HYDROGRAPHIC SERVICES REVIEW PANEL

MOST WANTED HYDROGRAPHIC SERVICES IMPROVEMENTS

FEDERAL ADVISORY COMMITTEE UPDATE REPORT 2010

September 17, 2010

"Like it or not, they're going to build these ships bigger and bigger. It's like squeezing ten pounds of ship into a five-pound channel.

We've got to get better systems in place to do this safely. That's my job, and I can't do it without the technology that's out there.

The problem is we're not getting the funding to get this thing going. We're not getting the charting, not getting the observation systems, and it's because it's not coming out of NOAA. We want the ounce of prevention instead of the pound of cure, and we're not getting that."

-- Capt. Andrew McGovern, Sandy Hook Pilot

Marine Transportation System: Vital Statistics

The MTS includes:

- 1,000 harbor channels
- 326 ports
- over 3,700 terminals
- 238 lock chambers
- about 100,000 aids to navigation
- 25,000 miles of inland, intracoastal, and coastal waterways

The MTS links:

- 174,000 miles of rail
- 460,000 miles of pipeline
- 45,000 miles of interstate highways

Each year the MTS:

- moves over 95 percent of the volume of overseas trade
- transports 134 million ferry passengers, 5 million cruise ship passengers, and 70 million recreational boaters
- contributes more than $742 billion to the U.S. GDP and employs more than 13 million people
- moves 720.2 million short tons of commodities on lakewise and internal waterways

Hydrographic Services Review Panel Members

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Acknowledgements

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The panel specifically thanks Ms. Rebecca Arenson, Mrs. Ashley Chappell, Ms. Virginia Dentler, Ms. Dawn Forsythe, Captain Gerd Glang, Ms. Tiffany House, and Ms. Kathy Watson for their dedicated and professional support throughout the process of updating and publishing the HSRP 2010 Update Report.

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Statement from the Chair

September 17, 2010

This most recent update from the Hydrographic Services Review Panel (HSRP) Federal Advisory Committee outlines actions NOAA must take to provide critical hydrographic and navigation services for the nation. The 2010 Most Wanted Update Report highlights the HSRP's most important recommendations to the NOAA Administrator for improving NOAA's Navigation Services.

This is the second such report from the HSRP, the original having been submitted on March 21, 2007. With the passage of three years and the presence of new leadership at NOAA following the 2008 presidential election, the HSRP concluded that an update to its prior report and a reaffirmation of any revisions to its prior recommendations were warranted.

The recommendations incorporated in HSRP Most Wanted Hydrographic Services Improvements: 2010 Update represent the panel's best advice to NOAA, the Administration, and Congress regarding near-term priorities and direction.

The HSRP strongly recommends that NOAA:

- aggressively map the nation's shorelines and navigationally significant waters;
- integrate coastal mapping efforts and ensure federally maintained channels, approaches, and anchorages are surveyed to the highest standard;
- modernize heights and implement real-time water level and current observing systems in all major commercial ports;
- strengthen NOAA's Navigation Services emergency response and recovery capabilities; and
- disseminate NOAA's hydrographic services data and products to achieve the greatest public benefit.

The panel urges NOAA to include the HSRP recommendations in its annual requirements-based resource assessment to achieve the agency's strategic goals, particularly with respect to supporting the nation's commerce with information to facilitate marine transportation. Because today's vessels carry more cargo and hazardous materials through United States waters than ever before, their safe, efficient movement relates directly to economic profit and loss and environmental protection in U.S. waters.

Edmund B. Welch
Chairman
Hydrographic Services Review Panel

The Hydrographic Services Review Panel, the Federal Advisory Committee established by Congress to advise NOAA on carrying out its Navigation Services mission, offers NOAA its top priority findings and recommendations after a three-year assessment of NOAA Navigation Services programs.

The HSRP's objective is to spur effective NOAA planning and budgeting to meet the nation's most immediate needs for hydrographic services for the U.S. marine transportation system (MTS) in support of commercial and recreational mariners, and to support NOAA's stewardship of the nation's coastal and ocean resources. The HSRP has continued to monitor the progress of our recommendations from the 2007 report; to that end, we now present a 2010 update of our Most Wanted report.

The U.S. marine transportation system is the U.S. gateway to the world's commerce, but investments to maintain and improve the system are insufficient and not comprehensive. Following listening sessions with MTS stakeholders in 1998, the Department of Transportation submitted the *1999 Report to Congress: An Assessment of the U.S. Marine Transportation System*. It noted the great extent to which the U.S. relies on an efficient and effective MTS to maintain its role as a global power and to gain competitive access to suppliers and markets in an increasingly global economy. Among other recommendations, The *1999 Report to Congress* advised establishing two committees — the MTS National Advisory Council and the Interagency Committee on the MTS (ICMTS) — to drive coordinated enhancements to the system. The U.S. Commission on Ocean Policy picked up this thread in 2004, arguing for a codified ICMTS and a new national freight transportation strategy to direct national transportation funds toward significant intermodal projects. President George W. Bush's Administration responded to the commission report with an Ocean Action Plan in late 2004.

Distressingly, the budget trend for NOAA Navigation Services programs continues to be far below what is required to fully address the MTS issues within NOAA's scope.

On July 19, 2010, President Obama issued an Executive Order "Stewardship of the Ocean, Our Coasts, and the Great Lakes." It generally adopts the recommendations of his Interagency Ocean Policy Task Force and directs executive agencies to implement those recommendations under the guidance of a National Ocean Council. The order establishes a national policy to ensure the protection, maintenance, and restoration of the health of ocean, coastal, and Great Lakes ecosystems and resources, enhance the sustainability of ocean and coastal economies, preserve the nation's maritime heritage, support sustainable uses and access, provide for adaptive management to enhance the understanding of and capacity to respond to climate change and ocean acidification, and coordinate with our national security and foreign policy interests. The order also provides for the development of coastal and marine spatial plans that build upon and improve existing governmental decisionmaking and planning processes.

For nearly a decade, individual HSRP members have participated in the listening sessions, conferences, and discourse on the state of the MTS, without seeing significant change in the approach to this critical component of the U.S. transportation infrastructure. In 2007, the HSRP believed the time had come to take real action, particularly on the water side of the MTS, and particularly in the area of HSRP purview: NOAA's Navigation Services programs.

Largely unnoticed by policymakers and the public unless something goes wrong (eg., the *Exxon Valdez* in 1989, a tragic 1980 ship strike of the Tampa Sunshine Skyway Bridge, the 2004 costly vessel grounding of the *Selendang Ayu* in Alaska, or the the massive Gulf of Mexico oil spill caused by the casualty of the drilling rig *Deepwater Horizon*), the information NOAA provides to mariners and other users is critical to safe, efficient, and environmentally sound navigation. The 21st century mariner — commercial or recreational — increasingly depends on NOAA's digital Electronic Navigational Charts (ENCs), real-time water levels and currents, accurate positioning data, and emergency preparedness and response to get people and goods safely where they need to go. Not only do NOAA products and services improve a mariner's situational awareness, improving safety and reducing costly delays, but NOAA navigation data also support national and economic security, emergency planning, coastal zone management (including sea level rise), scientific research, engineering and infrastructure building, delineation of boundary and property lines, and a host of other non-navigation uses.

Distressingly, the budget trend for NOAA Navigation Services programs continues to be far below what is required to fully address the MTS issues within NOAA's scope. It is the HSRP's hope that this report will prompt Congress to fully support the 2011 President's Budget in order to make progress in Navigation Services and to look harder at the unfunded MTS requirements. It is also our intent that this report encourages the Administration to increase the 2012 Navigation Services budget request in areas that benefit the MTS.

NOAA needs adequate resources to deliver its essential services to the nation, and the nation needs NOAA's services to keep commerce moving safely and efficiently on U.S. waters. The HSRP's top recommendations for additional investment and attention follow.

HSRP Most Wanted Hydrographic Services Improvements

Aggressively map the Nation's shorelines and navigationally significant waters

Finding 1:

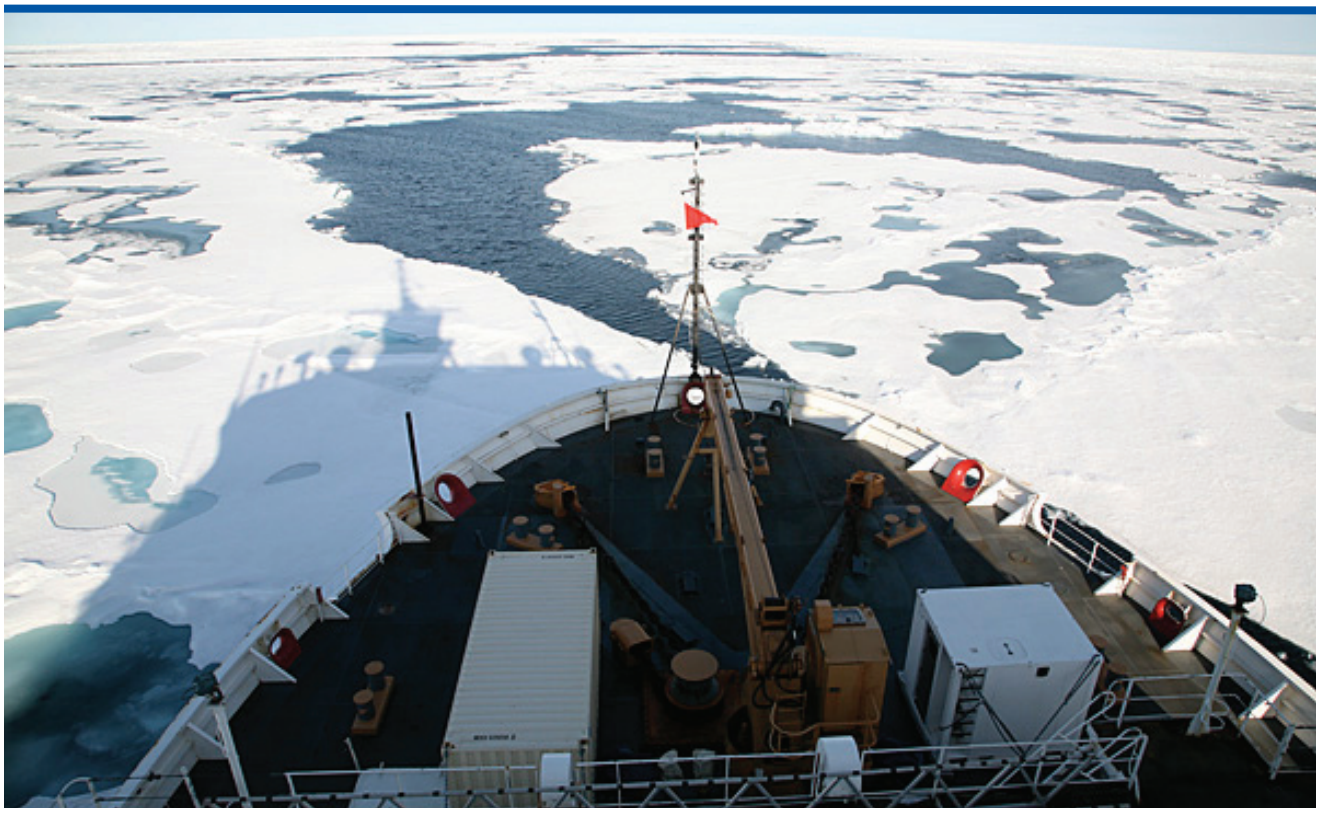
NOAA is unable to meet the Nation's need for updated marine navigation information, primarily because NOAA resources to deliver navigation services have not kept pace with U.S marine transportation system growth.

Recommendation 1:

The HSRP recommends that NOAA aggressively survey and map the 500,000 square nautical miles of navigationally significant areas at a rate of 10,000 square nautical miles per year and 95,000 miles of shoreline at a rate of 9,500 miles per year (this includes evaluating and remapping 20 percent of the priority port area shoreline) by:

- expanding funding for NOAA's in-house and contract survey capabilities to acquire and process more hydrographic and shoreline mapping data;
- developing a lifetime career program that fosters the hydrographic profession and continues the NOAA tradition of national and international leadership in hydrography;
- implementing more efficient surveying, mapping and processing techniques and technologies through the application of both in-house and external development; and
- replacing aging single-purpose hydrographic ships with modern, multi-purpose vessels to further maximize the use and reach of NOAA resources.

NOAA hydrographers survey the Arctic in 2008 from onboard the U.S. Coast Guard Cutter Healy.



Integrate coastal mapping efforts and ensure federally maintained channels, approaches, and anchorages are surveyed to the highest standard

Finding 2:

NOAA is not alone in its requirements for accurate hydrographic and shoreline data. Numerous federal and state agencies collect similar or related datasets to perform their own mission-critical functions. The lack of data integration, inconsistent standards, and the use of different vertical datums cause confusion among users. Federal agencies must accelerate efforts to integrate data in order to conserve resources, minimize duplication and inconsistency, and maximize taxpayer investments.

