WRITTEN TESTIMONY OF
DAVID KENNEDY
SENIOR ADVISOR FOR THE NOAA ARCTIC PROGRAM
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

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Introduction

Good morning Chairman Hunter, Ranking Member Garamendi, and Members of the Subcommittee. My name is Dave Kennedy, and I am the Senior Advisor for the Arctic Region at the National Oceanic and Atmospheric Administration (NOAA), within the Department of Commerce. Thank you for inviting NOAA to testify today on our work to support safe and efficient maritime transportation in the Arctic. NOAA appreciates the opportunity to participate today along with representatives from the U.S. Coast Guard, Center for Strategic and International Studies, University of Alaska Fairbanks, Alaska Ocean Observing System, and Pennsylvania State University. We cooperate and coordinate on a regular basis with these agencies and partners in support of the nation's economic and national security interests in the Arctic.

For over two hundred years, NOAA and its predecessor organizations have provided foundational data, products, and services to support safe, efficient maritime commerce. NOAA also has a long history in the Arctic, including conducting research and providing weather and climate services, sea ice forecasting, nautical charting and other navigation services, natural resource management, and oil spill preparedness and response. Today, as sea ice retreats and economic and maritime activity in the Arctic grows, NOAA remains committed to its work in the Arctic.[1] I will touch broadly on NOAA's services, but will focus on our nautical charting mission with an emphasis on the components that are necessary to support maritime transportation and informational infrastructure in the region.

International, Interagency and Local Engagement

NOAA has supported U.S. participation in the international Arctic Council since its

[1] Under the Arctic Research and Policy Act of 1984, the Arctic includes the Aleutian Islands, Bering Sea, Chukchi Sea, Beaufort Sea, and vast terrestrial areas of northern and western Alaska.

establishment in 1996. The U.S. served as the second chair of the council from 1998 to 2000 and chaired the Council again from 2015 to 2017. Through the Council's Protection of the Arctic Marine Environment working group and other efforts, NOAA has supported coordination of efforts to promote safe Arctic navigation. On May 15, the Council launched a public website to assist in implementation of the Polar Code.[2] To better address Arctic hydrographic and nautical charting challenges, NOAA has also participated in the Arctic Regional Hydrographic Commission since 2010.

Since 2016, NOAA has served as the Chair of the U.S. Arctic Observing Network Board and worked towards a sustained and well-defined network of Arctic observations across NOAA, other Federal agencies, the State of Alaska and Alaskan Native Tribes, academia, industry, and international partners, such as the Sustaining Arctic Observing Network. NOAA has been a long-standing sponsor of the Arctic Report Card, an annual, peer-reviewed report developed by 85 scientists across 12 countries. The Arctic Report Card issued its 12th report in 2017. The publication's annual update provides reliable data and observations to support local and regional decision makers in making informed decisions for Arctic communities, national security, industrial growth, environmental health, and food security.

On a local level, the increase in vessel traffic through the Bering Strait into the Chukchi and Beaufort Seas is of concern to Alaska Native coastal communities in the region. These communities rely on subsistence hunting of marine mammals, which are critical to their nutritional, cultural, mental and spiritual well-being. NOAA has been working with the Arctic Waterways Safety Committee (AWSC) to ensure the increase in research vessel traffic does not negatively impact the ability of the communities to hunt marine mammals. Since 2010, NOAA has requested community input for summer survey plans with the AWSC. During these briefings on our planned work, NOAA also details its findings from its prior year survey.

