

**WRITTEN TESTIMONY OF
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U.S. DEPARTMENT OF COMMERCE**

**HEARING BEFORE THE
SUBCOMMITTEE ON COAST GUARD AND MARITIME TRANSPORTATION AND
THE SUBCOMMITTEE ON WATER RESOURCES AND THE ENVIRONMENT
COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE
U.S. HOUSE OF REPRESENTATIVES**

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Introduction

Good morning Chairmen Hunter and Gibbs, Ranking Members Garamendi and Napolitano, and Members of the Subcommittees. My name is Shep Smith and I am the Director of the Office of Coast Survey at the National Oceanic and Atmospheric Administration (NOAA), within the Department of Commerce. I am pleased to have the opportunity to testify today on Federal Maritime Navigation Programs: Interagency Cooperation and Technological Change, and specifically how NOAA is advancing navigation services

We appreciate the opportunity to testify at this hearing along with the U.S. Coast Guard and U.S. Army Corps of Engineers (USACE) on these critical themes as a natural follow up to the February 2014 hearing on the future of Federal navigation aids. Our agencies cooperate and coordinate on a regular basis, united in support of the nation's economic and national security.

NOAA's unique contribution to maritime navigation is to employ the latest technologies to provide mariners and others with science-based information and services on the present and future condition of the marine environment. NOAA does this through the acquisition, management and delivery of essential environmental data, which inform thousands of decisions on the safe and efficient movement of goods through our coastal ports and inland waterways every day. This information infrastructure is delivered in the form of nautical charts, real time ocean and coastal observations, positioning services, weather and water-level forecasts, and other navigation-related products and services.

The Office of Coast Survey has been the Nation's chartmaker since 1807 when President Thomas Jefferson signed "An Act to provide for surveying the coasts of the United States." Today this responsibility extends to the entire 3.4 million square nautical miles of U.S. waters from our coasts and Great Lakes to the 200-mile limit of the Exclusive Economic Zone. An enormous task, NOAA has long focused its efforts and resources on supporting safe navigation primarily for commercial shipping through its nautical charting program and maintenance of the 1,000 raster and electronic nautical chart suite. NOAA cartographers verify and chart data from over 50 different sources, including NOAA's own hydrographic surveys, contractors, U.S. Coast Guard aids to navigation, USACE navigation channel condition surveys, and locations of key port infrastructure provided by port authorities.

NOAA's Coast Survey is committed to seeking out new opportunities to more efficiently fulfill our historic mission. New technologies are an essential component of this effort and I believe we are on the cusp of a new era for delivering the accurate navigation products and services required to meet the needs of increasingly complex marine transportation. Today I will focus on the drivers shaping NOAA's navigation program for the next 20 years, and how partnerships – with commercial industry and our sister agencies – will help us support not only commercial shipping, but also commercial and recreational fishing, recreational boaters, state and local government uses, and coastal zone managers, among others. I will discuss the current and future state of electronic charting and advances we are making on data acquisition and NOAA nautical chart updates, and close with a specific look at the Arctic region.

Supporting Blue Economies for Communities and Industry

NOAA is committed to supporting the “blue economy” -- businesses that rely on the oceans and coasts. We do this in two ways. First, the information we provide to the public is critical not only to major international shipping industry, but also coastwise commerce, tug and barge, fishing, recreational boating, military and government operations, and maritime small business industries. A 2015 NOAA study, *The National Significance of California's Ocean Economy*, examined the contributions of sectors such as tourism and recreation, marine transportation, and offshore mineral extraction. Marine transportation activities alone accounted for \$14.1 billion, or 31 percent, of the California ocean economy GDP in 2012. This included the transportation of cargo and passengers, port operations and the manufacture of marine instrumentation. California's marine transportation economy is also a key contributor to the national economy, providing points of entry and exit for inland U.S. industries to import and export goods and resources globally.