Recommendation 2:

The HSRP recommends that NOAA take a larger role in improving partnerships with other federal and state agencies and other non-governmental entities to:

- integrate coastal mapping efforts with coordinated mapping plans, for example NOAA, USGS, and USACE shoreline mapping efforts;
- collect ancillary multi-use data such as multibeam backscatter imagery concurrent with charting surveys to support marine spatial planning;
- refine, implement, and maintain tools such as VDatum to collect, integrate, and disseminate seamless coastal geospatial data; and
- ensure that the Nation's federally maintained channels, approaches, and anchorages are surveyed with full-bottom coverage technologies to NOAA's standard to facilitate safe maritime commerce in U.S. waters.

Modernize heights and implement real-time water level and current observing systems in all major commercial ports

Finding 3:

NOAA's Navigation Services are a critical component of the federal effort to build an Integrated Ocean Observing System (IOOS), delivering real-time data to a multitude of navigation and non-navigation users. The Integrated Coastal and Ocean Observation System Act of 2009 highlights the importance of observing systems and data, first and foremost for national defense, marine commerce, and navigation safety, among a host of other uses. The need for accurate and reliable ocean observing data is reiterated in the July 2010 *Interagency Ocean Task Force Final Recommendations* and the *National Ocean Policy*. Central to IOOS is the concept that, in many cases, measurements and predictions for a particular need can serve other national and regional needs.

A network of observation equipment measures tides, long-term sea levels, and lake water levels on all U.S. coasts.

Recommendation 3:

The HSRP recommends that NOAA expand and fully fund real-time water level and current observations, such as its National Water Level Observation Network, and Physical Oceanographic Real Time Systems (PORTS®) in commercial ports. The HSRP also recommends NOAA provide funding to the National Geodetic Survey to expand the height modernization program. This program will add new National Spatial Reference System (NSRS) monuments with accurate heights where needed, update existing NSRS network heights, and collect gravity data to improve the Nation's vertical reference system. Accurate nationwide heights are critical components of the IOOS.

Strengthen NOAA's Navigation Services emergency response and recovery capabilities

Finding 4:

NOAA's Navigation Services support emergency response to incidents such as hurricanes and oil spills, and are important contributors to homeland security. NOAA's role is crucial but under-resourced, requiring resource reallocation from primary mission critical tasks during times of need.

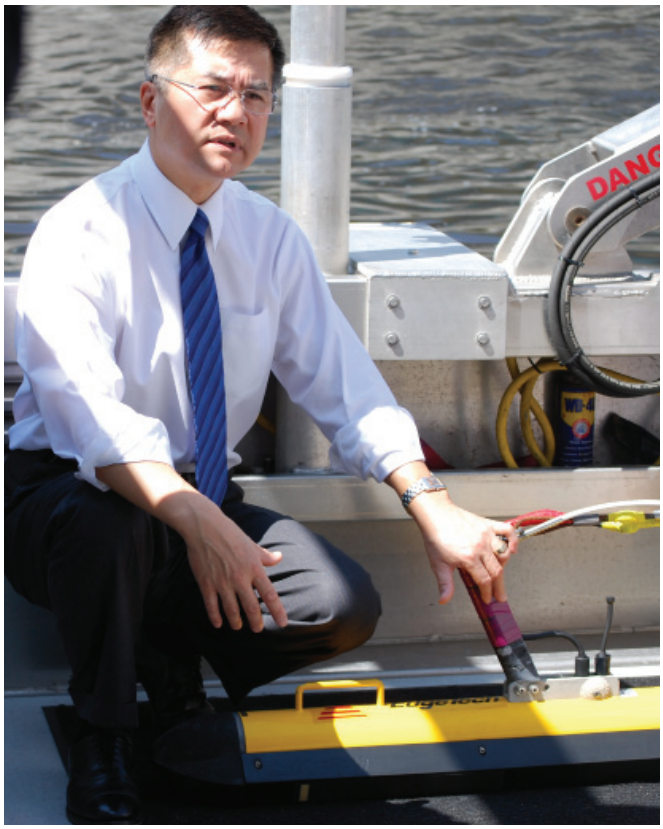
Recommendation 4:

The HSRP recommends that NOAA strengthen its Navigation Services emergency response and recovery capabilities, including kinematic GPS equipment for real-time surveying:

- by seeking adequate recognition and funding for its essential support functions within the federal response to all-hazard crises;
- through accelerated validation and the full implementation of VDatum to allow for near real-time surveying to chart datum; and
- by establishing cooperative agreements with local contractors before times of need.

Remote sensing technology and aerial photography measures and maps changes occurring throughout 95,000 miles of national shoreline.

Secretary of Commerce Gary Locke examines the sonar equipment of a private surveyor put to work with funds from the American Recovery and Reinvestmant Act of 2009.



Disseminate NOAA's hydrographic services data and products to achieve greatest public benefit

Finding 5:

More timely and widespread delivery of NOAA's navigation data will result in safer maritime navigation, enhance port operations and port security, and provide valuable geospatial information as our Nation addresses the challenges of sea level rise.

Recommendation 5:

The HSRP recommends that NOAA expand efforts to deliver its navigation products and services more quickly, and increase outreach to make navigation and non-navigation users more aware of the NOAA mapping and data resources available to them.

Aggressively map the Nation's shorelines and navigationally significant waters

Finding 1:

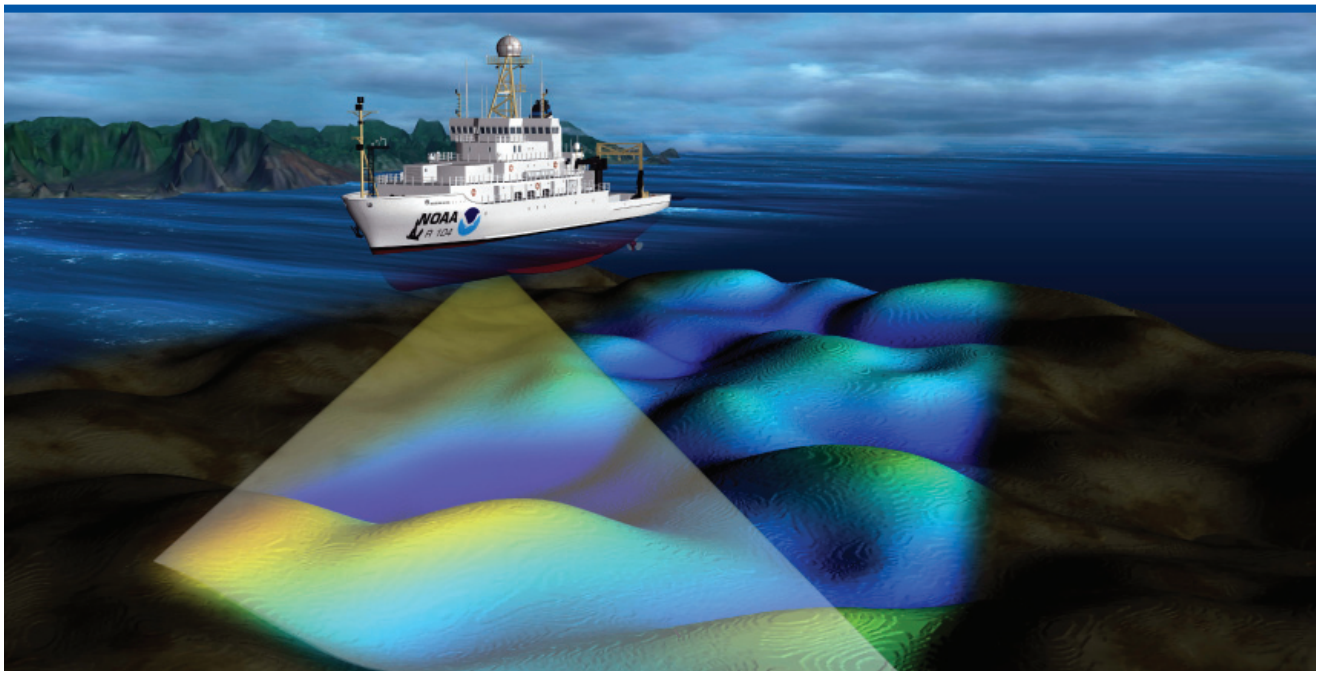
NOAA is unable to meet the nation's need for updated marine navigation information, primarily because NOAA resources to deliver Navigation Services have not kept pace with U.S. marine transportation system (MTS) growth.

U.S. waters and coasts, including significant navigation areas, have never been fully surveyed, leaving the MTS at risk when vessels are operating in U.S. waters. At current production levels, NOAA is unable to meet the Nation's need for marine navigation information, primarily because NOAA funding for Navigation Services has never been at adequate levels and production levels continue to decline with reduced or static funding.

Since NOAA was established in 1970, the number of commercial, military, and recreational vessels sailing in U.S. waters has increased significantly. More than 95 percent of U.S. foreign trade by weight moves by sea, and 2 billion tons of cargo moves each year through U.S. ports. Since 1955, maritime trade has doubled and the Nation's volume of international trade has nearly quadrupled. In addition, changes in the Arctic are leading to the emergence of new Arctic trade routes and other maritime uses. Despite the recent decline in economic growth, container traffic coming into the U.S. is nevertheless expected to increase substantially, particularly with the Panama Canal's planned capacity expansion.

As the world's leading trading nation, the United States depends on the quality of its port infrastructure and its ability to deliver goods efficiently, safely, and cost-effectively. Significantly, the Department of Transportation's *1999 Report to Congress: An Assessment of the U.S. Marine Transportation System* noted, "the greatest safety concern voiced at the Regional Listening Sessions and the November MTS National Conference related to the availability of timely, accurate, and reliable navigation information."

NOAA acquires primary depth measurements with multibeam echosounder technology.

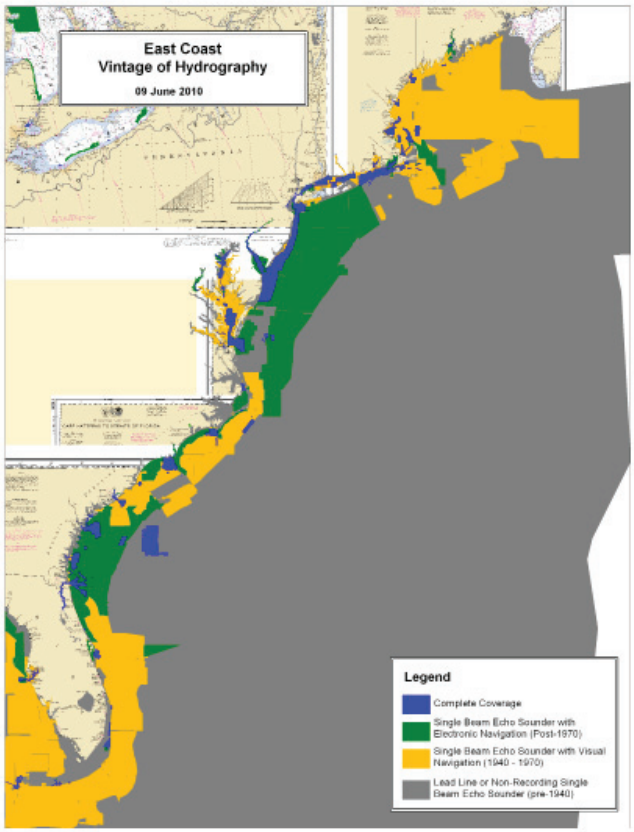


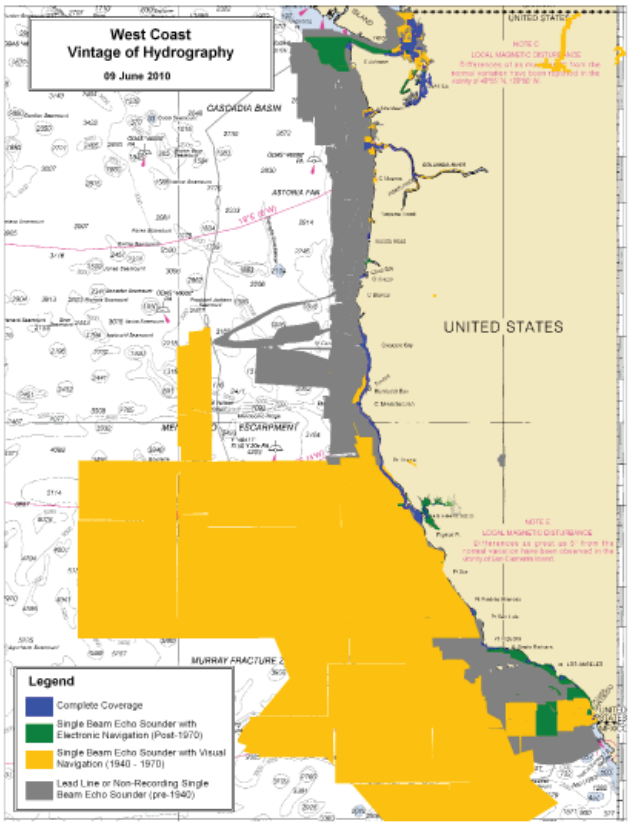
Ironically, NOAA's in-house hydrographic survey capacity decreased 64 percent in the 1990s, from a high-water mark of 11 NOAA hydrographic ships operating in U.S. waters. Today, NOAA operates three hydrographic surveying ships, two of which are over 40 years of age, with one additional ship originally scheduled for delivery in 2010.