Oil Spill and Hazard Preparedness and Response

Decreasing summer sea ice is contributing to growth in commerce, tourism, and energy exploration in the Arctic. According to a 2015 study coordinated by the U.S. Committee on the Marine Transportation System, shipping transits through the Bering Strait are expected to increase 500 percent by 2025. This increased activity heightens the risk of accidents and discharges of oil and hazardous materials. NOAA's Alaska regional Scientific Support Coordinator provides scientific support to the federal on-scene coordinator for oil spills and other emergencies such as search and rescue. NOAA's contributions include modeling the fate and movement of spills, identifying natural resources at risk, and providing software, mapping tools, and data management capabilities. By law, NOAA is also a trustee for natural resources that

2 The International Maritime Organization's International Code for Ships Operating in Polar Waters. The Web Portal is accessible at http://www.imo.org/en/MediaCentre/HotTopics/polar/Pages/default.aspx.

have been injured by oil and chemicals spills and conducts damage assessment and restoration of these resources.

NOAA participates in joint training and workshops with interagency partners and other Arctic nations on activities such as the use of mechanical recovery, dispersants, and in situ burning following transboundary spill events. NOAA compiles baseline information on natural resources in the Arctic and promulgates standard techniques and guidelines for observing and measuring oil spills and assessing shorelines. Last year, NOAA participated in an interagency oil spill response training for communities in the North Slope of Alaska and held a Science of Oil Spills class in Anchorage.

In 2012, NOAA launched the Arctic Environmental Response Management Application (ERMA®) to integrate and synthesize data into a single interactive map, provide quick geospatial visualizations, and improve communication and coordination among multiple responder agencies. As a common operational picture, ERMA® brings together all of the available information needed for an effective emergency response. In 2017, with funding assistance from the Bureau of Safety and Environmental Enforcement, NOAA improved its display for the Arctic by adding polar projection base maps. This provides a less distorted display of the region while maintaining accurate bearings to the coastline.

Interagency preparedness exercises are essential for critical improvements in spill response procedures. Most recently, in July 2017, NOAA participated in a Mutual Aid Deployment (MAD) exercise on Alaska's North Slope oil field. MAD exercises are held annually on the North Slope with alternating industry hosts. The 2017 exercise was hosted by Hilcorp Alaska (LLC) and included field equipment deployment, an Incident Command Center, and remote operations in Anchorage. NOAA participated in the Incident Management Team at the Command Center along with the U.S. Coast Guard, Hilcorp Alaska (LLC), Alaska Department of Environmental Conservation, and other federal, state, and local responders.

During the United States chairmanship of the Arctic Council for 2015 and 2016, NOAA chaired the Emergency Prevention, Preparedness, and Response (EPPR) Workgroup. Under this leadership, the U.S. delegation to the workgroup delivered several important projects including a Pan-Arctic Oil Spill Response Equipment Database, a Circumpolar Oil Spill Response Equipment Viability Analysis, an updated Guide on Oil Spill Response in Ice and Snow Conditions, and further advancement of exercise procedures for the Agreement on Cooperation on Marine Oil Pollution Preparedness and Response (MOSPA).

Nautical Charts for the Arctic

Since most of the U.S. Arctic is not connected by road or rail, marine transportation is an essential means of transporting goods and people, making NOAA’s navigation, observation and

positioning services important for safe and efficient surveying, construction, transportation, and other commerce-related activities. Thus, nautical charts for Alaska and the Arctic are a key component of NOAA's nautical charting mission.

The major requirements for nautical charts are (1) accurate positioning, (2) coastal oceanography such as tides and water levels, (3) shoreline mapping, and (4) hydrographic surveying. NOAA is taking steps to improve the accuracy and reliability of these core capabilities and the nautical charting and navigation services they support.

NOAA released its National Charting Plan in 2017 to improve chart coverage and take full advantage of the capabilities of today's technologies, including the digital Electronic Nautical Chart. This national plan augments NOAA's Arctic Nautical Charting Plan. Both of these plans are designed to ensure that NOAA continues to lead and implement international requirements for hydrographical surveying and charting.