Second, the industry of collecting and delivering environmental intelligence to the public supports the blue economy in its own right. A recent study by the NOAA-led U.S. Integrated Ocean Observing System (IOOS[®]), in partnership with the Maritime Alliance and ERISS Corporation, issued the first national-level assessment of the scale and scope of the "ocean enterprise." The study shows that the ocean enterprise -- the 400- plus for-profit and not-for-profit firms that support ocean measurement, observation, and forecasting -- accounts for \$7 billion of the U.S. economy annually and provides up to 30,000 jobs. An important industry cluster, the ocean enterprise focuses both on advancing ocean observing technologies and delivering value-added products from ocean data. We are looking at how NOAA can collaborate even more effectively with the ocean enterprise to develop tools and services that improve public safety, enhance our economy, and deliver environmental benefits.

National Charting Plan

Two major shifts are underway that are changing the paradigm of how NOAA produces and delivers nautical charts. First, Coast Survey has nearly completed the transition to a new charting system that uses one central database to produce all NOAA chart products. This system speeds new data and updates to all chart versions of the same charted areas and removes inconsistencies. We will complete this transition in time for the International Maritime

Organization's 2018 requirement to carry Electronic Navigational Charts as the primary chart on the bridge of large international commercial vessels. Second, since NOAA privatized all chart printing and transitioned to full print-on-demand in 2014, we can now support faster digital updates that are synchronized across all products rather than the delayed publications made necessary by the old paper chart system. Our charts can now reflect real world features that change monthly, such as updating an ocean inlet changed by winter storms in time for the summer boating season.

These changes also allow us to be more responsive to changing public needs for navigation data. In this context, Coast Survey has begun work on a National Charting Plan to outline the next steps for further improvement to NOAA's nautical charting services over the next generation. As part of this plan, NOAA will identify areas needing more detailed chart coverage, and reorganize our electronic charts to provide seamless electronic coverage for our coasts and Great Lakes. In order to aggregate the highest quality data to build new charts, we will first assess currently available data, including traditional hydrographic surveys and topo-bathymetric lidar data from our partners such as the USACE, U.S. Geological Survey, state and local groups, and other nontraditional sources. We will prioritize new data acquisition based on reported chart discrepancies, new traffic patterns, and coastal changeability. New techniques using satellite imagery to estimate water depth and crowdsourced depth data from volunteer boats will allow us to more efficiently target our survey resources to areas that will have the most impact.

For our core navigation users, we are planning a suite-wide update of our ENC's in order to optimize them for use in electronic navigation systems. We will re-examine the depth areas we digitized originally from paper charts to ensure they run across the full dataset rather than end at their former paper chart boundaries. We intend to re-scheme the entire ENC suite with an aim to reduce our number of scales from over 100 that existed in the corresponding paper charts to about 10. The digital environment allows for larger scale (more detailed) data and uniform scales and data will make the suite easier to manage, plan for, and most importantly - far easier to derive additional digital products from.

In addition to the re-scheming, we are working with the U.S. Coast Guard on the feasibility to access its Aids to Navigation database directly using specialized, semi-automated tools to make the changes to the chart based on the changes in the Coast Guard database. Similarly, we are working with the USACE to consolidate their channel condition surveys nationwide into a geo-database that is compatible with NOAA's charting system. Vector-to-vector tools will be able to automatically populate the charted channel information.

While more accurate and rapid chart updates are very important, we are seeking to do more than putting our ENC's, tide tables, current measurements, marine radio forecasts, and the latest hydrodynamic models up on a website. We are working to distribute these data in standard formats to charting systems, portable pilot units and port information systems to allow users to quantifiably manage navigation risk. As the U.S. representative to the International Hydrographic Organization, NOAA's Coast Survey is leading international efforts to develop new standards to ensure navigation data is interoperable with other kinds of geospatial data and

can be ingested easily into the user's decision tool of choice, whether that be an under keel clearance system or an iPhone.