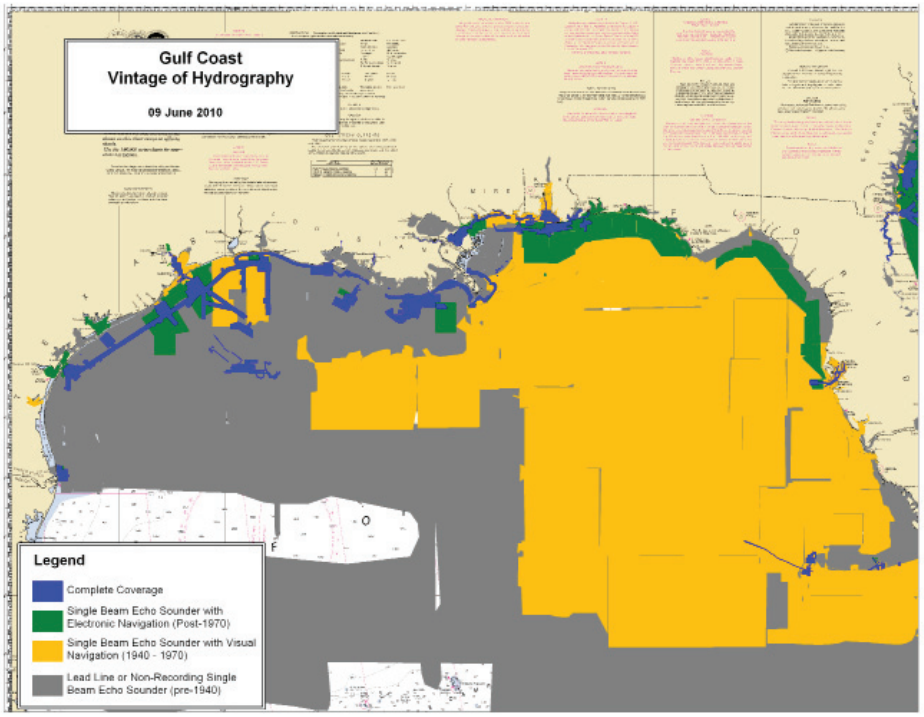
Contract support has replaced some of the lost survey ship capacity, but the scope of NOAA's surveying responsibility of U.S. waters is extremely vast. In fact, U.S. coastal waters have never been completely surveyed. In areas that *have* been surveyed, approximately 50 percent of the sounding data shown on NOAA nautical charts is pre-1940, collected by antiquated leadline soundings and wire drags.

NOAA's hydrographic surveys form the basis of the navigation data on official nautical charts required on vessels greater than 1600 gross tons. It is NOAA's full-bottom coverage surveys that alert mariners to the depths, rocks, wrecks, and other obstructions they must avoid to reduce risk of accident and damage to life, property, and the environment. But against the backdrop of even NOAA's priority surveying focus — the 500,000 square nautical miles (SNM) of navigationally significant EEZ waters deemed most in need of survey — NOAA has resources to accomplish roughly only 3000 SNM a year between contract and in-house vessels. This equates to less than one percent of navigationally significant area surveyed each year.

At this rate, with three to four ships, plus current funding levels for complementary contract efforts, it will take over 100 years to survey just the areas routinely transited by commercial shipping, ferries, cruise ships, Navy and Coast Guard vessels, and other ships with critical contributions to the economy and defense. This is a concern, as mariners continue to strike uncharted obstructions and NOAA hydrographic surveys discover over 2.5 hazards per day. Furthermore, each year additional areas are identified for resurvey due to natural shifts in sea bottoms and water depths caused by such phenomena as currents, hurricanes, glacier melts, and earthquakes.



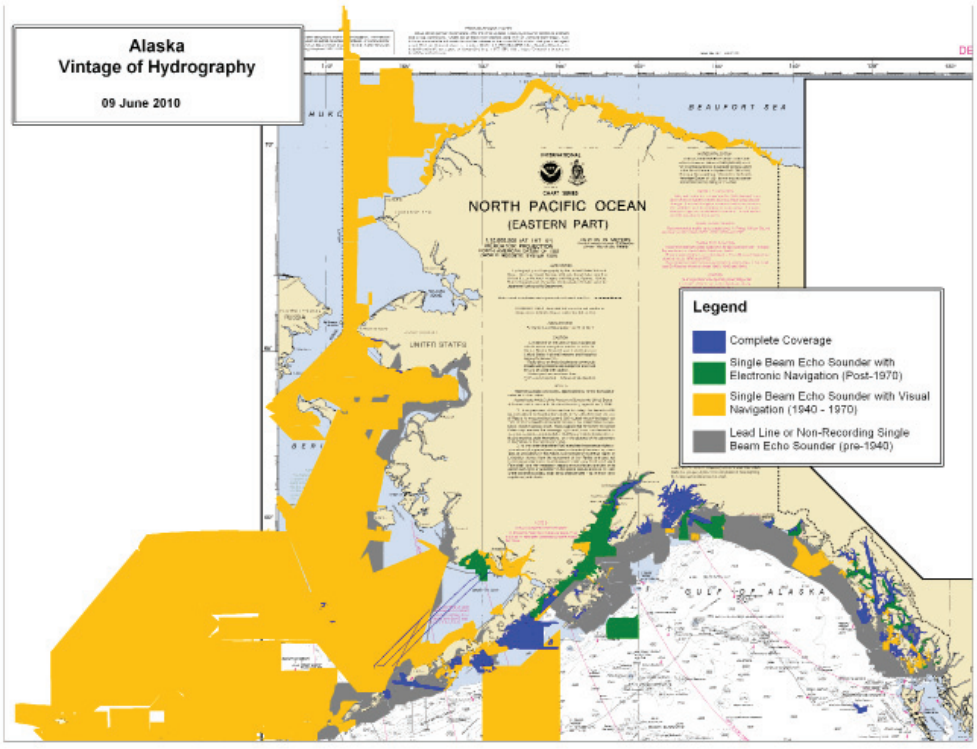




To help address these concerns, NOAA's current goal, which is fully supported by the HSRP, is to survey and process the data for 10,000 SNM of seafloor annually. This would put the navigationally significant areas on a 50-year resurvey cycle – arguably still an inadequate schedule from the commercial shipping perspective, but an objective the HSRP believes achievable with current technologies and sufficient resources.

The HSRP recognizes that NOAA needs funding to correct the fundamental problem of the agency's aging fleet of survey vessels. NOAA's current 20 ships support a wide range of operational and research missions, from fisheries services to oceanography, and atmospheric research programs to hydrographic surveying, but each platform is essentially single-purpose. These ships, along with available commercial charters and contracts, meet less than 40 percent of NOAA's total platform-dependent data collection requirements.

These 20 ships are also NOAA's only platforms to train personnel, build expertise, and test new technologies for efficiency and capacity gains. In addition, they are often pressed into duty to respond to emergency events and homeland security support.



Over the next 14 years, 13 of NOAA's ships will reach or exceed their 30-year service lives; two of NOAA's four hydrographic ships fall into this category, and are currently over 40 years old.

The HSRP commends NOAA for developing a fleet replacement plan but is concerned that it does not fully address the needs for NOAA's hydrographic survey vessels. For example, the *Fairweather* is scheduled to be retired at an age of 50 years in 2018, but a replacement vessel is not scheduled to begin operations until 2024, a gap of six years.

NOAA must replace its aging hydrographic survey ships on schedule to sustain current capability and avoid diminishing critical expertise in a function so key to U.S. economic security.

Building, maintaining, and fostering hydrographic expertise is a primary HSRP concern. The HSRP believes it is in the best interest of the Nation for NOAA to maintain and build on its core competencies in hydrographic surveying in order to protect valuable coastal resources and promote safe maritime commerce. The Nation looks to NOAA for its expertise in hydrography – through hands-on experience aboard NOAA ships, providing educational opportunities to advance careers, and establishing a lifetime career path with set goals and milestones. NOAA must build a seasoned staff of dedicated hydrographers competent to not only conduct surveys and analyze tides, but also to provide oversight of contract surveys, evaluate new equipment, and provide national and international leadership. By defining a career path in hydrography, NOAA will attract new recruits, retain talented staff, and develop hydrographers into seasoned professionals that will continue the NOAA tradition of providing selfless service to the Nation and lead the international hydrographic community. In the HSRP's view, maintaining NOAA's core hydrographic competency necessarily includes a fleet of modern hydrographic survey vessels.

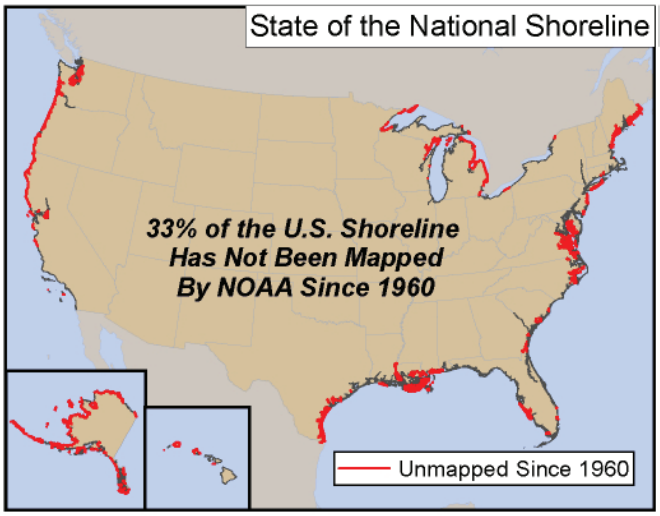
NOAA should also look internally for efficiencies. Such efficiencies would include fully equipping its entire fleet with bathymetric surveying capability, overhauling its vessel operational and staffing models for maximum efficiency, and replacing its aging single-purpose vessels with new multi-mission platforms to increase productivity and minimize redundant efforts. Mobilization to a project area is often the single largest cost borne by a program, so the more missions that can be served by one project, the greater the value per dollar spent. Modern survey platforms equipped with an array of modern sensors will not only efficiently obtain detailed bathymetric data for updating nautical charts, but also provide data for many other uses and reduce the redundancy of data collection efforts by other agencies. From the HSRP perspective, enabling more NOAA platforms to function as hydrographic survey vessels expands the reach and capacity of NOAA to map U.S. waters, even if only transiting to and from distant research destinations.

Equally important, NOAA must increase its capacity to contract for hydrographic surveys. There is simply no way to survey 10,000 square nautical miles of navigationally significant waters every year without contract support. The HSRP has scrutinized NOAA's updated policy on contracting for hydrographic surveying (NOAA Policy on Ocean and Coastal Mapping). The panel applauds NOAA's commitment to leverage its own surveying capabilities through contracting.

Since 1994, NOAA's funding for survey contracts has risen from $0 to $30 million per year, roughly half of its budget for hydrographic data collection. Through supplemental funding from the Gulf of Mexico Marine Debris Project for hurricane debris mapping and the American Recovery and Reinvestment Act (ARRA), hydrographic surveying efforts in 2009 reached an all time high of 4,677 SNM, with 1,459 SNM of survey work accomplished through ARRA funding. Despite this impressive progress, the base funding levels for NOAA remain the same, supporting a survey rate of less than 3,000 SNM per year. NOAA needs to continue to aggressively pursue increased funding levels and efficiencies in its contracting process to increase its capability to expeditiously contract for hydrographic services.

Another of NOAA's critical missions is to survey the 95,000 miles of U.S. coastline and to provide the nation with accurate, consistent, up-to-date national shoreline. The national shoreline provides the baseline data for demarcating U.S. marine territorial limits, including the Exclusive Economic Zone. It provides the geographic reference and detail needed to manage coastal resources, respond to emergencies, and perform damage assessments, along with many other uses – not the least of which is marine navigation. NOAA's shoreline data are considered authoritative when determining the official boundaries for the United States. Therefore, an accurate shoreline is critical. Unfortunately, NOAA's shoreline mapping effort is also falling short due to the scarcity of funding.

The HSRP recognizes that shoreline and hydrographic surveys are closely linked. Shoreline data is integral to NOAA's Electronic Navigational Chart (ENC) requirements for digital data, as well as for innumerable uses in geographic information systems. Outdated shoreline information depicted on nautical charts poses significant hazards to the Nation's commerce, transportation, and recreational boating sectors navigating along the coast.



Frequently, hydrographers engaged in survey operations to update nautical charts find that they are navigating across areas charted as land. In addition, due to these large shoreline changes, the hydrographers discover dangers to navigation (such as wrecks or pipes either emerging from the water or shallowly submerged) which on current charts are displayed as being on land but, in reality, are in the water. The rate of change of shoreline is faster than the rate of shoreline surveying, resulting in miles of difference between shorelines depicted on charts and the real world location of the current shoreline.

Despite the growing need for accurate shoreline across many disciplines, NOAA's shoreline mapping base budget has remained relatively static for many years.

NOAA's ability to collect hydrographic data has outstripped its capacity to collect shoreline data, but both datasets are required to update the same nautical charting products. This means that charts showing updated bathymetry do not always have updated shorelines, decreasing the overall accuracy of the updated product.

