Number: 7642016157924

KAPP Number(s): 0000

NGA Reference Number: 16XHA16079

Title: Alaska – Arctic Coast
Barrow

Scale: 1:20,000

at Latitude: 71° 19’ 30.0”N

Horizontal Datum: NAD83

Projection: Mercator

Soundings In: Fathoms and Feet

at: MLLW

Depth Curves:

Blue Tint Curve(s):

Limits

71º 25' 00.0" N

156º 50' 28.0" W

156º 12' 07.0" W

71º 16' 12.0" N

Total Latitude: 08' 48"

Total Longitude: 38' 21"

Neatline Height: 000.00mm

Neatline Width: 000.00mm

Source of Hydrography

ID: 07068	Year: 1947	Scale: 1:40,000
ID: 07069	Year: 1945	Scale: 1:20,000
ID: 07070	Year: 1945	Scale: 1:20,000
ID: 07071	Year: 1945	Scale: 1:20,000

Source of Shoreline

ID: CM8703A1	Year: 1987
ID: PH27	Year: 1948

Source of Tide and Currents Data

Description of Data Available:
Description of Additional Data Needed:

Source of Geodetic Control

Description of Data Available:
Description of Additional Data Needed:

Other Special Data, Instructions, Navigational Requirements or Notes:

Delong Mountain Terminal (Red Dog Mine): 16145 **1:40,000**

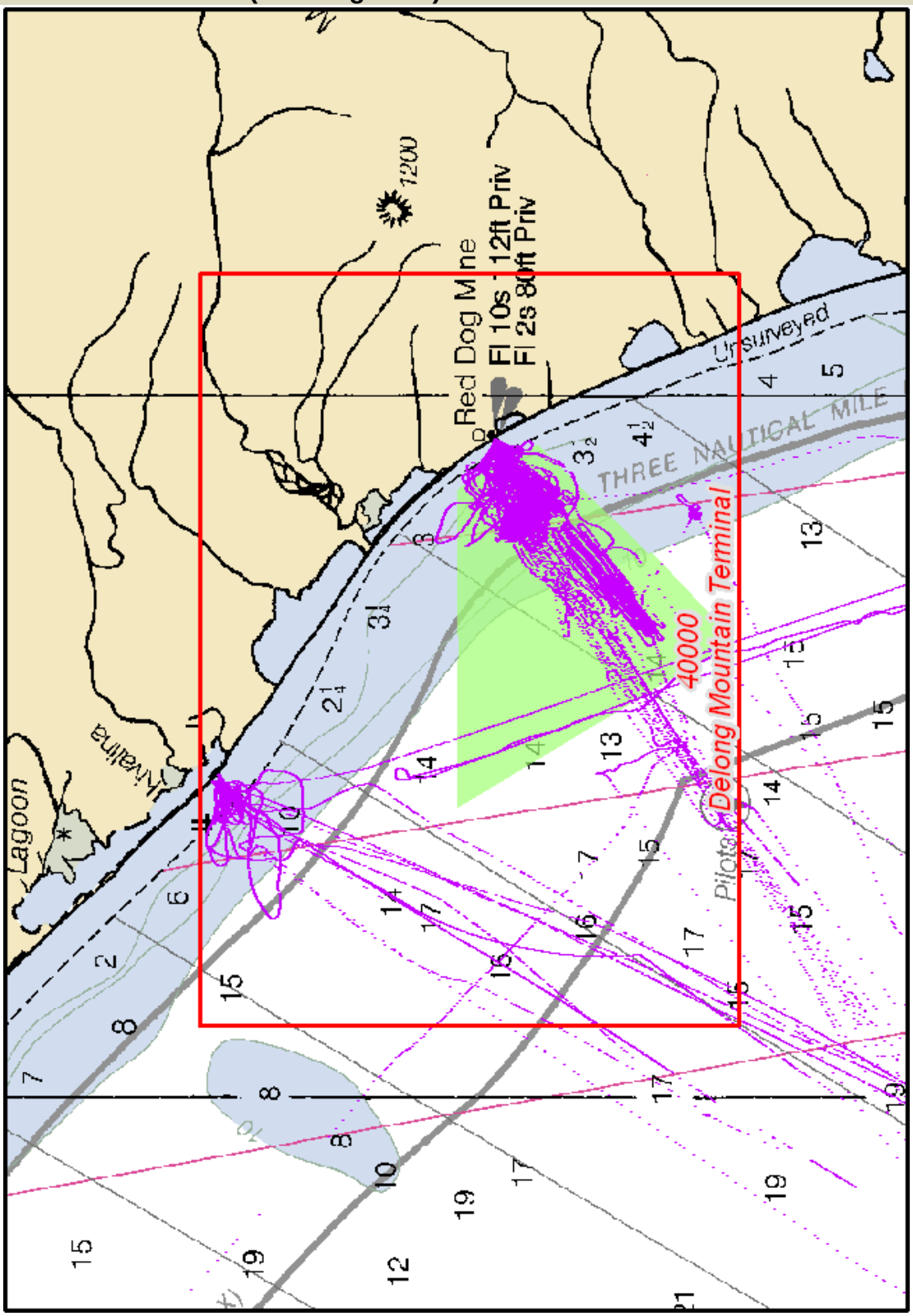


Chart Specification as of February 1, 2013

Chart Number: 16145

National Stock Number: 7642016100574

KAPP Number(s): 0000

NGA Reference Number: 16BHA16145

Title: Alaska – West Coast
Delong Mountain Terminal

Scale: 1:40,000

at Latitude: 67° 36’ 00.0”N

Horizontal Datum: NAD83

Projection: Mercator

Soundings In: Fathoms and Feet

at: MLLW

Depth Curves:

Blue Tint Curve(s):

Limits

67º 44' 08.0" N

164º 54' 00.0" W

163º 49' 42.0" W

67º 26' 33.0" N

Total Latitude: 17' 35"

Total Longitude: 01º 04' 18"

Neatline Height: 000.00mm

Neatline Width: 000.00mm

Source of Hydrography

Planned Year: 2012 Scale: To Be Determined

An extensive amount of additional hydrography will need to be obtained from a variety of sources including existing smaller scale coverage, the United States Navy, the United States Geological Survey, and any other available sources.

Source of Shoreline

ID: AK0302 Year: 2003
ID: PH28 Year: 1951

Source of Tide and Currents Data

Description of Data Available:
Description of Additional Data Needed:

Source of Geodetic Control

Description of Data Available:
Description of Additional Data Needed:

Other Special Data, Instructions, Navigational Requirements or Notes:

Kotzebue Harbor and Approaches: 16161 **1:50,000**

The first edition of chart 16161 was published in April 2012.