In the era of Google Maps, there is no longer a need to procure a new edition paper map or nautical chart. Whether on the road or on the water, users are increasingly using digital services and expect maps (now often referred to as Geographic Information Systems or GIS) to be seamless and continually updated. These digital products have no pages or edges and are useful at a wide scale range. While we have a ways to go, we are taking steps toward this next generation of charting services.

The National Charting Plan, as outlined above, is responsive to years of formal and informal feedback on our products from the public and our partners. We are committed to ensuring that our plans incorporate the best thinking and the considered requirements of our stakeholders; the development of this National Charting Plan will include a period for public review and comment.

Precision Navigation

Nautical charts are not used alone. Navigation services also includes dynamic and real time environmental information from across NOAA and marine safety information from the USCG. These observations, forecasts and underlying foundational data help mariners anticipate ocean and weather conditions that affect navigation. This is particularly critical in the tightly constrained waterway between the entrance buoys to a port, through tight channels to the berth. Where a ship at sea might feel that another ship or hazard is "close" when it is closer than half a mile, ships must routinely enter and leave ports with mere feet to spare under keel, to the sides, and overhead.

While ENCs, tides and currents, weather, and salinity have been broadly available in many ports, these data are provided separately. I once visited the director of a marine exchange, and asked him how he got all the information that he needed to determine the safe window of passage for an inbound heavily loaded tanker. He showed me his iPhone, which had two whole screens of shortcuts, most to NOAA web sites, including the Physical Oceanographic Real Time System (PORTS). Even though he had access to a state-of-the-art waterway management system, none of these data streams were integrated into his common operating picture. The same is true of most at-sea navigation systems.

We envision commercial "precision navigation" systems that are well integrated with observational and geospatial information - much of it acquired by NOAA, but also through other channels - to allow mariners to navigate in constrained waterways. NOAA is working towards achieving this by modernizing and integrating the navigational information and tools ship operators, port managers, pilots, and shipping companies need, providing them through a unified delivery system across the nation, and progressively working with individual ports to augment the standard data NOAA provides with tailored products and information that address unique local challenges. The significance of precision navigation is increasingly growing as vessel sizes

and cargo volumes are already outpacing the capacities and physical and information infrastructure of some U.S. ports.

Unlike existing paper and digital charts, we are prototyping new high-resolution charts for ports that provide the level of detail needed to optimize the management of risk/return in ship movements from the sea buoy to the berth. Working with commercial partners, these hi-res ENC's will support integration with real-time observations and rapid model forecasts to allow mariners to sail using dynamic depths representing the safe depth of water at the actual time of transit under the bottom of the vessel.

The Port of Long Beach provides a tangible example of the potential benefits. By using its new underkeel clearance decision support system that is fueled by several kinds of NOAA data, the port will save an estimated \$10M per year by eliminating the need to offload cargo from vessels offshore before they enter the port. This effort leveraged partnerships and capabilities of the port, pilots, private sector, Southern California Coastal Ocean Observing System, and USACE, as well as local National Weather Service modeling and model validation support. It is a model for future collaborations in other seaports, where NOAA can work with others to address challenging navigation safety margins by integrating high resolution data and products, and where feasible, leverage private investment.

We are also working with industry partners and app developers for mobile devices to deliver data in a unified, intuitive fashion to the mariner. This will provide mariners with accurate, real-time information that is simultaneously collected, integrated, analyzed, and delivered electronically to the user in a harmonized fashion to ensure their safety, the security of their vessel, and the protection of the marine environment.

Data Acquisition - Getting the Data We Need

For the past two decades, NOAA's hydrographic program has been focused on achieving full bottom coverage in an area of 43,000 square nautical miles that we referred to as the "critical area." This area was identified as needing high level survey attention because of the risk of deep draft ships hitting uncharted rocks, wrecks, and seafloor obstructions that were undetectable by previous survey technologies. This area was in approaches to major ports, coastal waterways and estuaries, and in specific areas of coastal Alaska. High resolution multibeam surveys done in these areas now and into the future will ensure they still meet the accuracies needed for this purpose.