Positioning and the National Spatial Reference System

Nautical charts rely on accurate shoreline information and precise positions and elevations of tide and water level stations, which are dependent on an accurate land-based reference framework. NOAA's National Geodetic Survey provides the land-based reference framework, known as the National Spatial Reference System (NSRS), provides the authoritative coordinate system for all positioning activities in the Nation. Due to tectonic activity, land elevation and positioning data in Alaska currently have errors of a meter or more. To rectify this and modernize the NSRS, NOAA is collecting airborne gravity data under its Gravity for the Redefinition of the American Vertical Datum (GRAV-D) initiative. Thus far, the data for the GRAV-D initiative in the Arctic has been collected using a combination of NOAA, other federal government, and contract aircraft. Specifically, we have used the NOAA P-3, the Bureau of Land Management PC-12 (other federal government), and the Dynamic Aviation King Air 200T (contract aircraft).

Under GRAV-D, NOAA collected airborne gravity data over 13.4 percent of Alaska in 2017 (excluding the Aleutian Islands). In FY18, we expect to reach 95 percent coverage of Alaska, (excluding the Aleutians) while collecting data in the Alaskan Arctic over an area the size of Virginia (110K sq. km). The overall GRAV-D effort in Alaska should be completed by the end of 2020. NOAA is also working to provide improved positioning in Alaska through its network of Continuously Operating Reference Stations. These efforts are part of NOAA's 2022 update to the NSRS, which will enable up to centimeter-level accuracy for latitude, longitude, and height, using Global Navigation Satellite System survey techniques at any location.

Tides, Water Levels and Coastal Oceanography

Accurate water level data is another essential component for building accurate nautical charts.

NOAA's Center for Operational Oceanographic Products and Services (CO-OPS) builds and maintains the country's National Water Level Observation Network (NWLON). In addition to providing data essential for surveying and charting, these long-term observations of coastal water levels improve understanding and predictions of coastal change, storm surge, and saltwater intrusion into freshwater systems that are urgently needed to inform decisions by increasingly vulnerable coastal communities in the Arctic. Presently, CO-OPS operates 27 long-term NWLON tide stations in Alaska, 10 of which are located in the Arctic. CO-OPS has identified over 30 gaps in NWLON coverage for Alaska, the majority of which are in the Arctic. Where gaps exist, local tide data must be taken from short-term water level studies or extrapolated from the nearest NWLON station, both of which will introduce potential error. Thus, reducing gaps in NWLON coverage improves the accuracy and redundancy of the reference system.

To address this need, CO-OPS and the Alaska Ocean Observing System (AOOS), which is a part of the NOAA-led Integrated Ocean Observing System (IOOS) program, are developing and testing new technologies to measure water levels in Alaska. AOOS has helped install portable, low-cost systems that help to fill NOAA National Weather Service observation gaps for monitoring storm surges in small coastal communities. Recently, the National Weather Service supported installation of a NWLON station in Unalakleet, Alaska, to provide real-time information for storm surge models, as well as navigation. The maintenance of this station, as well as others in Alaska, has been contracted out to a local Alaska company, JOA Surveys, LLC. JOA is also working with the National Park Service to install a water level sensor to NOAA standards in Cook Inlet that will also help fill a NWLON gap.

NOAA's Office of Coast Survey and CO-OPS are also collaborating to bring online the Cook Inlet Operational Forecast System (OFS), a 3-dimensional hydrodynamic model, in FY19. The OFS will provide nowcast and forecast information for water levels, currents, temperature and salinity to support navigation activities along the ship channel from the mouth of the estuary all the way to Anchorage. CO-OPS is working with AOOS and NOAA's Kasitsna Bay Laboratory to collect marine current information in Kachemak Bay to assist with circulation studies to update the U.S. Tidal Current Tables. These new data will also support the Cook Inlet OFS.

Shoreline Mapping

Shoreline surveys are also critical to keeping nautical charts up to date. In 2017, NOAA doubled its previous years' shoreline coverage, delivering accurate shoreline and topographic features for over 700 miles of coastline. This data enables mariners to pinpoint their locations relative to the coast, navigate to and from ports safely, and find harbors of refuge when in need. In addition to charting, accurate shoreline data is a key requirement for many other uses, including maritime domain awareness, waterways management, and environmental protection from oil spills and other hazardous events.