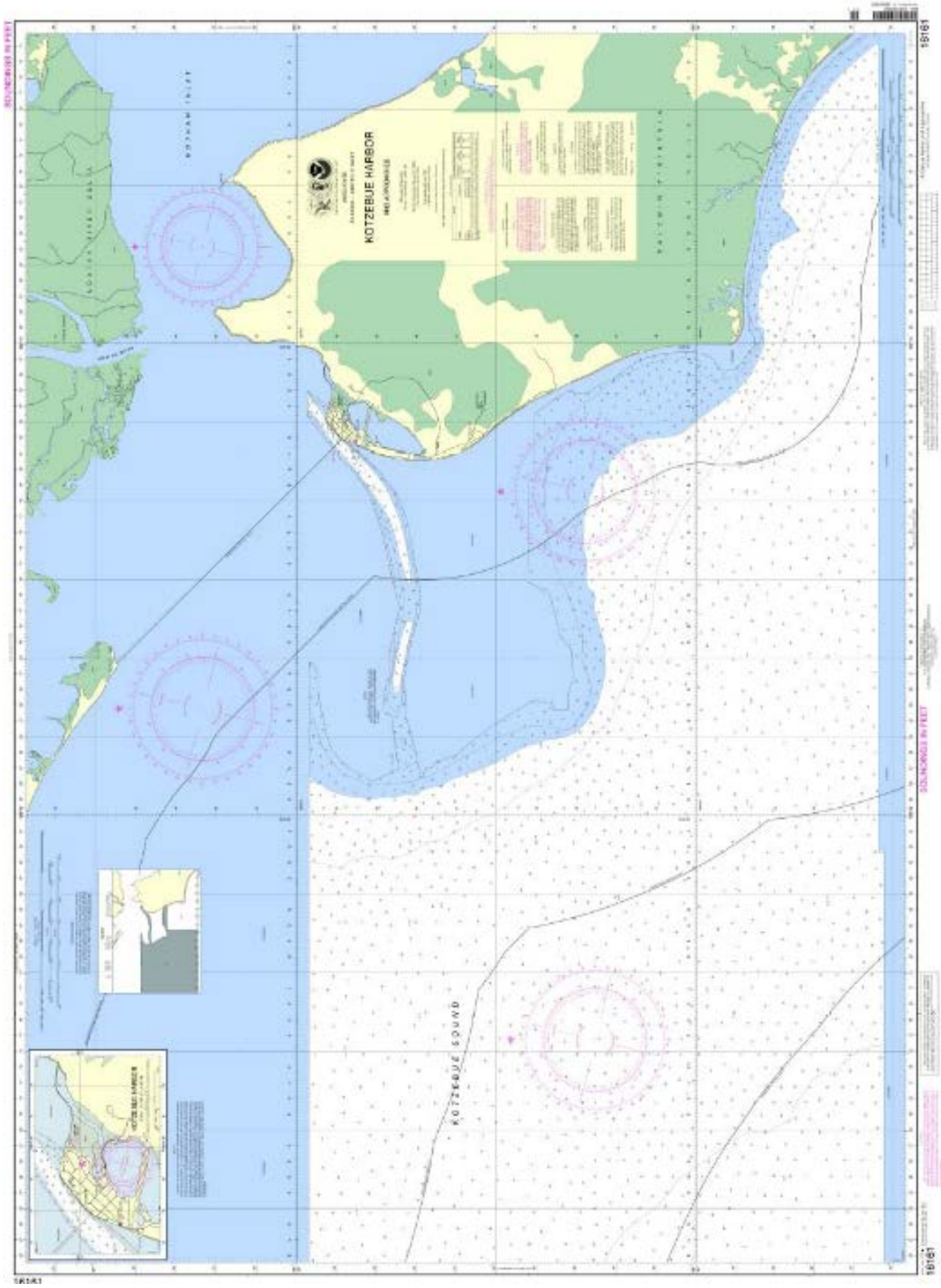


Chart Specification **as of April 2012**

The first edition of chart 16161 was published in April 2012.

Chart Number: 16161 National Stock Number: 7642016009631

KAPP Number(s): 2573, 2575 NGA Reference Number: 16BHA16161

Title: Alaska – West Coast
Kotzebue Harbor and Approaches

Scale: 1:50,000, inset 1:25,000 at Latitude: 66° 54' N

Horizontal Datum: NAD83 Projection: Mercator

Soundings In: Feet at: MLLW

Depth Curves: 6,12,18,30,60 Blue Tint Curve(s): 18

Limits

67 01' 43" N

163º 28' 26" W 162º 10' 12" W

66º 39' 42" N

Total Latitude: 22' 01" Total Longitude: 1º 18' 14"

Neatline Height: 818 mm Neatline Width: 1142 mm

Source of Hydrography

Survey	Year
H-12348	2011
H-12349	2011
H-12350	2011
H-12351	2011
H-12352	2011

For areas not covered by contemporary surveys, use existing chart 16005

Source of Shoreline

Survey	Year
GC-10903 (AK1017)	Imagery used ranges from 2009-2011

Source of Tide and Currents Data

Description of Data Available:
Description of Additional Data Needed:

Source of Geodetic Control

Description of Data Available:
Description of Additional Data Needed:

Other Special Data, Instructions, Navigational Requirements or Notes:

1:25,000 scale inset over Kotzebue Harbor will be produced as part of the 1st Edition of this chart. A second 1:25,000 scale inset covering Cape Blossom will be added to a subsequent edition after facilities have been constructed in this area.

Bering Strait: 16210	**1:100,000**
Bering Strait North: 16190	**1:100,000**
Little Diomede Island Inset: 16190	**1:40,000**