As we continue to survey these critical areas, we are also becoming increasingly aware of the need for updated hydrographic data in coastal areas frequented by smaller commercial, fishing, charter and recreational vessels. There are over two thousand instances where we have charted an estimated depth reported by the public. In many cases these reports are made after a vessel grounding or a near miss. Thousands of charted wrecks and obstructions are in estimated positions, which can be in error by up to a half mile or more. Surveying such discrete areas

where there are known needs for data will yield a large impact per unit of survey effort, but not produce impressive total square nautical miles figures--the productivity of this part of the hydrographic program will have to be measured in different ways.

The ability and capacity to perform hydrographic surveys is a core mission for Coast Survey. NOAA maintains mapping services to meet its statutory core mission requirements and continually builds expertise that is critical to overseeing activities like contracting for hydrographic and shoreline mapping surveys. In the 1960s, we had 14 vessels in the hydrographic fleet. Today, NOAA currently owns and operates four ships (two on each coast) that are dedicated to conducting hydrographic surveys: *Fairweather*, *Rainier*, *Thomas Jefferson*, and *Ferdinand R. Hassler*.

NOAA is working to ensure the Nation has a fleet of research ships that meet the Nation's observation requirements. Coast Survey is engaged with the NOAA planning efforts to identify and refine the requirements for replacement vessels. Concurrent with data collection, NOAA ensures that its hydrographic surveying personnel consisting of NOAA Corps Officers, physical scientists, cartographers, GIS specialists, and others maintain sufficient expertise to oversee contracts, develop specifications, interact with international hydrographic organizations, and interface with other government agencies and private contractors to conduct all hydrographic survey work and manage the nation's surveying and charting program.

To complement and extend the capacity of NOAA's survey operations, NOAA contracts for about half of its survey requirements. The contractors we use have solid experience doing surveys to our standards, and consistently deliver high quality work. In addition, they join our government hydrographers in a vibrant US community of practice that often leads the world in use of new technology and techniques.

Leveraging Other Sources of Data

We continue to improve the efficiency of our work using emerging sources of data beyond the more traditional ones. For example, NOAA recently operationalized its airborne topographic-bathymetric lidar program, which provides improved elevation data, both above and below the shoreline, particularly in areas of less than four meters of water. NOAA coordinates its lidar work with the USACE, which also acquires topographic-bathymetric lidar in coastal areas for sediment transport management and beach engineering. Use of this technology for charting has been made possible by VDatum, a NOAA tool allowing agencies to shift seamlessly between land- and tidal-based datums.

Satellite derived bathymetry (SDB) is being explored as a method for determining chart adequacy and, in some cases, for updating charts. This technique uses satellite images to estimate depths in relatively shallow and clear waters. While estimates from SDB are not reliable enough to be the sole source for charted depths, they provide a clear indication of bathymetric change and identifying shoals. We are adapting our planning process to use SDB to target more effective use of survey resources.

In response to stakeholders who requested NOAA's charting assistance, NOAA's Office of Coast Survey decided to create some prototype ENC's using only satellite data and issued provisional charts for barge operators and others traversing Alaska's challenging Yukon River. The Yukon was literally uncharted and these new provisional charts will help to address the concerns of the local barge industry that supply goods and services to western Alaska and have had to deal with a lack of data inshore of the 12-foot contour. The new Yukon River provisional ENC's offer 1:90,000 scale coverage that spans the entrance to the Yukon River, including Apoon Pass to Kotlik, and continues east to Russian Mission. Since the river is in a constant state of change, Coast Survey will use satellite images after the spring thaws to make annual updates.