Hydrographic Surveying

Nautical charts are only as good as the accuracy of the underlying hydrographic data and less than 5 percent of the U.S. maritime Arctic is charted to modern international navigation standards. The scale of the hydrographic survey requirement in Alaska and the Arctic is vast, with 426,000 square nautical miles within the U.S. Exclusive Economic Zone (EEZ) and nearly half of that significant to navigation.

Through the Office of the Coast Survey, NOAA continues to prioritize and undertake hydrographic surveying in the expansive, remote and often harsh Arctic environment. Over the past three years, NOAA and its contract partners have acquired nearly 1,500 square nautical miles of hydrographic survey data in the Arctic. For 2018, our survey plans include seven projects in waters off Alaska, covering 2,066 square nautical miles. Those areas include: the north slope of Kodiak, West Prince of Wales Island, Tracy Arm, Lisianski Strait and Inlet, southwest Alaska Peninsula, Morzhovoi Bay/Cold Bay, and Point Hope and Vicinity. Five of these projects will be carried out by our regional contracting partners. They are an essential component of the balanced hydrographic survey program NOAA employs in Alaska and across the nation.

NOAA also works with private sector partners and academia to develop and deploy Autonomous Surface Vessels (ASV) for chart-quality surveys. For the past two years, our contractor in Alaska has employed unmanned surface vehicles to conduct hydrographic surveys. Through a partnership with the University of New Hampshire's Center for Coastal and Ocean Mapping we plan to use an ASV and a NOAA ship-based crew to conduct a hydrographic survey in the Arctic this year. In 2016, we collaborated with the Pacific Marine Environmental Laboratory to use a Saildrone ASV to acquire data in the Bering and Chukchi Seas. Based on the success of that mission, we are currently updating our Bering Sea charts with the ASV-gathered data. This collaboration expanded in 2017 to five ASVs and we look forward to updating more charts with that data and further investigating the use of Saildrones as an additional, cost-effective survey capability.

The Nautical Chart

A primary purpose for many of these functions is to support NOAA's production of the Nation's nautical charts. As with all mapping and geospatial activities, the nautical chart has been transformed by modern technologies, including the transition to digital charts. NOAA released its National Charting Plan in 2017 to improve chart coverage and take full advantage of the capabilities of today's technologies, including the digital Electronic Nautical Chart. This national plan augments NOAA's Arctic Nautical Charting Plan referenced earlier. These plans are based on extensive outreach to users. They also are designed to ensure NOAA continues to lead and implement international requirements for surveying and charting.

Looking to the Future: Enhancing NOAA's Core Missions in the Arctic

While NOAA's core missions remain the same, advances in technology are providing opportunities to greatly enhance the accuracy, timeliness, and integration of our products and services, including those that inform and support marine navigation and transportation in the Arctic. To ensure that we consider the needs of and challenges facing our Arctic stakeholders, NOAA continues to look for innovative partnerships with the private sector and other stakeholders, including the ability of the private sector to incorporate NOAA data and services to develop new applications to enhance operations and efficiency. NOAA will continue reaching out to our Arctic stakeholders by convening a meeting of our Hydrographic Services Review Panel (a federal advisory committee) in Juneau this August.

Conclusion

NOAA plays a unique and important role in providing critical informational infrastructure to support safe, reliable, and efficient marine navigation in the Arctic and elsewhere. Local, state, federal, and international partnerships are critical to achieving successful Arctic operations in this unique and challenging environment. There is more work to be done to facilitate commerce in the Arctic and NOAA is working to develop and apply technology and data in innovative ways to improve our navigation products and services. Thank you again for the opportunity to testify today. I appreciate the Subcommittee's time and attention and look forward to answering your questions.