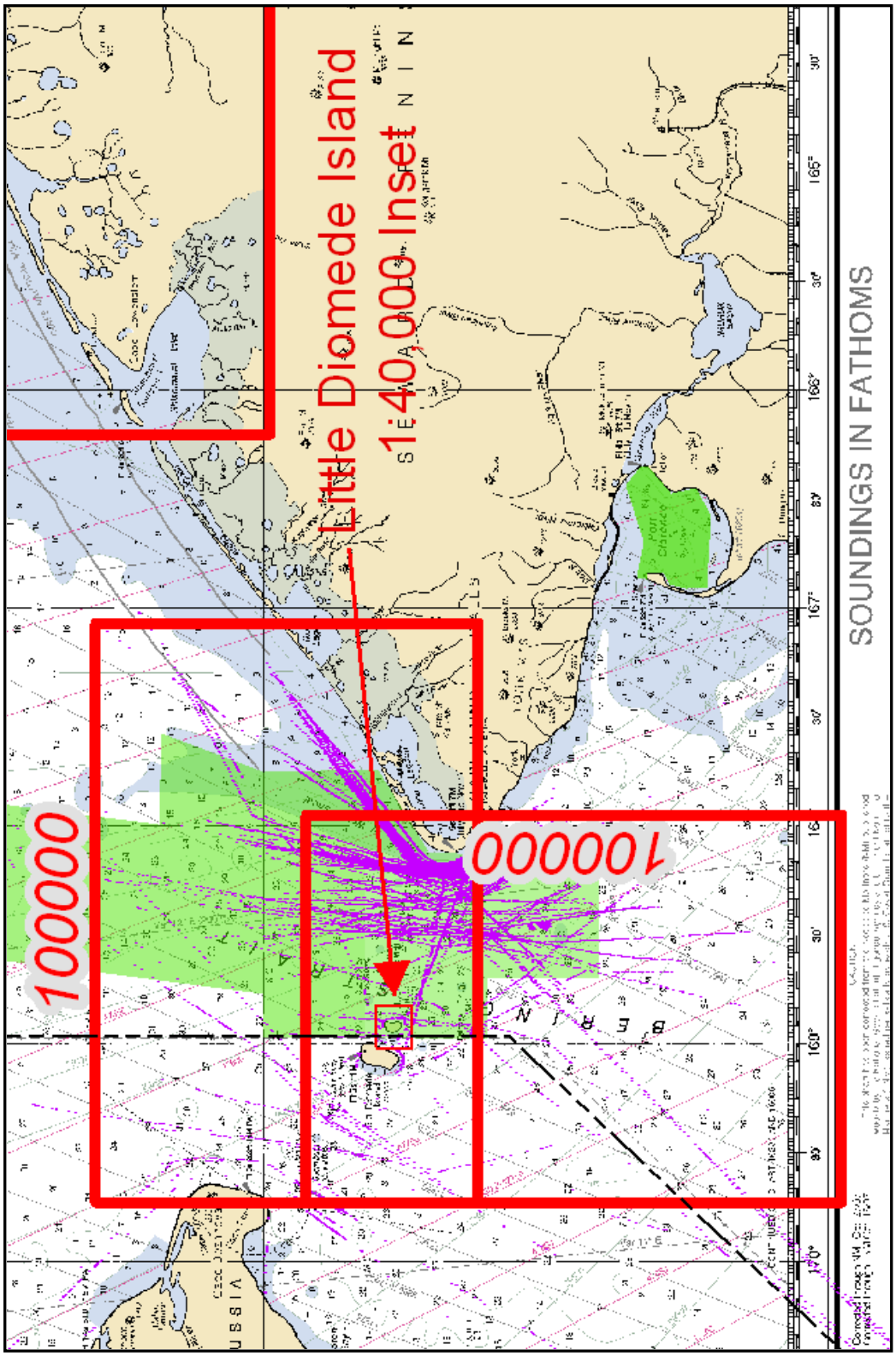


Chart Specification as of February 1, 2013

Chart Number: 16210 National Stock Number: 7642016122022

KAPP Number(s): 0000 NGA Reference Number: 16BCO16210

Title: Alaska – West Coast
Bering Strait

Scale: 1:100,000 at Latitude: 65° 24’ 00.0”N

Horizontal Datum: NAD83 Projection: Mercator

Soundings In: Fathoms and Feet at: MLLW

Depth Curves: 1, 2, 3, 6, 10, 20 Blue Tint Curve(s): 10

Limits

65º 55' 14.0" N

169º 43' 42.0" W 167º 57' 15.0" W

64º 53' 48.0" N

Total Latitude: 01º 01' 26" Total Longitude: 01º 46' 27"

Neatline Height: 847.725 mm Neatline Width: 1206.5 mm

Source of Hydrography

Planned	Year: 2010	Scale: To Be Determined
ID: 09020	Year: 1969	Scale: 1:40,000
ID: 09021	Year: 1969	Scale: 1:40,000
ID: 09022	Year: 1969	Scale: 1:40,000
ID: 08559	Year: 1960	Scale: 1:160,000
ID: 07849	Year: 1950	Scale: 1:20,000
ID: 07850	Year: 1950	Scale: 1:20,000
ID: 07845	Year: 1950	Scale: 1:40,000

An extensive amount of additional hydrography will need to be obtained from a variety of sources including existing smaller scale coverage, the United States Navy, the United States Geological Survey, and any other available sources.

Source of Shoreline

ID: AK1011	Year: 2010
ID: Ak0301	Year: 2003
ID: PH65ADZ	Year: 1951
ID: PH65A	Year: 1951
Chart: 16204	Scale: 1:100,000

Source of Tide and Currents Data

Description of Data Available:
Description of Additional Data Needed:

Source of Geodetic Control

Description of Data Available:
Description of Additional Data Needed:

Other Special Data, Instructions, Navigational Requirements or Notes:

Chart Specification as of February 1, 2013

Chart Number: 16190 National Stock Number: 7642016122021

KAPP Number(s): 0000 NGA Reference Number: 16BCO16190

Title: Alaska – West Coast
Bering Strait North

Scale: 1:100,000 at Latitude: 65° 57’ 00.0N

Horizontal Datum: NAD83 Projection: Mercator

Soundings In: Fathoms and Feet at: MLLW

Depth Curves: Blue Tint Curve(s):

Limits

66º 18' 45.0" N

169º 43' 51.0" W 167º 04' 10.0" W

65º 35' 46.0" N

Total Latitude: 42' 59" Total Longitude: 02º 39' 41"

Neatline Height: 000.00mm Neatline Width: 000.00mm

Source of Hydrography

ID: 12229	Year: 2010	Scale: 1:40,000
ID: 08661	Year: 1961	Scale: 1:160,000
ID: 08559	Year: 1960	Scale: 1:160,000
ID: 07845	Year: 1950	Scale: 1:20,000
ID: 07846	Year: 1950	Scale: 1:20,000
ID: 07849	Year: 1950	Scale: 1:20,000
ID: 7848A	Year: 1950	Scale: 1:20,000
ID: 7848B	Year: 1950	Scale: 1:20,000
ID: 07850	Year: 1950	Scale: 1:40,000

An extensive amount of additional hydrography will need to be obtained from a variety of sources including existing smaller scale coverage, the United States Navy, the United States Geological Survey, Russian Charts, and any other available sources.

Source of Shoreline

ID: AK1011	Year: 2009
ID: Ak0301	Year: 2003
ID: PH65ADZ	Year: 1951

Source of Geodetic Control

Description of Data Available:
Description of Additional Data Needed:

Other Special Data, Instructions, Navigational Requirements or Notes:

Little Diomede Island Inset: 65º43’14”N - 65º47’21”N, 168º49'26"W - 169º01'04"W, Scale 1:40,000

Chart Specification as of February 1, 2013

Chart Number: 16190 National Stock Number: 7642016122021

KAPP Number(s): 0000 NGA Reference Number: 16BCO16190

Title: Alaska – West Coast
Little Diomede Island (inset)

Scale: 1:40,000 at Latitude: 65° 45’ 00.0N

Horizontal Datum: NAD83 Projection: Mercator

Soundings In: Fathoms and Feet at: MLLW

Depth Curves: Blue Tint Curve(s):

Limits

65º 47' 21.0" N

169º 01' 04" W 168º 49' 26.0" W

65º 43' 14.0" N

Total Latitude: 04' 07" Total Longitude: 11' 38"

Neatline Height: 000.00mm Neatline Width: 000.00mm

Source of Hydrography

Planned	Year: 2010-2012	Scale: To Be Determined
ID: 08661	Year: 1961	Scale: 1:160,000
ID: 08559	Year: 1960	Scale: 1:160,000
ID: 07845	Year: 1950	Scale: 1:20,000
ID: 07846	Year: 1950	Scale: 1:20,000
ID: 07849	Year: 1950	Scale: 1:20,000
ID: 7848A	Year: 1950	Scale: 1:20,000
ID: 7848B	Year: 1950	Scale: 1:20,000
ID: 07850	Year: 1950	Scale: 1:40,000

An extensive amount of additional hydrography will need to be obtained from a variety of sources including existing smaller scale coverage, the United States Navy, the United States Geological Survey, Russian Charts, and any other available sources.