Applying hydrographic data from private sector sources is not new for Coast Survey. Private interactive cruising guides and other internet-based enterprises have set up services that allow commercial mariners and recreational boaters to share information about navigation hazards they see (or experience) while on the water. Through a no cost agreement with a private company, Coast Survey has access to these crowd-sourced discrepancy reports. Now we have taken it a step further by extending the traditional GEBCO track line database hosted at NOAA's National Centers for Environmental Information in Boulder, CO, to be compatible with commercial navigation systems already installed on tens of thousands of boats in the US and around the world. This has the potential to help us to more quickly identify changes in our waterways, and to validate reports of discrepancies. The United States Power Squadrons and the U.S. Coast Guard Auxiliary also have a decades-long tradition of sharing updates through our cooperative charting programs.

Interagency and International Partnerships

Nationally, the three agencies present today coordinate through the U.S. Committee on the Marine Transportation System (CMTS). Like the USACE and the USCG, NOAA is a charter member of the CMTS. Through the CMTS and its network of teams and working groups, we share information, seek synergies, and, where possible, integrate our related marine transportation services. As a result, issues including Arctic marine transportation, the future of navigation, resilience, development of marine transportation performance measures, and infrastructure investment are addressed in a unique federal government system-wide approach, setting the stage for interagency collaboration and efficiencies.

Locally, NOAA works with its partners in the Coast Guard and USACE throughout the nation's coastal regions. In Savannah, for example, the Coast Guard Captain of the Port requested a hydrographic survey to aid their investigation into the July 15, 2014, grounding of the casino vessel P/V Escapade, which struck a shoal with 123 passengers aboard. Coast Survey had last surveyed the area in 2005, and initial indications were that a charted shoal may have shifted westward. After surveying the area surrounding the shoal, which had in fact shifted westward, NOAA's Southeast Navigation Response Team issued a "danger to navigation" report that the Coast Guard used to warn vessel traffic until the charts could be updated. Less than one month after the grounding incident, Coast Survey cartographers used data from the survey to update the nautical chart. During the months following the incident, NOAA's Southeast Navigation

Manager toured the Coast Guard offices in several regions to train personnel on how to submit information on shoaling discovered during buoy inspections. This is an example of how our existing relationships with our sister federal agencies allow us to quickly turn a single situation into a nationwide solution moving forward.

We moved beyond the idea of one-use data acquisition several years ago under the Ocean and Coastal Mapping Integration Act of 2009, and have built on relationships and interoperability to maximize the societal value of government seafloor mapping efforts. As the pool of available data grows, we are finding an increasing amount of survey data that was collected by others that is relevant and suitable for chart application. NOAA's integrated ocean and coastal mapping program (IOCM) plans, acquires, documents, manages, integrates, and disseminates such data and derivative products in a manner that facilitates access to and use by the greatest range of users. NOAA embodies these practices throughout its mapping programs with the philosophy of "map once, use many times."

The Interagency Working Group on Ocean and Coastal Mapping (IWG-OCM) coordinates member organizations' collection of mapping data (including but not limited to hydrographic survey data) and integration of additional requirements into mapping projects with specific primary purposes. NOAA co-chairs this team with the USACE and U.S. Geological Survey. Both the NOAA IOCM team and the IWG-OCM work to be inclusive of states, localities, academia, and the private sector in their coordination efforts.

In June of this year, I attended an international Forum on the Future of Ocean Floor Mapping hosted by the Nippon Foundation, on behalf of GEBCO, the General Bathymetric Chart of the Ocean. This group of prominent international scientists, leaders, and stakeholders outlined the ambitious goal to map the world's oceans by 2030. I have since joined other leaders in US ocean mapping to discuss achieving this goal for U.S. waters. This would be a large interdisciplinary project, with benefits for navigation, fisheries management, ocean exploration, offshore energy, oceanography, and the blue economy in general. I am committed to ensure that all future surveys collected for the hydrographic program are open, interoperable, and collected to interdisciplinary, international standards in order to be consistent with this vision.