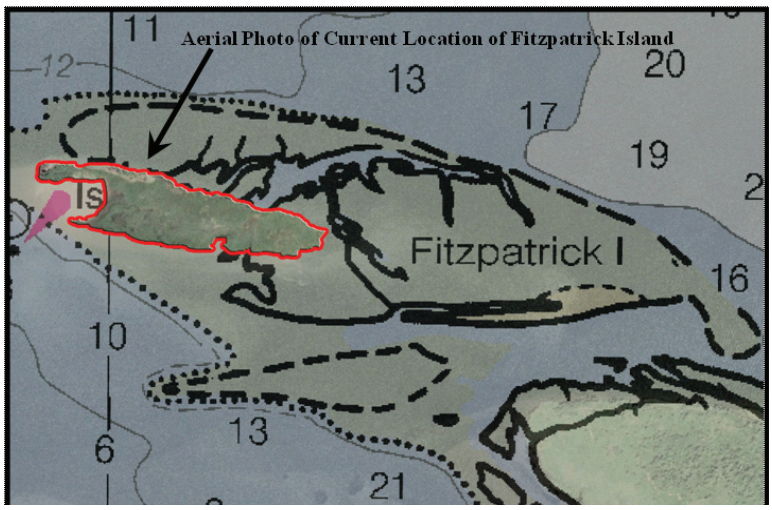
Currently NOAA and its contractors can evaluate and remap only 12 percent of priority port area shoreline annually, falling well short of NOAA's program target of 20 percent each year. The bulk of the 95,000 miles of U.S. coast is open shoreline, which NOAA can currently map at a rate of only three percent a year. Some U.S. shoreline, primarily in Alaska, has never been mapped to modern standards. There are also many charted areas with significant changes since they were last mapped. The HSRP strongly supports NOAA's stated goal of mapping the shoreline of major port areas every five years, with open shoreline surveyed on a 10-year cycle.

Satellite image shows shoreline changes in Savannah, Ga.

As noted above, updating nautical charts requires more than just updated bathymetric data. Thus, it is important to remember that increases in hydrographic activities, such as collecting more bathymetric surveys, require complementary increases in the other activities that support the production of nautical charts, such as oceanography (water levels), geodesy, and remote sensing.

Shoreline surveys not keeping pace with rate of shoreline change

Shoreline is not accurately depicted in many areas on U.S. nautical charts, resulting in mariners navigating across vast expanses of water charted as land. This is the result of both the age of the shoreline as well as the rate of change. The rate of change of shoreline in much of the U.S. is faster than the rate at which it is surveyed and charted, resulting in miles of difference between shorelines depicted on U.S. charts and the current location of the shoreline. This image illustrates the charted location of Fitzpatrick Island on the Lower Columbia River relative to a recent aerial photo. The charted location of Fitzpatrick Island is presently open water.



The HSRP also notes that NOAA's future success in nautical charting depends on its ability to both collect and rapidly process more data. NOAA must accelerate its data flow "pipeline" to reduce the time it takes to get information charted and disseminated. The most costly and labor-intensive elements of a nautical chart are hydrographic and shoreline data collection and processing efforts, including applying the needed water level correctors so that sounding can be corrected to the chart datum Mean Lower Low Water. However, technology advances in data acquisition have created a situation wherein, given its current allocation of resources, and even with improvements in the process, NOAA still collects data much faster than it can process and compile the data into navigation products. For example, modern multibeam sonar surveys obtain millions of soundings per hour, resulting in a vast amount of data.

In 2007, NOAA had over 350 surveys in the queue awaiting verification and compilation (data processing), with an average 16 months to fully package and disseminate the data to the mariner. Today, NOAA has fewer than 200 surveys in the queue and production time has been cut in half. The HSRP is pleased to see the significant improvement in the time from data collection to chart delivery, and urges NOAA to continue to take steps to remedy the situation.

Although NOAA gives mariners information about dangers to navigation in short order, the delay in delivering the full data set is unacceptable. Improving data flow technologies now will help eliminate the processing backlog and reduce the risk of accident due to outdated navigation information. Delays in getting soundings on the chart can be significantly eliminated by using spaced-based technology to determine water levels in near real-time, and improving vertical accuracy. To this end, HSRP supports NOAA's efforts to increase partnerships with qualified private contractors and collaborations with the private sector and academia, such as the NOAA/University of New Hampshire Joint Hydrographic Center.

To summarize, NOAA should take a more aggressive approach to shoreline and hydrographic data collection and processing. The HSRP recognizes that resources are scarce government-wide, but the cost of adequately funding NOAA pales beside the costs of incident response, clean-up, environmental damage, litigation, and the lost lives, property, and revenues that can result if a vessel grounds or strikes an obstruction. The HSRP strongly believes that the critical and growing national needs for updated hydrographic surveys and shoreline maps demand an increase in productivity and justify the necessary increase in public investment. In an ever-changing marine environment, modern and up-to-date hydrographic products significantly reduce operational risk and improve safety for users of NOAA navigation data.

Recommendation 1

The HSRP recommends that NOAA aggressively survey and map the 500,000 square nautical miles of navigationally significant areas and 95,000 miles of shoreline at a rate of 9,500 miles per year (this includes evaluating and remapping 20 percent of the priority port area shoreline) by:

- **expanding funding for NOAA's in-house and contract survey capabilities to acquire and process more hydrographic and shoreline mapping data;**
- **developing a lifetime career program that fosters the hydrographic profession and continues the NOAA tradition of national and international leadership in hydrography;**
- **implementing more efficient surveying, mapping and processing techniques and technologies through the application of both in-house and external development; and**
- **replacing aging single-purpose hydrographic ships with modern, multi-purpose vessels to further maximize use and reach of NOAA resources.**

NOAA Research Vessel Bay Hydro II scans the seafloor of the Chesapeake Bay, identifying navigation hazards, collecting hydrographic data, and testing new survey technologies.

INTEGRATE COASTAL MAPPING EFFORTS AND ENSURE FEDERALLY MAINTAINED CHANNELS, APPROACHES, AND ANCHORAGES ARE SURVEYED TO THE HIGHEST STANDARD

Finding 2:

NOAA is not alone in its requirements for accurate hydrographic and shoreline data. Numerous federal and state agencies collect similar or related datasets to perform their own mission-critical functions. The lack of data integration, inconsistent standards, and the use of different vertical datums cause confusion among users. Federal agencies must accelerate efforts to integrate data in order to conserve resources and minimize duplication and inconsistency to maximize taxpayer investments.

Integrating federal efforts to conduct ocean and coastal mapping is not a new concept. *Circular Number A-16*, an Office of Management and Budget directive on federal geospatial data collection and standards integration, dates from 1990. The 2002 revision to *A-16* sets forth supplemental guidance for a portfolio management approach to improvements in coordination and use of nationally significant geospatial data. It focuses on building the national spatial data infrastructure and following Federal Geographic Data Committee (FGDC) standards to integrate datasets and share products with accurate metadata defining methods, processes, and intended uses of each dataset. It also directs lead agencies, including NOAA, to efficiently and cost-effectively collect, integrate, maintain, disseminate, and preserve spatial data, building upon local data wherever possible. *Geospatial Line of Business OMB Circular A-16 Supplemental Guidance* (2008) was developed as a supporting document to *Circular A-16* by the FGDC steering committee to set the framework for a lifecycle-based portfolio management and reporting process intended to increase the transparency of the development and maintenance of nationally significant datasets.

The impetus for coordination was renewed with the 2004 U.S. Commission on Ocean Policy report recommendation on integrated federal mapping. The *U.S. Ocean Action Plan* echoed this recommendation, requiring agencies to be responsive to the coordination of federal and federally supported mapping activities for the U.S. coastal and marine environments. In 2009, Congress directed federal agencies to take an integrated approach to mapping, as outlined in Public Law 111-11, the Ocean and Coastal Mapping Integration Act of 2009. The July 2010 National Ocean Policy establishes as a priority strengthening and integrating federal and non-federal ocean observing systems, sensors, data collection platforms, data management, and mapping capabilities into a national system, and integrating that system into international observation efforts. A nationally coordinated mapping effort also supports goals of the Global Earth Observing System and the U.S. Integrated Ocean Observing System for particular observation parameters.

Timely surveys, consistent standards, integrated data, and updated nautical charts can prevent maritime accidents.

The HSRP concurs with the intent of the directives above, recognizing that no federal agency has the capacity to address one hundred percent of its mapping requirements. However, the HSRP wants to see demonstrable results from these coordination efforts, particularly in hydrographic and shoreline data collection and data sharing between NOAA's Navigation Services and agencies such as the U.S. Army Corps of Engineers (USACE), U.S. Navy, U.S. Coast Guard, Federal Emergency Management Agency (FEMA), and U.S. Geological Survey (USGS).

The HSRP urges NOAA to increase its efforts with other agencies to leverage federal resources to collect and integrate data of a predetermined quality standard so that everyone — federal, state, academia, and the private sector — can seamlessly use the same data, complete with metadata, to address their diverse requirements.

NOAA's tide-controlled, geo-referenced, digital data is an asset upon which other agencies rely. Integrating their own efforts into this standard will help all programs supporting the marine transportation system and coastal zone management meet requirements. Further, the HSRP finds that NOAA could acquire multibeam backscatter imagery and other marine spatial planning data concurrent with hydrographic operations, and urges NOAA to collect this multi-use data when practicable to foster agency collaboration.

In particular, NOAA, USGS, and USACE have overlapping data requirements that could be better coordinated to serve the nation's needs. One is shoreline mapping. USACE, USGS, and NOAA have coastal mapping programs, though each program is attuned to the individual agency's separate requirements. To leverage these somewhat duplicative activities, the agencies should develop a common standard that will meet each agency's needs. Currently there is some coordination of project areas, but the standards to which USGS and USACE collects its data does not meet those required by NOAA for charting applications. There have been a few examples of coordination and leveraging, but a comprehensive integrated ocean and coastal mapping standard should be derived and implemented.

NOAA is working to improve the measurement of elevations within coastal ecosystems that serve as buffers against floods.

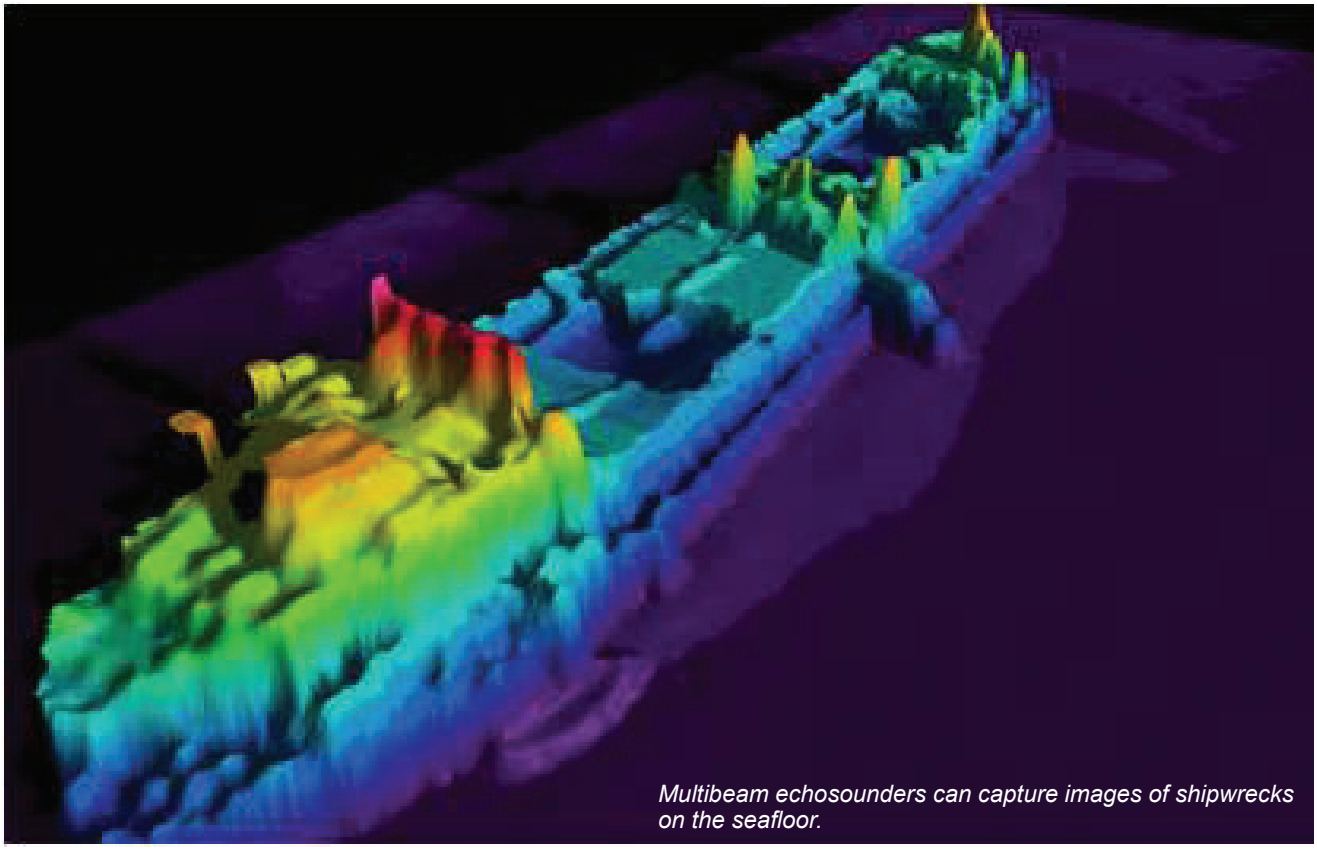
A joint national survey plan for shoreline mapping, akin to the NOAA Hydrographic Surveys Priorities document, should also be developed and implemented in order to maximize the internal and contract resources invested in data collection and processing. From the HSRP's perspective, this coordination would help address NOAA shoreline mapping, USGS coastal mapping, and USACE sediment transport modeling requirements. It would generate comprehensive integrated data sets that support a sound framework for multiple uses — such as coastal and marine spatial planning and the U.S. Integrated Ocean Observing System — with greater utility. The USGS, FEMA, and state efforts to improve the Nation's baseline floodplain maps should also be incorporated in the plan. Mapping in the coastal zone for this purpose should be coordinated with NOAA to identify coincident needs and means to address each agency's mission simultaneously.