Source of Shoreline

ID: AK1011 Year: 2010

Source of Tide and Currents Data

Description of Data Available:
Description of Additional Data Needed:

Source of Geodetic Control

Description of Data Available:
Description of Additional Data Needed:

Other Special Data, Instructions, Navigational Requirements or Notes:

West Nunivak Island: 16281	**1:100,000**
East Nunivak Island – Etolin Strait: 16282	**1:100,000**
Northern Kuskokwim Bay: 16301	**1:100,000**

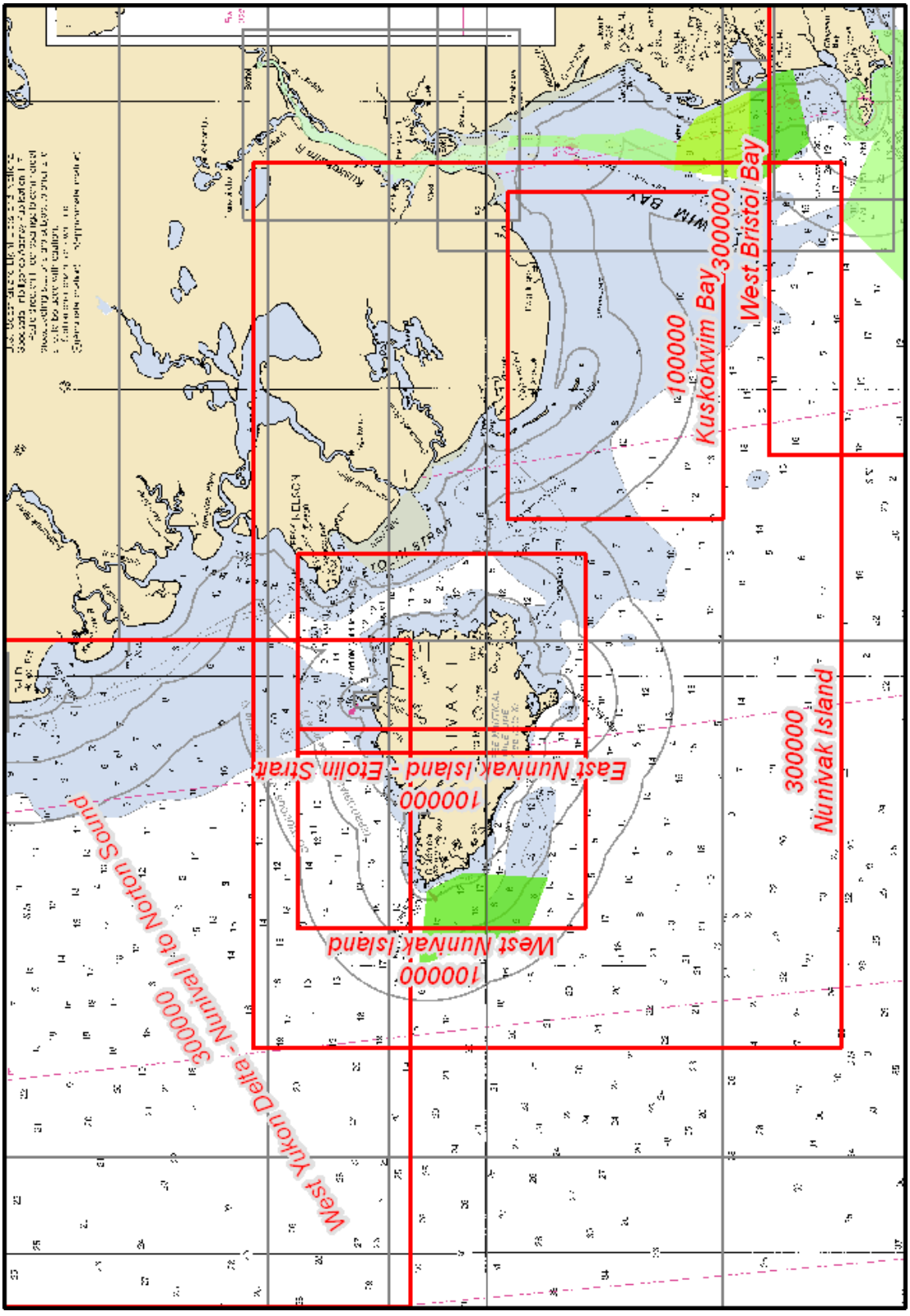


Chart Specification as of February 1, 2013

Chart Number: 16281 National Stock Number: 7642016157928

KAPP Number(s): 0000 NGA Reference Number: 16BCO16281

Title: Alaska – West Coast
West Nunivak Island

Scale: 1:100,000 at Latitude: 60° 10’ 00.0”N

Horizontal Datum: NAD83 Projection: Mercator

Soundings In: Fathoms and Feet at: MLLW

Depth Curves: Blue Tint Curve(s):

Limits

60º 38' 53.0" N

167º 45' 06.0" W 166º 21' 57.0" W

59º 39' 11.0" N

Total Latitude: 59' 42" Total Longitude: 01º 23' 09"

Neatline Height: 000.00mm Neatline Width: 000.00mm

Source of Hydrography

Planned	Year: 2013	Scale: To Be Determined
ID: 07950	Year: 1953	Scale: 1:500,000
ID: 02604	Year: 1902	Scale: 1:1,000,000
ID: 02619	Year: 1902	Scale: 1:80,000

An extensive amount of additional hydrography will need to be obtained from a variety of sources including existing smaller scale coverage, the United States Navy, the United States Geological Survey, and any other available sources.

Source of Shoreline

ID: PH56	Year: 1956	
Chart: 16006	Scale: 1:40,000	(Nash Harbor inset)

Source of Tide and Currents Data

Description of Data Available:
Description of Additional Data Needed:

Source of Geodetic Control

Description of Data Available:
Description of Additional Data Needed:

Other Special Data, Instructions, Navigational Requirements or Notes:

Chart Specification as of February 1, 2013

Chart Number: 16282 National Stock Number: 7642016157927

KAPP Number(s): 0000 NGA Reference Number: 16BCO16282

Title: Alaska – West Coast
East Nunivak Island – Etolin Strait

Scale: 1:100,000 at Latitude: 60° 10’00.0”N

Horizontal Datum: NAD83 Projection: Mercator

Soundings In: Fathoms and Feet at: MLLW

Depth Curves: Blue Tint Curve(s):

Limits

60º 38' 53.0" N

166º 31' 56.0" W 165º 08' 46.0" W

59º 39' 11.0" N

Total Latitude: 59' 42" Total Longitude: 01º 23' 10"

Neatline Height: 000.00mm Neatline Width: 000.00mm

Source of Hydrography

ID: 07950	Year: 1953	Scale: 1:500,000
ID: 02604	Year: 1902	Scale: 1:1,000,000
ID: 02619	Year: 1902	Scale: 1:80,000

An extensive amount of additional hydrography will need to be obtained from a variety of sources including existing smaller scale coverage, the United States Navy, the United States Geological Survey, and any other available sources.