NOAA's Partnerships with Industry

NOAA's partnerships with industry are critical to our understanding of marketplace needs. The U.S. currently has a thriving marine navigation systems marketplace, made possible in part by readily available NOAA charts and commercial charts derived from NOAA charts. This market serves all types of vessels, from small open boats to supertankers. In addition, NOAA charts, in the form of web services, feed a wide variety of web mapping applications across the government, non-profit, and academic sectors. In recent years, a number of the larger manufacturers have switched to NOAA raster charts themselves. These navigation systems include applications for tablets and mobile devices. At last count, there were over 60 mobile apps – as well as web mapping applications. These products increasingly use "tile" services to update their data. We addressed this emerging need by providing a service to the application

manufacturers and the end users that ensures both ease of access and up-to-date chart products. These tile sets are updated weekly with the latest Notice to Mariners, as well as any other changes to the charts that are made that week. NOAA's chart tile service will dramatically reduce the bandwidth requirements necessary to keep a vessel's chart suite up-to-date.

These types of commercial products are a critical part of NOAA's distribution system, and supports our mission to get up-to-date charts onto every vessel. Commercial involvement in distribution allows us to focus our efforts on updating charts with new information quickly, and to seek out the best available information to resolve charted discrepancies. To stay continually engaged with industry and improve and advance NOAA's navigation products and services, NOAA relies on its federal advisory committee, the Hydrographic Services Review Panel, which is composed of a diverse field of experts in hydrographic surveying, vessel pilotage, port administration, tides and currents, geodesy, recreational boating, marine transportation, and academia. Member guidance helps shape and define NOAA and industry roles in delivering beneficial products and services for successful navigation systems of the future.

Aligning Arctic Plans with Traffic Patterns

The Arctic provides a good example of new technologies and partnerships at work. We are prioritizing needs and focusing on areas with increasing traffic and special requirements as we expand charting in the Arctic.

NOAA continues to work with partners like the U.S. Coast Guard and local vessel pilots to assess nautical charting requirements and prioritize surveys of likely shipping lanes in the North Bering and Chukchi Seas and address the Bering Strait chokepoint in particular. More broadly we are looking at how to reduce the risk of accident and environmental impact in Arctic waters. In 2015, NOAA, and the Coast Guard worked together to collect trackline survey data as several ships passed north and south along this route. NOAA will continue to work with the U.S. Coast Guard and other agencies as they identify additional gaps where NOAA can leverage outside public and private data collection platforms to achieve full coverage of these areas.

The Arctic region poses unique operational challenges for hydrographic surveying, such as in predicting future ice conditions, planning surveys in advance, and conducting those surveys under harsh environmental circumstances. NOAA and its contractors are assessing safe and accurate approaches to Arctic data collection, as well as evaluating the technology and strategies needed for long-term monitoring of tides, water levels, and currents under harsh Arctic conditions. Putting good information into the hands of mariners is essential for safe navigation and environmental protection, and coastal communities and scientists must have the same foundational support for good operational and research decisions. NOAA's hydrographic services are an essential component of an open Arctic where conservation, management, and use are based on sound science to support U.S. economic growth and resilient and viable ecosystems and communities.

This summer, NOAA plans to acquire 275 square nautical miles (SNM) of Arctic hydrographic survey data in the Etolin Strait east of Nunivak Island and off the North Coast of Unalaska Island. In addition, the NOAA ship *Fairweather* will conduct a fisheries habitat survey in Bristol Bay to optimize data quality for habitat mapping; any usable hydrographic survey data that meets NOAA charting requirements will be applied to nautical charts. NOAA will install, maintain, and process data from six short-term water level stations and will use data collected from three long-term National Water Level Observation Network stations to support these surveys.

Conclusion

NOAA plays a unique and important role by providing critical information infrastructure to support safe, reliable, and efficient navigation and maritime commerce. Thank you for the opportunity to discuss some of those efforts with you. We would welcome the opportunity to provide the Committee with greater detail on any of NOAA's navigation and infrastructure related services.