Another area for collaboration supported by the HSRP derives from NOAA's work on a new vertical datum transformation tool (VDatum). VDatum enables any user — federal, state, local, or individual — to integrate bathymetric and topographic coastal data from different sources and different reference datums. The tool provides tremendous value to the taxpayer because it removes the most serious impediments to data sharing, resulting in data that can serve more than one purpose. It saves time, money, and effort by reducing redundant data collection. VDatum will help NOAA acquire hydrographic and shoreline data more efficiently, and improve the accuracy of surveys and maps by eliminating the need for time-consuming water-level corrections and post-processing.

The HSRP acknowledges the Administration's support of VDatum in the FY2010 budget request, and encourages Congress to provide adequate funding to develop, maintain, and support the tool.

Seamless integration of geospatial data has many applications, from homeland security and natural disaster preparedness to tsunami and storm-surge inundation modeling and coastal restoration. Federal agencies operating in coastal and marine settings rely on NOAA's expertise to develop, maintain, and provide access to the VDatum tool. The HSRP acknowledges the Administration's support of VDatum in the FY2010 budget request, and encourages Congress to provide adequate funding to develop, maintain, and support the tool.

The HSRP is pleased to see improved cooperation between federal agencies regarding vertical datum standards. NOAA assisted in the development of the 2009 USACE regulation, "Policies for Referencing Project Elevation Grades to Nationwide Vertical Datums." This regulation establishes USACE policies for referencing project elevation grades to nationwide vertical datums established and maintained by the U.S. Department of Commerce. It ensures that controlling elevations and local datums for USACE projects, such as dredging, are properly and accurately referenced to nationwide spatial reference systems used by other federal, state, and local agencies responsible for flood forecasting, inundation modeling, flood insurance rate maps, navigation charting, and topographic mapping. NOAA continues to support USACE in the development of a VDatum model development and training programs for implementing the new policy.



Multibeam echosounders can capture images of shipwrecks on the seafloor.

HSRP is gravely concerned that in federally maintained channels — where deep-draft commercial ships transit and where there is minimal underkeel clearance — the federal government is not using the most effective technology to detect the presence of submerged objects. The USACE, responsible for maintaining, dredging, and surveying inside the channel, does not use the same technology and standards as NOAA, whose area of responsibility falls outside federally designated channels.

The HSRP recommends ensuring that the Nation's federally maintained channels, approaches, and anchorages are surveyed to NOAA's standards that provide full-bottom coverage for object detection to facilitate safe maritime commerce in U.S. waters.

Since 1985, NOAA has conducted multibeam and sidescan sonar surveys to achieve full-bottom coverage for depths and obstructions. These surveys give a complete picture of the bottom. Previously undetected rocks, pipes, wrecks, and other marine debris are frequently found by NOAA in navigable waters transited by large container ships, cruise ships, and tankers. Using this technology, NOAA finds new hazardous obstructions at an average rate of about 2.5 per day. However, federally maintained channels, which are the responsibility of USACE, do not often receive this level of scrutiny because USACE's survey mission centers more on sediment management rather than hazard detection.

The HSRP is well aware that NOAA and USACE agencies have historically surveyed to address different purposes, but finds that with channel clearances so tight, the *status quo* is no longer acceptable. The HSRP strongly recommends NOAA either be authorized and funded to survey all federally maintained channels on a routine basis, or both agencies should use a single standard that implements the best available technology and full-bottom coverage to prevent accidents and ensure navigation safety. Otherwise, the HSRP anticipates more environmentally and economically devastating incidents such as the *Athos I* tanker spill, caused by an undetected anchor, pump casing, and concrete block submerged in the Delaware River channel and anchorage. Other examples include the

Hai Kang strike of the remains of a Burlington Northern Railroad bridge pier in the Willamette River, and the *Teal Arrow* rock pinnacle grounding in a deepened Coos Bay channel.

The HSRP finds the fact that these channels and anchorages were inadequately surveyed by USACE to be unacceptable, and is concerned that the nation's other channels may also mask hidden dangers. Our waters are much too busy with commercial, military, and recreational traffic to leave so much to chance.

Homeland security presents another argument for full-bottom coverage surveys in U.S. waterways. Rapid military mobilization depends on safe maritime transits in the same channels used by commercial mariners and recreational boaters. The health of our coastal economies and the Nation's success in the global markets require safe and efficient marine operations conducted in an environment of assured security, with special focus on sustaining the rights of safe passage. The increasing level of maritime trade poses risks, not only in the form of accidents caused either by human error or environmental conditions, but also by terrorist attacks.

Countering this threat requires an improved maritime domain awareness to prevent port and waterway closures. NOAA, the U.S. Navy, and the U.S. Coast Guard have partnered on homeland security surveys to establish a baseline dataset for countermine warfare change analysis. NOAA and the Department of Defense have worked together to enhance unmanned survey capabilities, including underwater vehicles, to help ensure U.S. ports, harbors, and inland waterways are clear of underwater explosives and other hazards. These coordinated efforts should continue routinely among NOAA, the Navy, USACE, and the Coast Guard.

The HSRP recognizes that it is not a simple task for NOAA and its fellow agencies to actively pursue integration of standards and activities for an improved MTS infrastructure. Such integration will require considerable discussion at the highest levels of the agencies and the Administration. In integrating data acquisition across agencies, it is typically necessary to utilize the most stringent specifications in order to serve the broadest range of data needs. Since data collected in support of safe navigation, e.g., NOAA chart data, typically have the most stringent specifications, the HSRP recommends that NOAA take the lead in such integration. Specifically, the HSRP recommends that NOAA pursue this issue within the Committee on the Marine Transportation System to ensure widespread support and awareness of the potential partnerships and benefits to navigation safety and the integrity of our maritime borders.

Recommendation 2

The HSRP recommends that NOAA take a larger role in improving partnerships with other federal and state agencies and non-governmental entities to:

- **integrate coastal mapping efforts with coordinated mapping plans, for example NOAA, USGS, and USACE shoreline mapping efforts;**
- **collect ancillary multi-use data such as multibeam backscatter imagery concurrent with charting surveys to support marine spatial planning;**
- **refine, implement, and maintain tools such as VDatum to collect, integrate and disseminate seamless coastal geospatial data; and**
- **ensure the Nation's federally maintained channels, approaches, and anchorages are surveyed with full-bottom coverage technologies to NOAA's standard to facilitate safe maritime commerce in U.S. waters.**

An example of integrated mapping: NOAA and Oregon State University map Oregon's seafloor

Over two years, surveyors and scientists from NOAA's Office of Coast Survey, private contractors, and Oregon State University (OSU) will create the most detailed maps ever generated of the seafloor along Oregon's coast. Using the latest technologies, they will measure water depth, search for navigational hazards, and record the natural features of coastal seabeds and fragile aquatic life. The images will help researchers and coastal managers protect coastal communities and marine habitat.

"These projects help Oregon prepare for future challenges," said Oregon Governor Ted Kulongoski. "With the data collected from these surveys, we can model tsunamis, identify marine habitats, select alternative energy sites, identify geological hazards, and enhance safe and efficient marine transportation."

NOAA awarded $5 million to private contractors to assist in the joint effort. The State of Oregon provided $1.3 million in funding to OSU. NOAA will use the data from the surveys to update nautical charts that currently contain depth information acquired before 1939.

"Officials need the best possible information to manage ocean and coastal resources," said John H. Dunnigan, former Assistant Administrator for NOAA's National Ocean Service. "Updated nautical charts will also make ocean shipping and recreational boating along Oregon's coasts much safer."

"Along with the governors of California and Washington, I set a goal of mapping our three states' ocean areas by the year 2020," Kulongoski added. "Thanks to the strong partnership between NOAA, academia, private industry, fishermen, state legislators, and multiple state and federal agencies, Oregon is on track to reach that goal."

Oregon State University's Marine Mammal Institute refitted the Pacific Storm, a gifted fishing vessel, for research purposes.

With a resolution of a half-meter, the maps will cover about 34 percent of the state waters and 75 percent of its rocky reefs, recording every bump, depression, reef, and boulder on the seafloor. Additional information acquired during the survey includes seafloor imagery data to provide detailed habitat mapping. A moving vessel water column profiler is also used to help define dead zones by measuring dissolved oxygen levels in the water. The survey area extends from a depth of 10 meters out to three miles, the boundary of Oregon's territorial sea.

What we can't see does hurt us:
NOAA's ability to survey federally maintained channels is tragically under-utilized

On November 26, 2004, the 750-foot, single-hull tanker *Athos I* was reported to be leaking oil into the Delaware River *en route* to its terminal at the CITGO asphalt refinery in Paulsboro, New Jersey. As two tugboats were helping the vessel maneuver to its terminal, the oil tanker listed eight degrees and lost power. Divers later confirmed two punctures in the tanker's hull, measuring 1-by-2 feet and 1-by-6 feet. The *Athos I* spilled an estimated 265,000 gallons of oil into the Delaware River, affecting about 115 miles of shoreline.

Home to the country's fifth largest port complex in waterborne commerce, the Delaware River and Bay sees 70 million tons of cargo every year. It is the second largest oil port in the U.S., handling about 85 percent of the East Coast's oil imports. Because of this event, the Port of Philadelphia closed for days. Waterfowl, migratory birds, and wildlife perished.

A full-bottom coverage hydrographic survey would have found this anchor before the collision.

This accident was preventable. The *Athos I* collided with three uncharted and undetected submerged obstructions in the channel and anchorage that the pilot and captain had no way of knowing existed. Had the federal government conducted a full-bottom coverage hydrographic survey, the objects — later identified as a ship's anchor, a pump casing, and a 64-cubic-foot slab of concrete — would have been located, charted and/or removed from the tanker's path.

The U.S. Coast Guard's final report on the spill cleared the ship's crew and pilot of blame. Officially, the accident was caused by large metal debris in a government-maintained channel and anchorage, which had not been fully surveyed.

NOAA has the technology to survey the federally maintained waters where the accident occurred. Unfortunately, NOAA is often not called to survey within a channel until after an accident occurs. The *Athos I* incident cost the ship owner and his insurer over $165 million. The true value of wildlife lost and port commerce delayed or deferred cannot be calculated.

Modernize heights and implement real-time water level and current observing systems in all major commercial ports

Finding 3:

NOAA's Navigation Services are a critical component of the federal effort to build an Integrated Ocean Observing System (IOOS), delivering real-time data to a multitude of navigation and non-navigation users. The Integrated Coastal and Ocean Observation System Act of 2009 highlights the importance of observing systems and data, first and foremost for national defense, marine commerce, and navigation safety, among a host of other uses. The need for accurate and reliable ocean observing data is reiterated in the July 2010 *Interagency Ocean Task Force Final Recommendations* and the *National Ocean Policy*. Central to IOOS is the concept that, in many cases, measurements and predictions taken and made for a particular need can serve other national and regional needs.

NOAA is the lead agency for IOOS, and the physical observations collected by the Navigation Services programs are a critical component of the IOOS backbone. The environmental parameters (meteorological, currents, water levels, hydrography, bathymetry, shoreline, and geo-positioning) that NOAA Navigation Services gathers, integrates, and quality controls on behalf of the mariner are also baseline datasets for other stakeholders: coastal zone managers, coastal engineers, researchers, and first responders. Some of these parameters also provide information critical to mitigating natural hazards, such as storm surge, tsunamis, and other extreme events. Thus, the HSRP believes support for comprehensive expansion of the maritime components and building on existing capabilities to link users to useful and timely data should be the top priority for IOOS, and for NOAA.

From the U.S marine transportation system perspective, the HSRP views NOAA's IOOS contributions to navigation as the means by which ships can safely exploit the existing capacity within U.S. ports and waterways. And exploit it we must; to maintain U.S. position in the global marketplace, the current — and future — demands of our nation's commerce, military sealift, and recreational uses require us to maximize the throughput of our MTS infrastructure. In the 1930s, the average steamship was 460 feet long and 63 feet wide, with a draft of 26 feet. Now modern ships calling at U.S. ports are over 1,400 feet long and 200 feet wide, with drafts of 60 feet or more — a keel depth equivalent to a five-story building plunging below the waterline. Today, ships routinely transit our ports and harbors with 2 feet or less of under keel clearance, risking contact with the seabed or other obstructions. In a number of ports, clearance under bridges (known as air gap) is also a concern, because bridges flex up and down (resulting in a variable air gap), and the tallest ships can avoid hitting the bridge only during the lowest of tides.