Source of Shoreline

ID: PH56	Year: 1956	
Chart: 16006	Scale: 1:40,000	(Nash Harbor inset)

Source of Tide and Currents Data

Description of Data Available:
Description of Additional Data Needed:

Source of Geodetic Control

Description of Data Available:
Description of Additional Data Needed:

Other Special Data, Instructions, Navigational Requirements or Notes:

Chart Specification as of February 1, 2013

Chart Number: 16301 National Stock Number: 7642016157929

KAPP Number(s): 0000 NGA Reference Number: 16BCO16301

Title: Alaska – West Coast
Northern Kuskokwim Bay

Scale: 1:100,000 at Latitude: 59° 33’00.0”N

Horizontal Datum: NAD83 Projection: Mercator

Soundings In: Fathoms and Feet at: MLLW

Depth Curves: Blue Tint Curve(s):

Limits

59º 55' 38.0" N

164º 54' 36.0" W 162º 38' 02.0" W

59º 09' 55.0" N

Total Latitude: 45' 43" Total Longitude: 02º 16' 34"

Neatline Height: 000.00mm Neatline Width: 000.00mm

Source of Hydrography

ID: 07949	Year: 1953	Scale: 1:500,000
ID: 03551	Year: 1913	Scale: 1:100,000

An extensive amount of additional hydrography will need to be obtained from a variety of sources including existing smaller scale coverage, the United States Navy, the United States Geological Survey, and any other available sources.

Source of Shoreline

ID: PH56	Year: 1956
ID: PH56A	Year: 1958
ID: PH41	Year: 1951
Chart: 16304	Scale: 1:100,000

Source of Tide and Currents Data

Description of Data Available:
Description of Additional Data Needed:

Source of Geodetic Control

Description of Data Available:
Description of Additional Data Needed:

Other Special Data, Instructions, Navigational Requirements or Notes:

Kotzebue Sound: 16160	**1:200,000**
Point Hope: 16140	**1:200,000**

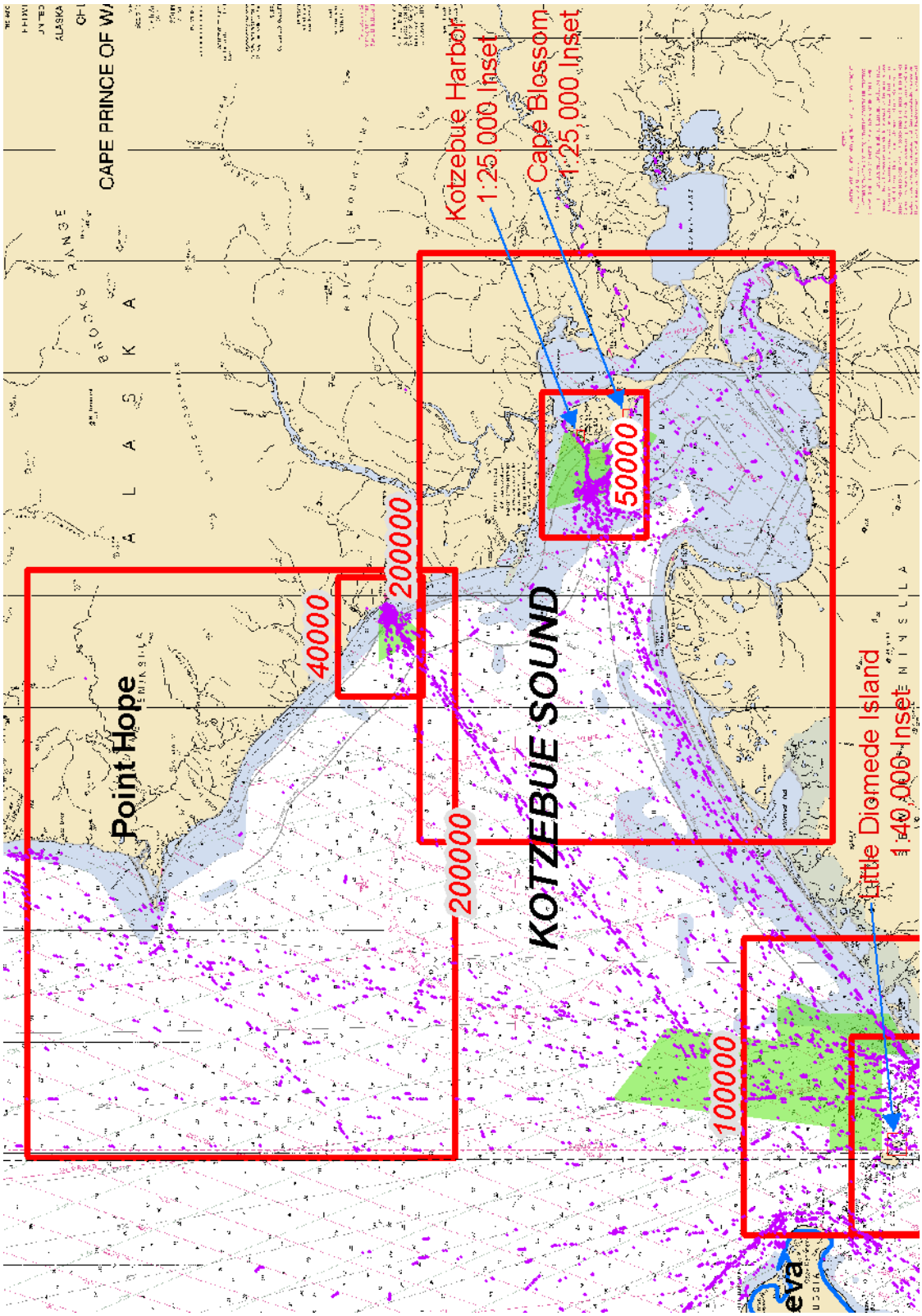


Chart Specification as of February 1, 2013

Chart Number: 16140 National Stock Number: 7642016157931

KAPP Number(s): 0000 NGA Reference Number: 16BCO16140

Title: Alaska – West Coast
Point Hope

Scale: 1:200,000 at Latitude: 68° 05’ 00.0”N

Horizontal Datum: NAD83 Projection: Mercator

Soundings In: Fathoms and Feet at: MLLW

Depth Curves: Blue Tint Curve(s):

Limits

68º 49' 42.0" N

169º 02' 56.0" W 163º 46' 10.0" W

67º 21' 41.0" N

Total Latitude: 01º 28' 01" Total Longitude: 05º 16' 46"

Neatline Height: 000.00mm Neatline Width: 000.00mm

Source of Hydrography

Planned	Year: 2011	Scale: To Be Determined
ID: 08661	Year: 1961	Scale: 1:160,000
ID: 08662	Year: 1961	Scale: 1:160,000

An extensive amount of additional hydrography will need to be obtained from a variety of sources including existing smaller scale coverage, the United States Navy, the United States Geological Survey, and any other available sources.