With help from NOAA's PORTS®, the USS New York safely passed under the Huey Long Bridge just north of downtown New Orleans with only 2.1 feet to spare.

Tide level predictions alone are not enough to ensure navigation safety. Due to these tight clearances below (to the sea floor) and above (bridge clearance), and because the water levels vary with time as a result of tidal an non-tidal forces, real-time water level and air gap data is critical.

The potential for serious injury to people, property, and the environment is compounded by the fact that over half the cargo transported by ship in U.S. waters is oil or other hazardous material.

NOAA's marine observations help address these concerns by enhancing a mariner's situational awareness. In particular, water levels and currents are key parameters when navigating in tight conditions. NOAA's National Water Level Observation Network (NWLON) and National Current Observation Programs (NCOP) deliver this information through a variety of means, and provide the foundation for NOAA's Physical Oceanographic Real Time Systems (PORTS®).

A critical component of IOOS, PORTS® is a localized sensor suite that disseminates observations and predictions of water levels, currents, salinity, winds, atmospheric pressure, and air and water temperatures for an area every six minutes. A recent addition is the air gap, or bridge clearance sensor, which addresses the emerging issue of ever taller vessels striking bridges. Each system installation is uniquely tailored to the needs of local users. All PORTS® observations are quality controlled 24 hours per day, seven days per week.

In addition to improving navigation safety, PORTS® also improves efficiency. With reliable, accurate, and timely information, larger ships can load more heavily and time their arrivals and departures more efficiently, all while maintaining a high confidence in navigation safety. This margin of safety opens limited channel depths to larger commercial ships, allowing port operators to maximize throughput and economic gain with less risk to the environment.

NOAA also develops and implements operational forecast models that leverage and extend the benefits of real-time data by accurately forecasting oceanographic conditions 24 to 30 hours into the future. These forecasts further improve the mariner's ability to make sound safety and efficiency decisions.

The HSRP is a strong proponent of PORTS® and NOAA's other observing systems that enhance commerce, support marine models and flood predictions, and provide fast response support to natural or manmade hazards (such as storms or oil spills) or homeland security events.

As with hydrographic and shoreline mapping, funding gaps limit the expansion of these networks, a situation that must be remedied given the benefits they provide to safety and the economy. NOAA is far from achieving adequate coverage of NWLON, with only 210 established stations of the 300 water level stations required to meet national program targets, and only 20 PORTS® partnerships servicing just 39 of the top 175 U.S. seaports. NOAA has been able to implement operational forecast models at only three of the 20 existing PORTS® systems (New York/ New Jersey Harbor, Chesapeake Bay, and Houston/Galveston Bay).

Often in financial jeopardy, the PORTS® depend on both NOAA and its port partners to obtain their funding shares each year. For example, port funding shortfalls forced the Delaware Bay and River PORTS® off-line for six months in 2004, and the San Francisco Bay PORTS® has barely avoided shutdown, with much of its sensor suite no longer operating. Although the 2008 Hydrographic Services Improvement Act authorized full federal funding for these systems, regrettably, permanent funding has not been appropriated to fund the purchase and installation of equipment for new systems, nor the annual operations and maintenance needed to keep systems operational. However, in 2008, 2009, and 2010, NOAA did receive earmarks for PORTS® annual operations and maintenance.

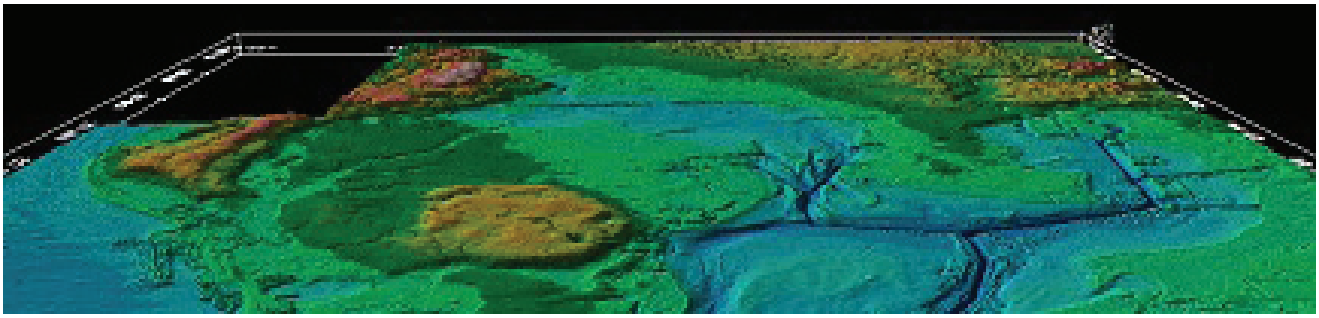
The HSRP recommends the expansion of the PORTS® program to additional major U.S. seaports be made a high priority for future IOOS funding appropriated to NOAA, including the ability to implement operational forecast models coupled with each PORTS® system. PORTS® is already a well-developed NOAA capability, a demonstrated success with documented benefits, and has high visibility with the user community and Congress. A 2005 Tampa Bay economic study and its $7 million in quantifiable economic benefits demonstrate the potential of PORTS®, its relatively low cost, and the benefits from avoiding accidents and damage to the environment. Similarly, a 2007 study of the Houston/Galveston PORTS® identified $18 million in benefits to the Gulf Region.

The HSRP also supports NOAA's management of the National Spatial Reference System (NSRS) as a primary element of IOOS infrastructure, given that precise positioning information is an essential component of all observing systems. The NSRS allows global positioning system (GPS) receivers to determine positional coordinates to centimeter-level accuracy or better anywhere on the surface of the earth. Unfortunately, NOAA's efforts to improve the height element in GPS positioning and provide better nationwide access to accurate and reliable height information have not been efficient, as much of the funding available for this function comes from state-specific earmarks. Thus far, 17 states have received funds, primarily through earmarks. An increase in competitive grant funding for the National Height Modernization Program would give NOAA more discretion to efficiently obtain accurate heights.

Because of insufficient resources to collect gravity data, unreliable elevation data are being used for floodplain mapping and storm surge modeling.

Collecting airborne gravity data efficiently obtains elevations for height modernization efforts. Currently these data are severely lacking, especially along the coasts where it is perhaps most critical. Because of insufficient resources to collect gravity data, unreliable elevation data are being used for floodplain mapping and storm surge modeling. The HSRP supports the new NOAA initiative to collect new gravity data nationwide, which will enable development of an improved national vertical datum. The HSRP recommends increased resources be dedicated to this effort, to improve current predictions, VDatum transformations in the coastal regions, storm surge modeling, hydrographic surveying, shoreline mapping via GPS surveying, and various IOOS observations.

Coastal digital elevation models help determine how storm surge will affect an area.



Scientists track three-dimensional movements of land and coastal wetlands, including subsidence -- sinking of land -- that is a growing concern to many coastal areas as global sea levels rise.

Many states have indicated a strong interest in NOAA's National Height Modernization Program to address regional or national problems, such as coastal and river flooding in the mid-Atlantic and subsidence (sinking) along the Gulf of Mexico. Height modernization is critical for the calculation of sea level rise and climate-change impacts, vessel under keel and bridge air gap measurements, safe hurricane evacuation routes determination, subsidence and crustal motion monitoring, storm surge modeling, and restoration of coastal habitats. In addition to the benefits height modernization provides along the coast, it is also critical to inland applications such as precision agriculture, flood plain mapping, construction, and stream gauge monitoring.

As with PORTS®, investments in improving our ability to obtain accurate heights are relatively low in relation to the possible benefits and return on investment. As cited in a 1998 report to Congress, improved height data from GPS has cost benefits to the nation of over $9 billion. To fully realize the benefits of height modernization, the HSRP believes NOAA needs more resources and flexibility in allocating National Height Modernization Program funds.

Recommendation 3

The HSRP recommends that NOAA expand and fund real-time water level and current observations, such as its National Water Level Observation Network, and Physical Oceanographic Real Time Systems, or PORTS®, in commercial ports. The HSRP also recommends NOAA provide funding to the National Geodetic Survey to expand the Height Modernization Program. This program will add new National Spatial Reference System (NSRS) monuments with accurate heights where needed, update existing NSRS network heights, and collect gravity data to improve the Nation's vertical reference system. Accurate nationwide heights are critical components of the Integrated Ocean Observing System.

Strengthen NOAA's Navigation Services emergency response and recovery capabilities

Finding 4:

NOAA's Navigation Services support emergency response to incidents such as hurricanes and oil spills, and are important contributors to homeland security. NOAA's role is crucial but under-resourced, requiring resource reallocation from primary mission critical tasks during times of need.

Gathering hydrographic data, surveying coastal disaster areas, and monitoring emergency spill situations… These activities do not often make headlines or news video clips. That is why NOAA emergency response efforts remain relatively invisible to the public. Nevertheless, the HSRP recognizes how significant they are. In fact, NOAA's work — before, during, and after a crisis — provides key information that other agencies and responders depend on. During Hurricane Katrina and other 2005 storms, for example, NOAA's real-time water level and survey data were fundamental indicators of what was happening when and where in the Gulf of Mexico. NOAA worked in concert with other federal and state agencies, but the tools it provided — namely hydrographic data and response services — are unique to NOAA.

The U.S. economy and national security depend on the reliable movement of waterborne cargo. Without data, collisions with charted or uncharted features can lead to huge economic impact. Even a brief disruption in a major port can cause significant economic losses. For example, in June 2006, a major oil spill shut down the Calcasieu Ship Channel, closing the Port of Lake Charles, Louisiana, for nine days. Four percent of the nation's refining capability and one-third of the nation's liquefied natural gas import capacity are located on the channel. The strategic petroleum reserve was opened because of this temporary disruption. According to an economic analysis released by the port, the nine-day closure resulted in over $1 billion in increased energy costs to U.S. consumers.

In 2005, NOAA responded to Hurricane Katrina — the most devastating storm in U.S. history, resulting in at least 1,300 casualties and damages exceeding $80 billion — with NOAA ships, planes, scientific experts, and specialized response teams. In addition to the thousands of homes and businesses that were destroyed, and human lives lost and displaced, Katrina caused Exxon Valdez-size oil spills in Louisiana. Using its unique capabilities, NOAA responded immediately. In conjunction with other agencies and contractors, NOAA surveyed transportation corridors to re-open ports and waterways to safe transport of commerce and relief supplies. NOAA assessed hurricane damage, conducted environmental assessments, and provided critical scientific support to the U.S. Coast Guard, Environmental Protection Agency, and the Federal Emergency Management Agency. In a situation fraught with communication challenges, NOAA coordinated its emergency response with numerous agencies, giving encore performances after Hurricanes Rita and Wilma.

Living through a hurricane is dangerous but, to mariners, navigation after the hurricane can be just as debilitating.

To restore fishing grounds and improve navigational safety after Hurricane Katrina, Congress directed NOAA's Office of Coast Survey and the Office of Response and Restoration's Marine Debris Program to survey and map the impacted Gulf coast areas. As of August 29, 2009 — the fourth anniversary of Hurricane Katrina — the NOAA project team surveyed over 1,550 square nautical miles from Mobile Bay, Alabama, to the Louisiana/Texas border, and located more than 7,000 debris items in offshore fishing and shrimping grounds. The Gulf of Mexico Marine Debris Project received an Environmental Protection Agency "Gulf Guardian" award. Funding from the American Recovery and Reinvestment Act continues to support marine debris surveys to detect hazards left in the region's waterways.

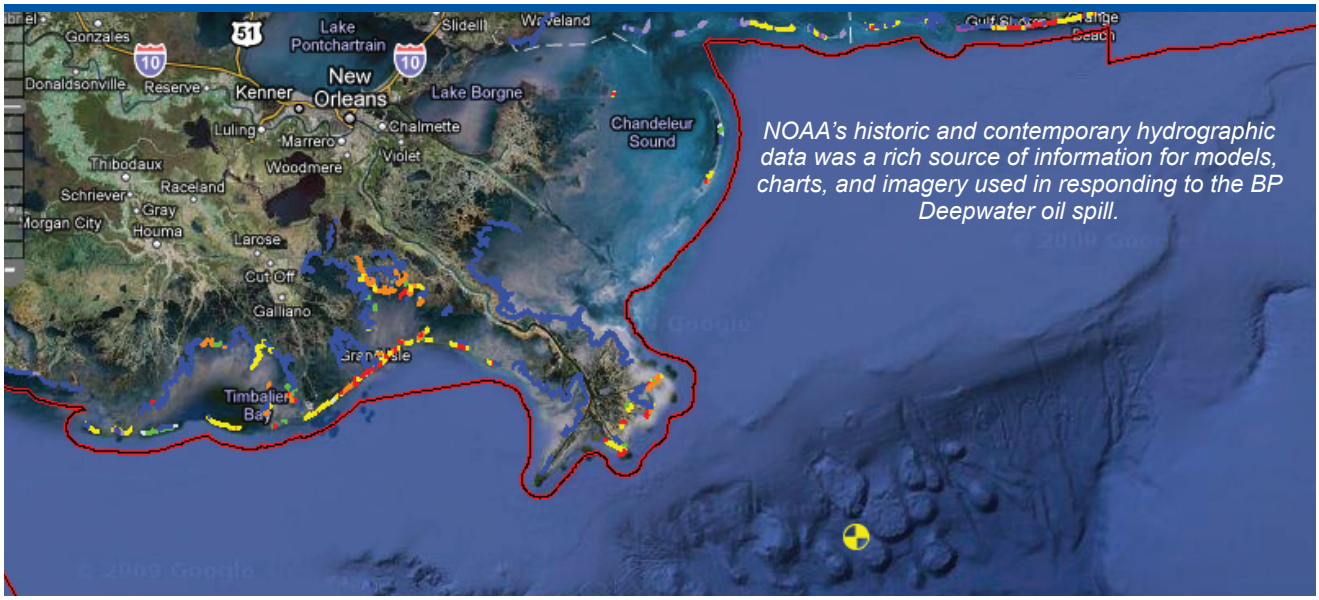
Accurate high-resolution bathymetry, tidal current measurements, and shoreline maps are critical to oil spill models. By working with ports to evaluate their development plans, NOAA can also pinpoint likely areas of risk and help to establish more disaster-resistant ports.

NOAA gears its response to each emergency. In case of hurricanes or maritime accidents, the agency rapidly mobilizes both in-house and contractor assets to conduct post-event aerial remote sensing/imagery and hydrographic surveys to assess damage, obstructions, and debris. In advance of a hurricane's onslaught, NOAA delivers storm surge warnings from its real-time systems to support the evacuation of tourists, alert residents to coastal flooding, and allow the U.S. marine transportation system infrastructure time to batten down the hatches.

When our waters suffer a chemical or oil spill, NOAA scientists track and predict spill movements, improving the deployment of response teams and protecting sensitive coastal environments. Accurate high-resolution bathymetry, tidal current measurements, and shoreline maps are critical to oil spill models.

By working with ports to evaluate their development plans, NOAA can also pinpoint likely areas of risk and help establish more disaster-resistant ports.

NOAA manages its emergency preparedness and response in concert with other agencies, often in advance of an incident. For example, NOAA partners with the Coast Guard and other authorities to maintain spill preparedness in major U.S. ports, helping to minimize the impact of oil or chemicals to the environment. In matters of homeland security, NOAA supports the U.S. Navy and the Coast Guard with aerial imagery, hydrographic survey vessels, and navigation response teams. To protect our ports, harbors, and coastal borders, NOAA uses its state-of-the-art technologies to create highly accurate surveys of our nation's coastal areas and navigation routes.



NOAA's historic and contemporary hydrographic data was a rich source of information for models, charts, and imagery used in responding to the BP Deepwater oil spill.

The HSRP learned from reviewing NOAA's performance in the 2005 hurricane season that information and service delivery during emergency events is stellar, but the agency lacks the capacity to sustain its response broadly and for extended periods. Further, resources to respond to the emergency needs of the Nation deplete resources from other NOAA primary missions.

This situation concerns the HSRP, particularly with the predictions of increasing catastrophic-level storm activity. All of NOAA's unique emergency response capabilities need to be funded and staffed to meet this critical national demand. First and foremost, NOAA's navigation response teams (NRTs) must be expanded from the current six teams operating on a shoestring budget to a minimum of 10 fully funded and staffed teams staged regionally around the country. Highly mobile, the NRTs respond on short notice to emergencies requiring hydrographic survey support, such as vessel groundings and hurricane damage, 365 days a year. Consider that within a few weeks after Katrina and Rita made landfall, NOAA surveys, in conjunction with the survey efforts of the U.S. Army Corps of Engineers, the U.S. Coast Guard, and contractors, enabled the re-opening of all 13 major ports and waterways in the region, opening access for more than a hundred ships awaiting entry with food and relief supplies. To achieve this quick post-hurricane response in the Gulf Coast, NOAA had to pull NRTs from California and the Great Lakes, leaving those areas vulnerable.

The utility of NOAA's Navigation Response Teams is limited only by their numbers. The six NRTs — two each on the east and west coasts, one on the Gulf Coast and one in the Great Lakes — cannot provide adequate rapid response on a national scale. The HRSP believes that NOAA's response to customer needs, navigation safety, homeland security, and economic stability will dramatically improve when NOAA can provide NRTs for more geographically diverse customers. Additional teams, as well as the funding to staff and equip the teams with the most modern survey technologies, will also allow the NRTs to complete critical port surveys more quickly.

NOAA should consider equipping all new and existing NRTs with multibeam, side scan sonar, and position and orientation systems that include dual frequency GPS receivers tightly coupled with an inertial solution. Using these systems in conjunction with VDatum allows for real-time surveying to chart datum, thereby decreasing response time and eliminatng the need to install water level gauges.

A comparatively small investment in more NRTs can make a dramatic and meaningful improvement to the resiliency of our marine transportation system. Re-opening our Nation's ports and waterways quickly after a significant incident is imperative.

Navigation Response Team 5 prepares to conduct a full-bottom survey off the coast of Maine, where a series of fatal fishing boat accidents spurred an urgent request for NOAA assistance.

NOAA can also increase emergency response capability by implementing several hydrographic survey contracts in advance, in areas not served by in-house NRTs. Local surveyors with local knowledge, and vessels already staged in the area of need, can expedite an emergency response. In NOAA has reported success in utilizing a contractor to support an emergency navigation response survey and this approach was also useful in responding to Hurricane Ike. To speed NOAA's response to emergency events, the HSRP recommends that NOAA use contractors in times of need.

Similarly, NOAA's capacity to respond to oil and chemical spills is stretched thin. Since 2004, the annual appropriation for this function has been lower than the President's Budget Request, cutting into the program's base budget by 18 percent. The HSRP is alarmed by this reduction, as it significantly diminishes NOAA's ability to execute its core scientific responsibilities: hazard characterization, environmental chemistry, oil slick tracking, pollutant transport modeling, natural resources at risk analysis, information management, and assessment of environmental trade-offs related to alternative spill countermeasures and cleanup techniques.

NOAA responds to an annual average of 120 incidents, primarily oil spills, but also hazardous materials releases, abandoned vessel searches, body searches, and whale strike casualties. Some years have many more incidents; in fiscal year 2009, NOAA provided support on 202 incidents, including 164 oil spills, 24 chemical spills, and 14 miscellaneous incidents. After Hurricane Katrina, NOAA scientists remained on-scene, providing guidance to the Coast Guard for removal of hazardous containers from wetlands and waterways, and the salvage of derelict vessels from commercial waterways.

In response to the BP Deepwater oil spill, NOAA Ship Thomas Jefferson undertook a research mission in the Gulf, testing methodology for detection of submerged oil. Cmdr. Shephard Smith and Dr. Jane Lubchenco briefed reporters on the mission.

Currently, NOAA has the capacity to respond to one major incident a year. The HSRP believes it is critical to restore the budget for NOAA's emergency response so the program can provide its breadth of capabilities for a minimum of two simultaneous major incidents. Future incidents of national significance — caused by weather, pollution, or threats to homeland security — are not only foreseeable; they are probable. NOAA must be fully funded and staffed to execute its unique federal response and recovery missions for the Nation.

NOAA's Navigation Services also need to be recognized and adequately funded as essential support functions in the National Response Framework. In the past NOAA received partial reimbursement for hurricane Katrina, Rita and Wilma efforts; however, FEMA funding does not always fully reimburse NOAA, and it is not always available. The HSRP recommends that NOAA seek a dedicated source of annual funding for emergency training, planning, and coordinating joint response strategies with other federal agencies. If this is unachievable, NOAA should continue to seek funding through FEMA's Disaster Relief Fund to reimburse the agency for its emergency response activities.

NOAA cannot sustain acceptable levels of mission performance without identifying, seeking, and receiving reimbursement for significant unbudgeted expenses incurred by the Navigation Services program in response to incidents of national significance.

NOAA must think creatively to increase awareness of its emergency response efforts. For example, the extensive aerial imagery that NOAA collects after hurricanes is sometimes not credited to NOAA. Including a simple "watermark" on each NOAA image, identifying the creator of the image, would increase the awareness of NOAA response efforts. A similar "watermark" could be placed on charts and other images. Making data more easily accessible is another way of increasing awareness of NOAA's response efforts. For example, NOAA could create KMZ files for existing data and new incoming data and images that could be easily used in Google Earth.

Recommendation 4

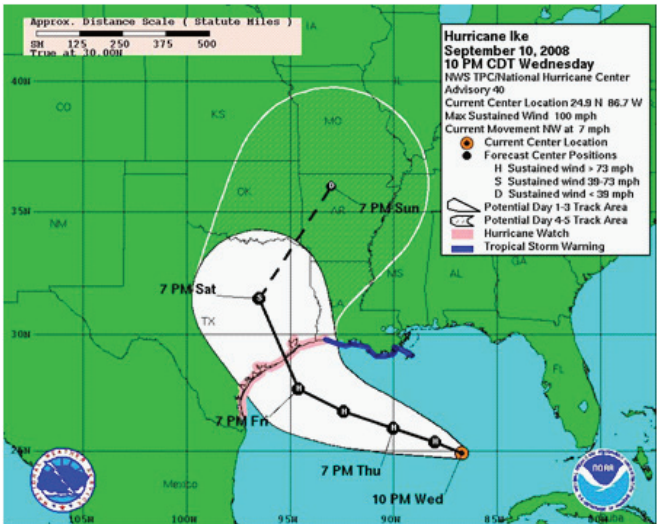
The HSRP recommends that NOAA strengthen its Navigation Services emergency response and recovery capabilities, including kinematic GPS equipment for real-time surveying:

- **by seeking adequate recognition and funding for its essential support functions within the federal response to all-hazards crises;**
- **through accelerated validation and the full implementation of VDatum to allow for near real-time surveying to chart datum; and**
- **by establishing cooperative agreements with local contractors before times of need.**

Scientists on board NOAA Ship Thomas Jefferson collect hydrographic data at the ship's survey acquisition station.

Emergency response for Hurricane Ike:
accelerating the opening of shipping channels

Quickly reopening the waterways of major ports after a natural disaster is crucial to the national economy. One way to accelerate this process is to use local private hydrographic firms to survey the sea bottom as soon as it is safe. For example, prior to the landfall of Hurricane Ike in September 2008, a plan of action was developed by the United States Army Corps of Engineers (USACE), NOAA, and other agencies. This plan organized a hydrographic survey response team utilizing NOAA, USACE, Coast Guard, and Navy resources as well as multiple local hydrographic survey contractors. They deployed 17 survey vessels in the initial survey, before Hurricane Ike made landfall.



Within hours after Ike struck Galveston, the USACE determined where surveys were required, and assigned priorities to each vessel. This massive undertaking was conducted in a very short time, under adverse conditions, and with few land facilities. Sidescan sonar data was monitored real time and transferred electronically to hydrographic survey contractors' offices to map significant bottom features. The hydrographic data was processed overnight, allowing the USACE to develop a strategy for the next day's fieldwork.

Ike hit the Texas coast on September 13. Two days after landfall, the Houston Ship Channel and Sabine-Neches Waterway were opened to shallow draft vessels. Within three days, the survey crews had assessed the majority of the waterways, and contract efforts were scaled back to two vessels. Four days after landfall, many of the other channels were opened for deep draft vessels and, on September 23, the Houston Ship Channel opened to normal vessel traffic.

Utilizing the local knowledge and resources of private hydrographic survey companies through federal contracting resulted in quick completion of emergency response surveys, allowing salvage crews to clear the waterways. As a result, the ports and waterways affected by Ike opened to normal ship traffic in a very short timeframe.

Remote sensing imagery aids emergency response

To support NOAA's homeland security and emergency response requirements, the National Geodetic Survey (NGS) Remote Sensing Division acquires and rapidly disseminates a variety of spatially referenced datasets to federal, state, local government agencies, and to the public. Remote sensing technologies deployed by NOAA include light detection and ranging and high-resolution digital cameras.

In a large response effort, NOAA collected over 8,000 aerial images of the hardest hit areas in Alabama, Mississippi, and Louisiana after Hurricane Katrina landfall. These images were available to emergency personnel and the public on the NOAA/NGS web site (http://www.ngs.noaa.gov/). Several commercial vendors incorporated the aerial imagery into web-based map servers, allowing for searches on street addresses, city names, and points of interest. In addition, NGS provided similar emergency response support after Hurricanes Isabel (2003), Ivan (2004), Jeanne (2004), Dennis (2005), Ophelia (2005), Rita (2005), Wilma (2005), Ernesto (2006), Humberto (2007), Gustav (2008), and Ike (2008).