Source of Shoreline

ID: AK0302	Year: 2003
ID: PH28	Year: 1951
Chart: 16122	Scale: 1:50,000
Chart: 16123	Scale: 1:50,000
Chart: 16124	Scale: 1:50,000

Source of Tide and Currents Data

Description of Data Available:
Description of Additional Data Needed:

Source of Geodetic Control

Description of Data Available:
Description of Additional Data Needed:

Other Special Data, Instructions, Navigational Requirements or Notes:

Chart Specification as of February 1, 2013

Chart Number: 16160 National Stock Number: 7642016157930

KAPP Number(s): 0000 NGA Reference Number: 16BCO16160

Title: Alaska – West Coast
Kotzebue Sound

Scale: 1:200,000 at Latitude: 66° 45’ 00.0”N

Horizontal Datum: NAD83 Projection: Mercator

Soundings In: Fathoms and Feet at: MLLW

Depth Curves: Blue Tint Curve(s):

Limits

67º 27' 18.0" N

166º 12' 10.0" W 160º 55' 24.0" W

65º 59' 17.0" N

Total Latitude: 01º 28' 01" Total Longitude: 05º 16' 46"

Neatline Height: 000.00mm Neatline Width: 000.00mm

Source of Hydrography

Planned Year: 2012 Scale: To Be Determined

An extensive amount of additional hydrography will need to be obtained from a variety of sources including existing smaller scale coverage, the United States Navy, the United States Geological Survey, and any other available sources.

Source of Shoreline

ID: AK0301 Year: 2003
ID: AK0302 Year: 2003
ID: PH28 Year: 1951

Source of Tide and Currents Data

Description of Data Available:
Description of Additional Data Needed:

Source of Geodetic Control

Description of Data Available:
Description of Additional Data Needed:

Other Special Data, Instructions, Navigational Requirements or Notes:

Nunivak Island: 16280 **1:300,000**

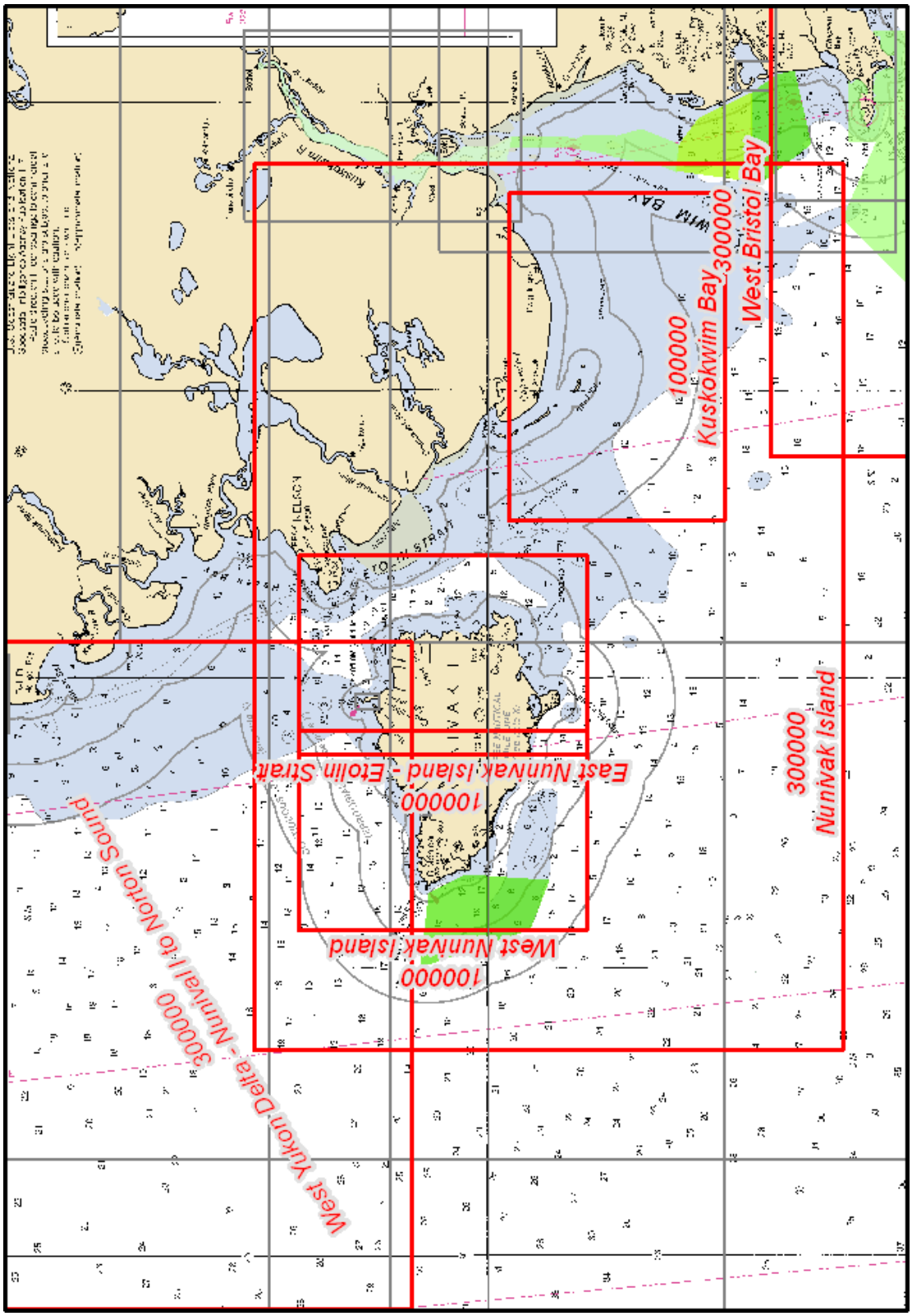


Chart Specification as of February 1, 2013

Chart Number: 16280 National Stock Number: 7642016157932

KAPP Number(s): 0000 NGA Reference Number: 16BCO16280

Title: Alaska – West Coast
Nunivak Island

Scale: 1:300,000 at Latitude: 59° 55’ 00.0”N

Horizontal Datum: NAD83 Projection: Mercator

Soundings In: Fathoms and Feet at: MLLW

Depth Curves: Blue Tint Curve(s):

Limits

60º 48' 14.0" N

168º 34' 58.0" W 162º 25' 45.0" W

58º 44' 26.0" N

Total Latitude: 02º 03' 48" Total Longitude: 06º 09' 13"

Neatline Height: 000.00mm Neatline Width: 000.00mm

Source of Hydrography

Planned (4)	Year: 2010-2013	Scale: To Be Determined
ID: 07949	Year: 1953	Scale: 1:500,000
ID: 07950	Year: 1953	Scale: 1:500,000
ID: 03551	Year: 1913	Scale: 1:100,000
ID: 02619	Year: 1902	Scale: 1:80,000
ID: 02604	Year: 1902	Scale: 1:1,000,000
ID: 2462B	Year: 1900	Scale: 1:514,000

An extensive amount of additional hydrography will need to be obtained from a variety of sources including existing smaller scale coverage, the United States Navy, the United States Geological Survey, and any other available sources.