Disseminate NOAA's hydrographic services data and products to achieve greatest public benefit

Finding 5:

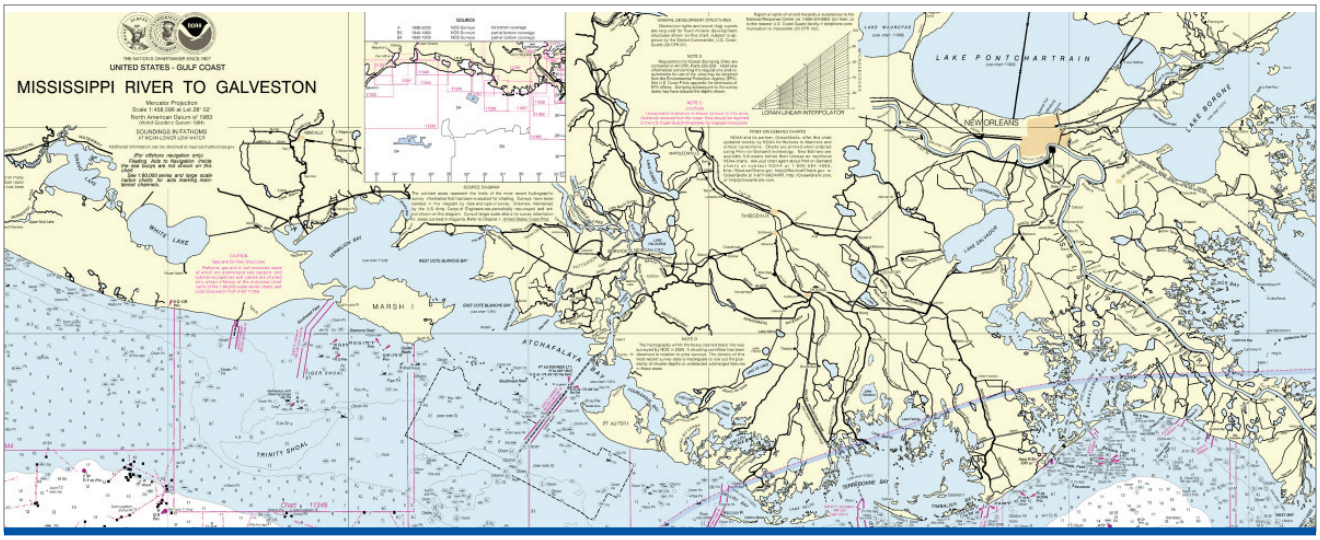
More timely and widespread delivery of NOAA's navigation data will result in safer maritime navigation, enhance port operations and port security, and provide valuable geospatial information as our Nation addresses the challenges of sea level rise.

The HSRP firmly believes the federal government needs to invest in programs that give the greatest return on public investment. NOAA's Navigation Services not only support safe, efficient, and environmentally sound navigation, but the same dollar invested in hydrographic surveys, Electronic Navigational Charts (ENCs), water levels, or positioning accuracies yields multiple benefits to a wide variety of stakeholders.

The scope and impact of NOAA's hydrographic information on U.S. marine transportation system users is significant. NOAA's nautical charts, shoreline surveys, PORTS® real-time data, seafloor images, and other products are absolutely essential to the safe movement of vessels transiting U.S. waters. What the public may not realize, however, are the broader applications of NOAA's hydrographic services. In addition to navigation, these services form the basis for inundation modeling, marine habitat mapping, coastal resource management, engineering projects, long-term sea-level trends, climate change, and more.

Navigation Services play a critical role in coastal and maritime communities; and they also influence the lives of varied and unexpected stakeholders – from farmers in America's heartland to urban schoolchildren. Whether the issue is the timely transportation of goods to market, a classroom discussion about hurricanes or oil spills, the impacts of port expansion on the environment, or an emergency manager's decision to order a mandatory hurricane evacuation, NOAA hydrographic products and services are often at the core.

Half of the wheat grown in the U.S. is destined for export, requiring fast and efficient port operations. Photo courtesy of U.S. Wheat Associates



The HSRP applauds the development of hydrographic products and services available to mariners. The digital raster charts and ENCs that NOAA makes available on the Internet at no charge to the consumer have eclipsed traditional paper charts. Printed predicted tide tables have been supplanted with electronic versions of the tables. Real-time water level is available every six minutes in most areas. NOAA's products — including the NOAA Pocket Chart, the chart downloads booklet, small-craft charts, and the Coast Pilot® series of navigational books — help mariners navigate safely and efficiently at sea, in harbors, and in the Great Lakes.

Despite NOAA's impressive record of achievement, especially considering its constrained resources, the HSRP sees a strategic need for NOAA to accelerate the development and dissemination of certain hydrographic products and services. The HSRP is particularly concerned over the pace at which NOAA is building its ENC coverage to match the area covered by the suite of 1000 paper charts. Recognizing that this is both a funding and capacity issue — the Administration's budget requests have sought the same $2 million increase for ENCs every year since 2004 — the HSRP understands the delay. However, it notes that an incomplete suite of ENCs directly affects safety of navigation and homeland security; without adequate funding, NOAA is falling short in its responsibility to provide ENCs coincident with the U.S. Coast Guard's introduction of electronic charting system carriage regulations. The HSRP hopes that this situation is remedied with the FY2011 appropriation.

Additionally, the HSRP urges NOAA to accelerate the rationalization of its separate raster chart and ENC production lines into an integrated single process. While the HSRP recognizes the short-term challenges, including the re-training of some personnel, NOAA needs to follow through on its commitment to complete its ENC portfolio.

In addition to continuing to improve its navigation and geospatial positioning products, the HSRP recommends that NOAA expand use of navigation data to non-navigational purposes. For example, at the same time that ports and shippers are under pressure to remain competitive, coastal zone managers are juggling responsibilities for effective use of coastal resources and planning for climate change. NOAA's decision-support tools — high-accuracy nautical charts, positioning information, and real-time water-level and current data — help the mariner maximize use of limited channel depths safely, and also help the coastal manager make informed decisions on sustainable development and protection of coastal and ocean resources. NOAA navigation data can also benefit surveyors, managers, planners, engineers, and scientists working in the coastal zone, including marine spatial planners.

The HSRP recommends that NOAA increase its efforts to educate its diverse stakeholders — from mariners and navigators to consumers and coastal zone managers — on the importance of accurate surveys, charts, real-time information, and other hydrographic data. NOAA should expand the reach of its regional navigation managers and state geodetic advisor programs, currently focused primarily on traditional constituencies, to include new geospatial stakeholders such as GIS and natural resources managers.

The HSRP is aware of several examples of the ways in which the use of hydrographic information goes far beyond mariners, and encourages NOAA to develop a better understanding of the needs on non-navigation users of hydrographic data. Since our first report in 2007, the HSRP has heard testimony from a wide spectrum of non-traditional users, including industrial plant managers, conservationists, scientists, and coastal managers, who have described their use of hydrographic data in both traditional and emerging applications.

One unusual application of navigation information was explained in a presentation on the use of real-time water level, wave height, and wind speed data for industrial manufacturing. At our April 2009 meeting in Baltimore, Maryland, a representative from the American Sugar Refining Company described the importance of hydrographic data and forecasting to its Domino Sugar Refinery in Baltimore, one of the largest plants of its kind in North American. Hydrographic data provided by NOAA and other agencies to the refinery has traditional applications, such as ship movements and tidal surge predictions for dockside facilities. It is also used to predict unsafe winds for operating the large cranes that unload the refinery's bulk carriers, for industrial water withdrawals, and for water discharge (to ensure the ambient water temperature is within acceptable levels). It was recommended that the development of more predictive trends, with a longer lead-time and in a more useable format, would assist manufacturers like Domino by warning of situations (wind, waves, and water heights) that make it necessary to shut down a facility.

Accurate, up-to-date hydrographic information may provide practical solutions to multiple-user conflicts. At an HSRP meeting in 2008, experts from Florida's Coral Reef Conservation Program and the National Oceanographic Institute separately noted that the Port of Miami's chart designated ship anchorage was located in an area where vessel anchors and their chains destroyed significant coral reefs critical for habitat, biodiversity, and for controlling coastal erosion. To help the Port of Miami Harbor Safety Committee Anchorage Working Group locate a new anchorage away from coral reefs, NOAA has provided the Coral Reef Institute with recent bathymetric data for this anchorage and will send updated charts. By working together to locate new anchorages, port officials and conservationists can maintain safe vessel operations for the port *and* protect one of Florida's key marine resources.

The HSRP has also heard from several coastal managers on the importance of working with NOAA to use the highest quality hydrographic information for seafloor and habitat mapping, resource management, marine spatial planning, and inundation modeling. With a renewed focus on offshore renewable energy, sand mining for beach nourishment, and other non-traditional ocean uses, states are increasing their role in partnering with NOAA and other federal agencies. Information from the Commonwealth of Massachusetts and the State of California on the importance of ocean and coastal mapping for their respective states was presented to the HSRP. They discussed interagency seafloor mapping projects, and the progress being made, both procedurally, in terms of uniform protocols and datums, and spatially, with an increase in nearshore high-resolution mapping coverage.

The HSRP finds that scientists can also benefit from the ancillary data that NOAA collects with its hydrographic surveys. In October 2009, reiterating comments she made at a 2006 HSRP meeting, a fish biologist with the Alaska Department of Fish and Game, Division of Commercial Fisheries, expressed a desire for more NOAA data.

"Within the last two or three years, we've been using NOAA's multibeam bathymetry where available for survey planning and for determining available habitat," said Margaret Spahn. "[This] works toward stock assessments and fisheries management."

Margaret and others use the NOAA data to help them assess numerous Alaska fisheries, including lingcod, rockfish, spot shrimp, sidestripe shrimp, weathervane scallops, cod, black cod, and tanner crab.

Multibeam surveys collect data that help characterize sediments of essential fish habitat.

Fisheries experts are also interested in using the backscatter data collected with multibeam surveys to characterize soft sediments (an essential fish habitat) as well as rocky reef areas. Clearly, opportunities exist for NOAA and fisheries scientists to combine resources and jointly map for both navigation and fish population monitoring.

NOAA's marine transportation services are critical to mariners for safe navigation, and are just as useful to the coastal manager facing the challenges of day-to-day decision-making. The HSRP supports NOAA's interest in the relationship between marine transportation and the health of coastal ecosystems, communities, and economies. Coastal areas have intrinsic economic, cultural, and aesthetic value; and NOAA's Navigation Services offer baseline data to monitor the health, status, and changes in these areas, so that they can be conserved, adapted, or restored. NOAA nautical charts and hydrographic and geodetic surveys play key roles in many non-navigational uses; and recently, additional applications related to tides, water level, and datum information have emerged as well. These new applications — including emergency response, wetlands restoration, land-use project management, and climate change and sea-level trend analyses — help protect lives, save property, restore the environment, and maintain the economic vitality of the nation.

Recommendation 5

The HSRP recommends that NOAA expand efforts to deliver its navigation products and services more quickly, and increase outreach to make navigation and non-navigation users more aware of the NOAA mapping and data resources available to them.

NOAA NEEDS TO REACH OUT TO RECREATIONAL BOATERS

NOAA's outreach efforts tend to target stakeholders tied to commercial activities in the U.S. marine transportation system. But in 2008 alone, some 70 million recreational boaters traveled the same waters in motor yachts, fishing boats, ski boats, sailboats, and everything in between. In addition, about 18 million boats were in use in 2008, and 12.6 million boats were state-registered.

NOAA's navigation data is quite accessible to the recreational boater. Undoubtedly, these user-friendly products — including the NOAA Electronic Navigational Chart, the Pocket Chart, small-craft charts, and the Coast Pilot® series — have helped many recreational mariners navigate safely. A 2009 survey of CO-OPS data users found that 36 percent are recreational boaters.

In many instances, recreational boaters may operate with a false sense of security. As the consumer market for marine electronics, GPS navigation systems, and chart plotters continually expands, boaters presume that the data they zoom in on is as accurate as the GPS systems in their cars. This is not necessarily the case. Electronic charts are often only as good as the paper charts they were built on. Depending on a boater's location, the NOAA backlog of charting and surveying work can render these products slightly, or even grossly, inaccurate. The information could be years, even decades, out of date.

While the commercial shipping navigators may have a professional awareness of NOAA charting shortfalls, the average recreational boater probably does not. The tragic results are borne out in the statistics. The U.S. Coast Guard reports that for 2008, recreational boating deaths (the largest marine category) increased to 709, from 685 in 2007.

For boat insurers, two of the most common types of claims are "striking a submerged object" and groundings, two scenarios in which accurate NOAA surveys and charts can play a major role. An estimated 104,000 claims a year are filed, with losses of about $470 million. With broader use of updated charts, these losses could be reduced.

NOAA needs to enhance its outreach efforts to recreational boaters and educate them on the benefits and limitations of electronic charts. In conjunction with boating associations BoatU.S., the U.S. Coast Guard Auxiliary, and the U.S. Power Squadrons, NOAA outreach would go a long way toward improving recreational boaters' understanding of the uncertain marine environment in which they are operating.

Boaters who use NOAA charts have a better chance of avoiding groundings and other other accidents. Photo courtesy of Take Me Fishing.

Additional Resources

NOAA's Hydrographic Survey Priorities reflect recommendations made by the HSRP and other stakeholders, such at the U.S. Coast Guard, pilots, and port authorities. Updated every year or so, the document is available at http://www.nauticalcharts.noaa.gov/hsd/NHSP.htm

The Integrated Ocean Observing System, or IOOS®, is a coordinated network of people and technology that work together to compile and distribute data on our coastal waters, Great Lakes, and oceans. For more infomation: http://oceanservice.noaa.gov/facts/ioos.html

NOAA PORTS® Ocean Observing System in Houston/Galveston produce big economic benefits. For a summary of the report, go to http://oceanservice.noaa.gov/news/pressreleases/may07/supp_050407.html

Socio-Economic Benefits Study: Scoping the Value of CORS and GRAV-D is available at http://www.ngs.noaa.gov/PUBS_LIB/Socio-EconomicBenefitsofCORSandGRAV-D.pdf