Source of Shoreline

ID: PH56	Year: 1956
ID: PH56A	Year: 1958
ID: AK6056	Year: 1955
Chart: 16300	Scale: 1:200,000
Chart: 16304	Scale: 1:100,000

Source of Tide and Currents Data

Description of Data Available:
Description of Additional Data Needed:

Source of Geodetic Control

Description of Data Available:
Description of Additional Data Needed:

Other Special Data, Instructions, Navigational Requirements or Notes:

West Yukon Delta / Nunivak Island to Norton Sound: 16260 **1:300,000**

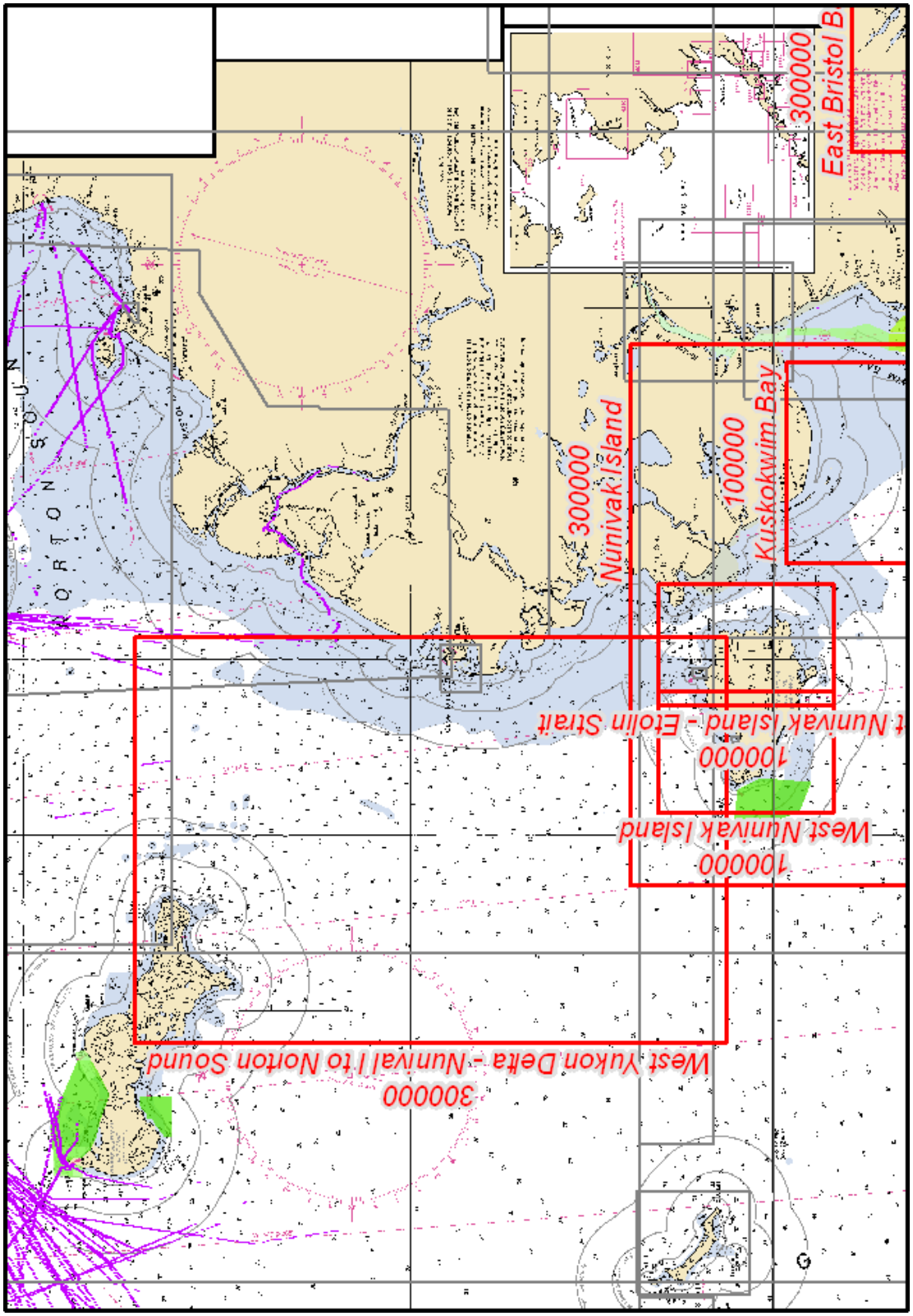


Chart Specification as of February 1, 2013

Chart Number: 16260 National Stock Number: 7642016157933

KAPP Number(s): 0000 NGA Reference Number: 16BCO16260

Title: Alaska – West Coast
West Yukon Delta / Nunivak Island to Norton Sound

Scale: 1:300,000 at Latitude: 61°55'00"N

Horizontal Datum: NAD83 Projection: Mercator

Soundings In: Fathoms and Feet at: MLLW

Depth Curves: Blue Tint Curve(s):

Limits

63º 26' 47.0" N

170º 22' 27.0" W 165º 44' 52.0" W

60 15' 44.0" N

Total Latitude: 03º 11' 03" Total Longitude: 04º 37' 35"

Neatline Height: 000.00mm Neatline Width: 000.00mm

Source of Hydrography

ID: 09048	Year: 1970	Scale: 1:100,000
ID: 09178	Year: 1970	Scale: 1:251,000
ID: 09027	Year: 1969	Scale: 1:100,000
ID: 07950	Year: 1953	Scale: 1:500,000
ID: 07912	Year: 1951	Scale: 1:20,000
ID: 07913	Year: 1951	Scale: 1:20,000
ID: 02604	Year: 1902	Scale: 1:1,000,000
ID: 02620	Year: 1902	Scale: 1:40,000
ID: 2462B	Year: 1900	Scale: 1:1,514,000
ID: 02462	Year: 1899	Scale: 1:200,000

An extensive amount of additional hydrography will need to be obtained from a variety of sources including existing smaller scale coverage, the United States Navy, the United States Geological Survey, and any other available sources.

Source of Shoreline

ID: PH56	Year: 1956
ID: AK-6056	Year: 1955
ID: PH53	Year: 1953
Chart: 16240	Scale: 1: 1:300,000

Source of Tide and Currents Data

Description of Data Available:
Description of Additional Data Needed:

Source of Geodetic Control

Description of Data Available:
Description of Additional Data Needed:

Other Special Data, Instructions, Navigational Requirements or Notes:

West Bristol Bay: 16310 **1:300,000**
East Bristol Bay: 16320 **1:300,000**

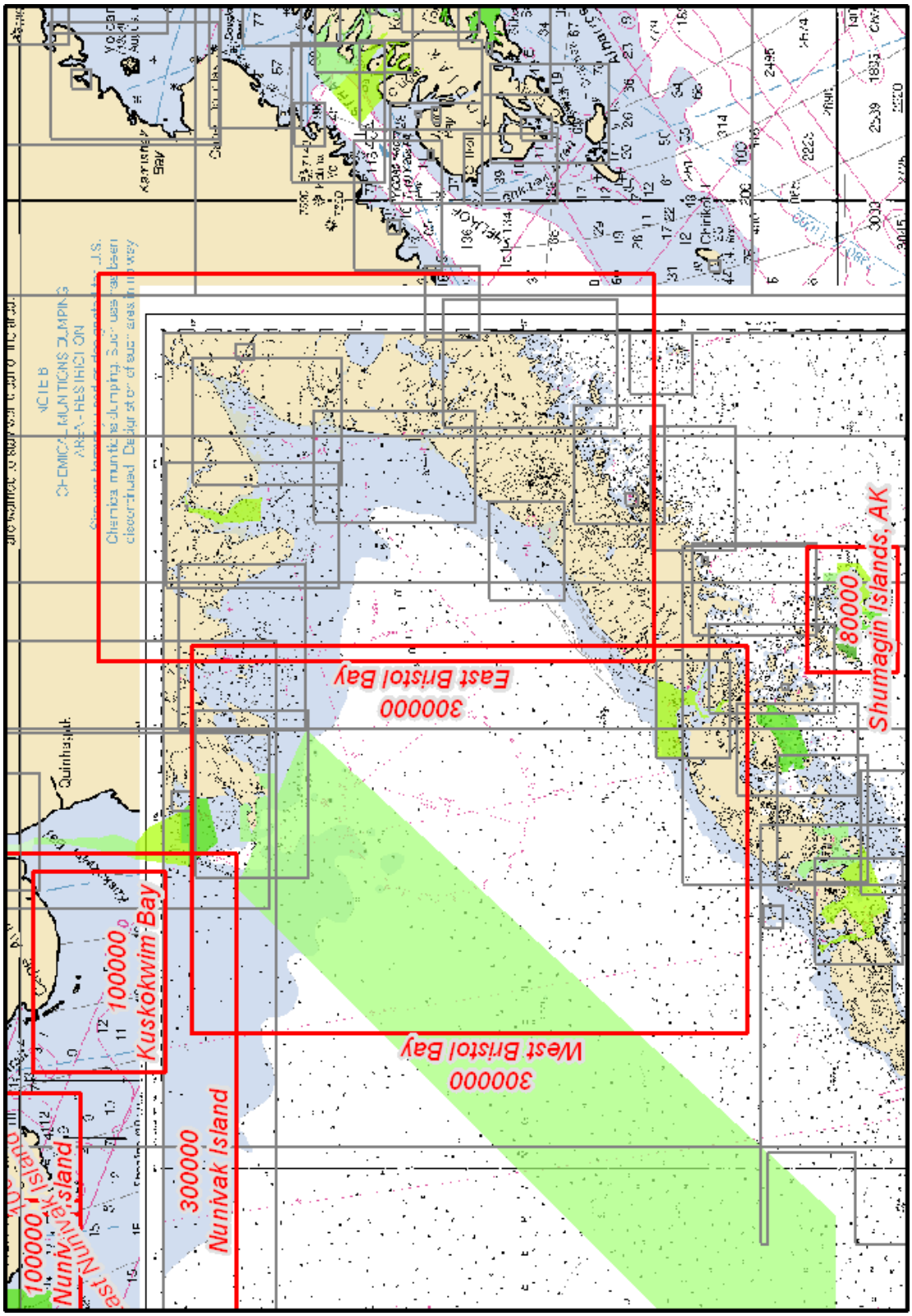


Chart Specification as of February 1, 2013

Chart Number: 16310 National Stock Number: 7642016157934

KAPP Number(s): 0000 NGA Reference Number: 16BCO16310

Title: Alaska – West Coast
West Bristol Bay

Scale: 1:300,000 at Latitude: 57° 20’ 00.0”N

Horizontal Datum: NAD83 Projection: Mercator

Soundings In: Fathoms and Feet at: MLLW

Depth Curves: Blue Tint Curve(s):

Limits

59 00' 12.0" N

164º 27' 43.0" W 160º 03' 19.0" W

55º 35' 06.0" N

Total Latitude: 03º 25' 06" Total Longitude: 04º 24' 24"

Neatline Height: 000.00mm Neatline Width: 000.00mm

Source of Hydrography

Planned	Year: 2013	Scale: To Be Determined
ID: 07949	Year: 1953	Scale: 1:500,000
ID: 02604	Year: 1902	Scale: 1:1,000,000
ID: 02619	Year: 1902	Scale: 1:80,000
ID: 2562B	Year: 1900	Scale: 1:1,514,000

An extensive amount of additional hydrography will need to be obtained from a variety of sources including existing smaller scale coverage, the United States Navy, the United States Geological Survey, and any other available sources.

Source of Shoreline

ID: PH40	Year: 1955
Chart: 16300	Scale: 1:200,000
Chart: 16305	Scale: 1:100,000
Chart: 16315	Scale: 1:100,000
Chart: 16363	Scale: 1:80,000
Chart: 16540	Scale: 1:300,000

Source of Tide and Currents Data

Description of Data Available:
Description of Additional Data Needed:

Source of Geodetic Control

Description of Data Available:
Description of Additional Data Needed:

Other Special Data, Instructions, Navigational Requirements or Notes:

Chart Specification as of February 1, 2013

Chart Number: 16320

National Stock Number: 7642016157935

KAPP Number(s): 0000

NGA Reference Number: 16BCO16320

Title: Alaska – West Coast
East Bristol Bay

Scale: 1:300,000

at Latitude: 57° 54'00.0"N

Horizontal Datum: NAD83

Projection: Mercator

Soundings In: Fathoms and Feet

at: MLLW

Depth Curves:

Blue Tint Curve(s):

Limits

59º 32' 54.0" N

160º 14' 22.0" W

155º 49' 58.0" W

56º 11' 01.0" N

Total Latitude: 03º 21' 53"

Total Longitude: 04º 24' 24"

Neatline Height: 000.00mm

Neatline Width: 000.00mm

Source of Hydrography

Chart: 16315	Scale: 1:100,000
Chart: 16322	Scale: 1:100,000
Chart: 16323	Scale: 1:100,000
Chart: 16338	Scale: 1:100,000
Chart: 16343	Scale: 1:80,000
Chart: 16566	Scale: 1:77,477
Chart: 16568	Scale: 1:106,600
Chart: 16570	Scale: 1:50,000
Chart: 16587	Scale: 1:135,000

ID: H-11054	Year: 2001
ID: H-10981	Year: 2000
ID: H-10184	Year: 1985
ID: H-06925	Year: 1943

ID: F-00076	Year: 1949
ID: F-00073	Year: 1948
ID: F-00074	Year: 1948
ID: F-00063	Year: 1947

The scale of the F surveys is approximately 1:1,000,000, because of this and coverage gaps, additional hydrography will need to be collected to produce this chart.

Source of Shoreline

Charts north of Alaska Peninsula:

Chart: 16315	Scale: 1:100,000
Chart: 16322	Scale: 1:100,000
Chart: 16323	Scale: 1:100,000
Chart: 16338	Scale: 1:100,000
Chart: 16343	Scale: 1:80,000

Charts south of Alaska Peninsula:

Chart: 16566	Scale: 1:77,477
Chart: 16568	Scale: 1:106,600
Chart: 16570	Scale: 1:50,000
Chart: 16587	Scale: 1:135,000

ID: PH40	Year: 1955
ID: CS319	Year: 1947

Source of Tide and Currents Data

Description of Data Available:
Description of Additional Data Needed:

Source of Geodetic Control

Description of Data Available:
Description of Additional Data Needed:

Other Special Data, Instructions, Navigational Requirements or Notes: