**Meeting Summary  
Hydrographic Services Review Panel  
September 11-13, 2017  
Portsmouth, NH**

*Monday, September 11, 2017*

On the call of the Designated Federal Official (DFO), Rear Admiral Shepard M. Smith, NOAA, the Hydrographic Services Review Panel (HSRP) meeting was convened on September 11-13, 2017, at the Sheraton Portsmouth Hotel, 250 Market Street, Portsmouth, NH. The following report summarizes the deliberations of this meeting. The agenda, presentations, and documents are available for public inspection online at

<http://www.nauticalcharts.noaa.gov/ocs/hsrp/meetings.htm>

Copies can be requested by writing to the Director, Office of Coast Survey (OCS), 1315 East West Highway, SSMC3, N/CS, Silver Spring, Maryland 20910.

**Welcome and Meeting Overview**

**Bill Hanson, HSRP Chair**

The meeting was called to order at 8:33 a.m. Chair Hanson welcomed the attendees and expressed the Board’s appreciation for NOAA and NOS’ efforts in fulfilling their national emergency response mission in the wake of Hurricanes Harvey and Irma. Vice Chair Miller remembered former HSRP member Dr. Michele Dionne who passed away four years prior and was head of the National Estuarine Research Reserve in nearby Wells, Maine. CAPT Andy Armstrong requested a moment of silence in recognition of the 16th anniversary of the 9/11 terrorist attacks.

After eight years on the Panel, Chair Hanson will be leaving the HSRP after this meeting. He announced that Joyce Miller will be the new HSRP Chair and Ed Saade will be the new Vice Chair. Kim Hall will also serve as Co-Chair of the Planning and Engagement Working Group.

RDML Shepard Smith welcomed everyone to the meeting and announced three new members that will be joining the HSRP: Sean Duffy, Jr., Executive Director of the Big River Coalition; Julie Thomas, Program Manager for the Coastal Data Information Program at Scripps Institution of Oceanography, and Executive Director of the Southern California Coastal Ocean Observing System; and CAPT Ed Page, Executive Director of the Marine Exchange of Alaska. In addition to Chair Hanson’s departure, this will also be the last meeting for members Lawson Brigham and Scott Perkins. RDML Smith reviewed the agenda for the meeting and expressed his thanks to the participants and staff that put it together. He acknowledged that fewer NOS staff members were present due to the hurricane response.

**Welcome from New England Congressional Staff**

Kerry Holmes read a statement on behalf of New Hampshire Senator Maggie Hassan acknowledging the HSRP’s critical role in improving NOS products and services to ensure all users of the nation’s waterways have the necessary tools to navigate safely and efficiently. A well-functioning Marine Transportation System is critical for global commerce and the U.S. economy.

Elizabeth Wester read a statement on behalf of the New Hampshire Senator Jeanne Shaheen regarding the importance of the stewardship and sound management of the ocean coast for New Hampshire residents, tourists, and a variety of industries. Focusing on research and new hydrographic technologies will facilitate greater understanding of the ocean and how it can be made safer for private and commercial travel. Modernizing the way we survey, chart, and navigate our oceans will enable better decision making for life in coastal regions.

Patrick Carroll read a statement on behalf of New Hampshire Representative Carol Shea-Porter supporting the Panel’s mission to promote the importance of the U.S. ports to the nation’s economy and the need to secure them. The accuracy of navigation services is vital, but particularly challenging in New England. Representative Shea-Porter is committed to working hard to ensure that NOAA is adequately funded to maintain its critical navigational services and hoped that NOAA will continue to give strong support for the JHC.

Chair Hanson read a statement on behalf of Maine Senator Susan Collins expressing her appreciation for the Panel’s work towards contributing to our understanding and stewardship of America’s oceans.

Video of a statement from Maine Representative Chellie Pingree was played commending NOAA’s navigational services’ exceptional job collecting and distributing vital information for the state’s residents. As a member of the House Appropriations Committee, Representative Pingree will continue advocating for the resources NOAA needs to carry out its important mission.

Chair Hanson said that coastal communities across the country are facing issues similar to New England’s. There is bipartisan support in Congress on coastal and ocean issues and he encouraged the staffers to build coalitions to address them.

**Paul Doremus, Acting Assistant Secretary for Conservation and Management, NOAA, and Deputy Assistant Administrator for Operations, NOAA Fisheries**

Dr. Doremus discussed the extreme weather events in Florida and Texas. Preparation, response, and long-term restoration activities require extensive collaboration across government, private sector, academic sector, and the society at-large. HSRP plays a pivotal role in linking those communities around the programmatic areas for hydrographic services. The Panel has put forward a very impressive set of recommendations, issue papers, and comments on a wide variety of issues facing NOAA and these have been influential to the agency’s thinking and operations.

NOAA is in the middle of an extended transition. Dr. Tim Gallaudet, former Oceanographer of the Navy, was recently appointed to be Assistant Secretary for Earth Observations and Predictions. He is very knowledgeable about the physical infrastructure needed to observe the environment in all its dimensions. As NOAA’s number two position, it is expected that Dr. Gallaudet will replace Ben Friedman as Acting Administrator. NOAA career executives are maintaining operational continuity for the agency. Commerce Secretary Wilbur Ross has a very strong focus on trade, which has presented an opportunity to talk about the various ways commerce depends upon NOAA’s services. The Secretary is also interested in building domestic capacity in seafood production, which could come largely through the expansion of aquaculture activities. NOAA is looking forward to collaboration with the administration on addressing the shortcomings in the nation’s infrastructure. Dr. Doremus commended the work of the Panel in drawing attention to the infrastructure dimensions that the hydrographic survey enterprise contributes to. NOAA is and will continue to be committed to getting the best value for the public’s investment in navigation services. The agency is looking to extend the Long Beach precision navigation pilot and hopes to make similar improvements in the Gulf of Mexico. The UNH-JHC/CCOM effort is a perfect example of the type of partnership that is needed to be successful in this domain and has been a major contributor to NOAA’s advancement over the recent years.

**Larry Mayer, Director, Center for Coastal and Ocean Mapping, University of New Hampshire; and Co-Director, NOAA/UNH Joint Hydrographic Center**

Dr. Mayer provided an overview of the activities of UNH-JHC, OCS, and their industrial partners following the Deepwater Horizon oil spill. UNH-JHC had previously worked with industry to develop a sonar product that would allow them to extract information from the water column that would be relevant to fisheries work. They found it was able to detect gas seeps just a few months before the Deepwater Horizon drilling rig explosion, which was on April 20, 2010. Dr. Mayer described in detail the course of events leading to the discovery of a giant plume forming below the surface. The wellhead was approximately 1,500 meters depth. The Secretary of Energy’s Review Panel came up with a plan for capping the well but they needed assurance that the sonar would be able to detect the slightest gas leak. Dr. Mayer’s team agreed they would be able to and after the capping operation, found a small leak coming from a scratch on a metal-to-metal flange releasing a few bubbles a second. They monitored the leak and it turned out to be fine. Once a multibeam system was brought to the site, the team was able to get a better picture of the various gas seeps. After further enhancements, the software has become useful for oil and gas exploration, locating hazards, and scientific research.

**Unmanned Systems for Hydrographic Surveying**

**Carol Lockhart, HSRP Technology Working Group Co-Chair,** introduced and moderated the panel looking at how industry is moving forward with autonomous systems to serve mapping, surveying, charting, and marine navigation.

**CAPT E.J. Van den Ameele, Chief, NOS OCS Coast Survey Development Laboratory,** discussed OCS’ draft Autonomous Systems Strategy. With over a decade of experience with autonomous and unmanned systems, OCS has developed a strategy for moving forward that looks to academic and industrial partners to help fulfill its objectives. The strategy is still pending final comments and review. As OCS looks to how autonomous systems can be leveraged, they consider three focus areas: (1) critical underkeel clearance areas in ports, approaches, corridors, and passes; (2) reported or observed chart discrepancies; and (3) systematic, interdisciplinary seafloor mapping. The Arctic is also a priority and these systems will have a key role in fulfilling NOAA’s mission there. CAPT Van den Ameele gave an overview of NOAA’s unmanned work to date using small and large AUVs and USVs, initially using them as force multipliers and eventually exploring whether they could be used for the typical missions of a hydrographic survey launch or ship. Key findings from a recent chartered ASV survey mission include: dedicated Launch & Recovery Systems are necessary to ensure the safety of equipment and personnel; staffing is consistent with manned survey launches and can require new skill sets; the current state of autonomy and situational awareness is rudimentary and requires supervision from a manned platform; and limits in bandwidth and range dictate operational concepts. There are some environments, such as busy ports, where unmanned technologies will not be the best tool for the job.

Under the autonomy assessment framework that NOAA has been utilizing, five levels of technological maturity are assessed in three categories: vessel autonomy, operational autonomy, and sensor autonomy. The highest level of autonomy, Level 5, requires a holistic view of the vessel in which the three categories merge and the vehicle can make decisions based on a deliberative consideration of possibly competing objectives. Most currently available technologies are rated as Level 1 or 2. Key findings that have helped drive the Autonomous Strategy forward include: unmanned systems require the development of new technologies; unmanned systems must provide new capabilities or mission profiles; they require skilled personnel to operate and maintain; they do not diminish the need for ships; they require unique shipboard infrastructure; and they require supervision, as autonomous navigation is rudimentary. OCS’ Strategy recommends: the continued development of technology and processes that support unmanned operations and enable unmanned systems; standing up an operational unit with expertise in unmanned systems; collaborating with academic and industry partners on developing the technology; and contracting for the conversion of one or more NOAA survey launches to dual-mode (optionally manned) capability.

**Thomas Chance, President and Chief Executive Officer, ASV Global,** provided an overview of unmanned surface vessels from a manufacturer’s perspective including a more technical discussion of ASVs, what challenges there are moving forward, and where the industry is heading. He reviewed the unmanned marine vehicles ASV Global offers, which have primarily been used for work in defense. To date, they have delivered 93 systems from 6’ to 42’ in length. These operate in a supervised autonomous mode with radio telemetry or satellite. ASV Global has done extensive work on payload integration, improved Launch and Recovery Systems, and collision avoidance. Mr. Chance discussed the features available on their ASV systems and some of ASV Global’s payloads. The company has received a lot of interest in mid-frequency multibeam and they will soon be installing a seismic compressor on a 40’ boat for Shell’s seismic testing.

ASVs have repeatedly demonstrated benefits in hydrography including substantial production increases and safety. Until autonomy is perfected, ASVs must remain supervised and will require new training. Ships and personnel cannot be eliminated. ASV Global’s C-Worker 5 has proven to be a great hydrographic force multiplier and will be further enhanced. NOAA should upgrade its existing launches to be optionally unmanned.

**Doug Lockhart, Vice President & General Manager, Teledyne CARIS, Inc.,** discussed the importance of balancing capital and operational costs, looking at cash flow to understand where and when autonomy currently fits in hydrography, and where it can be expected to fit as improvements are made to autonomous control and processing software. The discussion focused on surface vehicles operating in depths of navigational interest. Revisiting the levels of autonomy that CAPT Van den Ameele discussed, Mr. Lockhart stressed that the situation gets more complicated for hydrography. Integration and sensor fusion really matter. Teledyne has seen many technologies that are very advanced in terms of their autonomous capabilities that have not been demonstrated in an operational environment. As a technology advances, many projects flounder in the “Valley of Death” between research funding and commercial investment. In the hydrographic industry, the commercial pull is much smaller than in other areas, such as automobiles. Many advanced technologies have been proven but no one has figured out how to get them into the marketplace. HSRP could be very helpful in identifying these stalled projects.

Mr. Lockhart discussed the risk benefits of autonomous systems. Autonomous survey vessels have an immediate benefit of taking people out of harm’s way, which is a strong reason for adopting the technology. He also discussed the productivity and cost benefits of systems operating at higher levels of autonomy. To fully optimize autonomous survey assets, the systems will need to be able to independently analyze the seafloor and direct the vessel based on what it sees.

**Rebecca T. Quintal, Hydrographic Survey & Data Solutions Manager, Leidos,** discussed lessons learned from the development of the Anti-Submarine Warfare Continuous Trail Unmanned Vessel (ACTUV) and the challenges for autonomous surface vessels operating for long durations including avoiding hazards, COLREGS compliance, and the need for redundant systems. The ACTUV program was undertaken to build and demonstrate an unmanned surface vessel with ocean-spanning range, months of endurance, and the capacity for a substantial payload. It needed to demonstrate high-level autonomy for independent operations under sparse supervisory control and comply with COLREGS (Compliance with International Maritime Organization Rules for Preventing Collisions at Sea). The program is currently at the end of the first year of a two-year sea trial phase and is transitioning from DARPA to ONR, which means it has been deemed successful. ONR will decide how best to deploy it to the fleet. Open Systems Architecture (OSA) was a keystone for the development of the system’s platform. OSA allows for the incorporation of line following capabilities that are needed for hydrographic surveys. The system needs to be able to monitor its own health status and what the optimal performance is for each item on board.

Ms. Quintal discussed asset protection, which will be very relevant to any unmanned shipping vessels. Protecting the intellectual property of the technologies is also a key consideration. Robust communications and cyber-security are essential to effective and successful autonomous platforms. Autonomous platforms and collaborative teams of manned and unmanned autonomous platforms can execute current missions at a lower cost and risk profile, as well as enabling new missions.

**HSRP Q&A**

Member Saade asked about launches without a mother ship. Mr. Chance responded that the optionally manned C-Worker 12 will be set up for that and they plan to test it in the coming months. Dr. Mayer said that the infrastructure to support autonomous vessels is still in the very early stages of development. The HSRP should be considering what kind of port infrastructure they think will be necessary. Ms. Quintal added that there is also a long way to go in updating national and international maritime rules and regulations to allow for legal unmanned operation of these platforms. Mr. Lockhart said that the autonomy levels should give some sense of when these developments will happen; Autonomy Level 4 should be sufficient if you have good a priori information on the geometry of the port; Autonomy Level 5 should be able to get you around a port whether you have any a priori information on it or not.

Member Maune asked how one positions underwater autonomous vehicles. Mr. Chance said ultra-short baseline acoustic positioning is usually used to position them relative to the mother ship. Inertial navigation systems and Doppler Velocity Logs can help figure out which way the system is travelling, but present practical challenges. Underwater GPS systems are available but very expensive. Mr. Lockhart added that Simultaneous Location and Mapping technologies will come along and help many of the underwater navigation issues.

Vice Chair Miller said redundancy is a good philosophy but is not necessarily possible on a small vessel. She said she has yet to see some of the practicalities about going to sea addressed. Ms. Quintal said cost-benefit analyses are used to determine if another level of technology is needed or if redundant systems are sufficient to reduce risk. $20M does not compare to the cost of a submarine, so the Navy will need to determine at what point they believe that, in certain cases, the vessels are disposable.

Member Saade noted that there has been a tremendous amount of vandalism on meteorological moorings. Mr. Chance said there is a lot you can do on an unmanned boat’s design to minimize piracy and tampering.

Member Brigham said that the use of smaller ASVs with survey vessels (whether manned or unmanned) would be much more cost-effective and less manpower-intensive in frontier areas. CAPT Van den Ameele said NOAA is trying to determine how many ASVs can be monitored at once for maximum effectiveness. Mr. Chance said one of their customers is deploying eight ASVs from the mother ship at a single time.

Chair Hanson noted that this is a fast-moving area that the Panel should keep up with because the situation could change dramatically in six months.

**Public Comment**

RDML Gerd Glang, Director, IIC Technologies, asked Dr. Mayer how NOAA has applied the lessons learned from the Deepwater Horizon response. Specifically, are multibeam systems and software now available aboard more NOAA ships to be effective in responding to future events where observation of oil leaking into the water column needs to be understood? Dr. Mayer said he believes there has been an expansion of the capability and most of NOAA’s large ships are equipped with multibeam systems. There are many more options available if a similar situation should arise and the software development has progressed significantly.

Guy Noll, Esri, said the HSRP needs to weigh in on the importance of shore-side infrastructure, as was demonstrated in recent extreme weather events. Many coastal regions may not be as well-understood as they need to be. He asked Dr. Mayer to expound upon his comments about enhanced port infrastructure. Dr. Mayer said that, as autonomous technologies continue to advance, a parallel shore-based infrastructure needs to be developed to their efficiency and utility. Mr. Noll added that state Departments of Transportation have frameworks and data infrastructure for autonomous automobiles to traverse, which is augmented by the remote sensing that the vehicles are doing in real time. Something similar needs to be created for the seaway.

**Adjournment**

The Panel stood in recess at 12:17 p.m.

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*Tuesday, September 12, 2017*

The meeting was called to order at 9:04 a.m.

Chair Hanson welcomed everyone to the second day of the meeting. RDML Smith reviewed the Panel’s site visit the previous day to the hydrographic facilities at the University of New Hampshire.

Rich Edwing discussed a hardened tide gauge in Barbuda. A video of the station operating during Hurricane Irma provided an illustration of the value of hardened tide gauges.

Chair Hanson reviewed the presentations from day one and opened the floor for Panel members to share their thoughts. Vice Chair Miller asked what percentage of the technology developed at UNH successfully makes it over to industry. CAPT Armstrong said he suspects about 30% of the technologies developed there in recent years make it to industry. Much of what is not immediately adopted will eventually be incorporated into other technologies.

Member McIntyre said there is a danger of too much clutter in the visualizations they saw demonstrated and end users should be engaged on what they would want to see included. Member Shingledecker said she would like to see how the technology could be used to help recreational boaters be more compliant with COLREGS. She would also like the HSRP to interact more with students to help them understand the realities of policy. Member Saade suggested UNH make a series of YouTube videos demonstrating their capabilities in a way that would appeal to the general public.

**Working Group Report Outs and Discussion**

**Technology Working Group**

Member Saade said the most significant product of the working group since the previous meeting is the position paper on the transfer of technology from NOAA, UNH and other labs, over to industry. The paper includes examples demonstrating the return on investment of tech transfer. The working group would like to continue technology panels at future meetings and asked the HSRP to provide input on what subject to address next.

**HSRP Consensus Comments on the OCS Draft Autonomous Systems Roadmap**

Member Hall led the discussion to complete the Panel’s consensus comments on OCS’ draft Autonomous Systems Roadmap. One of the key overarching comments was whether it should be a strategy or a statement on OCS’ autonomous enterprise. The intent and scope of the document needed clarification. Panel members suggested including cost and risk benefits, how autonomous systems will address OCS focus areas, the logistical challenges of getting large unmanned vehicles back on board ships, and mention collaborating with the Naval Oceanographic Office to access their expertise with unmanned systems. CAPT Van den Ameele, the author of the roadmap, responded that he intends to include safety benefits in the final edition. The intent of the draft plan was to state where NOAA and OCS want to go with automated systems and invite industry and academia to assist in getting there. Member Hall suggested keeping the roadmap general enough that other areas of NOAA can adopt parts of it and add an addendum that dives into the specifics of what OCS would like to see.

After some discussion, the Panel wanted to leave it to NOAA to decide whether to expand the scope of the document to include unmanned aerial systems or to address those in another venue.

Vice Chair Miller was concerned that the document glosses over personnel requirements. Member Gee added that a key part of NOAA’s planning going forward with this strategy should be determining what skills are needed, how to recruit and train the workforce, and what effect autonomous systems will have on the existing workforce.

Member Brigham said that the IMO is going to be the central organization to regulating the surface vessels and that NOAA’s involvement on IMO committees should be a part of the strategy. CAPT Van den Ameele agreed that the document does not address the regulatory or policy side of the issue.

Member Lockhart raised the issue of data processing capabilities. Though it may not belong in the OCS plan, data management is a topic the Panel should address.

Member Brigham said the term “roadmap” may be preferable to “strategy” because it is less definitive and more flexible to evolutions that will take place in the coming years.

Member Kelly said there should be a synergistic development with end users, data collectors and producers to create a faster track towards usable products.

**Technology Transfer Issue Paper**

Member Saade, Technology Working Group Co-Chair, led the discussion on the issue paper covering technology transfer. Member Shingledecker wanted to ensure that the R&D in NGS’ mission areas are sufficiently covered in the paper. Ms. Blackwell said that as it relates to UNH-JHC/CCOM, the activities of the Remote Sensing Division are covered. Chair Hanson suggested mentioning collaborations with other agencies and highlighting efficiencies. Mr. Edwing suggested mentioning NOAA’s Emerging Technologies Workshop. Members thought the paper should clarify that JHC/CCOM is an example of a successful structure for tech transfer rather than the subject of the paper itself.

Member Maune asked if the paper should mention the R&D projects underway within NGS, such as the use of differential interferometric synthetic aperature radar for mapping subsidence rates. Ms. Blackwell responded that a separate paper should be created to highlight those efforts and the work being done at JALBTCX.

**Precision Navigation Issue Paper**

Member Hall presented the precision navigation issue paper and asked for comments. The Panel voted unanimously to accept it, pending minor edits.

**Future Issue Papers**

Member Maune led the discussion about topics for future issue papers. Member Thompson had recommended to him that an issue paper on licensure or certification of hydrographic surveyors was needed. Vice Chair Miller suggested first having a panel on the topic to learn more, potentially at the next HSRP meeting. Member Hall said getting a process in place for prioritizing subjects would be helpful. Issues to be prioritized include licensure of hydrographic surveyors, information infrastructure, education, crowdsourcing, autonomous vehicles, data management, offshore leases, disaster response, and an internal communications strategy. Member Brigham said that education and licensure could be a subject for a working group.

**Brief Updates**

**Jeff Lillycrop, Technical Director, Engineer Research Development Center, U.S. Army Corps of Engineers**

Mr. Lillycrop provided an update on USACE’s R&D activities, focusing on eHydro and utility crossings. eHydro is a tool used to provide channel reports to NOAA, calculate metrics for reporting to Congress on the condition of navigation channels, and to plot the data. The tool has greatly improved standardization and made all of these functions very easy to do, as well as creating metadata that allows USACE to track these as enterprise assets. There are currently more than 24,000 surveys in USACE’s database collected over the last few years. The Corps is focused on getting more consistent application of the tool and appending it so that the data is accessible to NOAA. There are efforts underway to move it to the cloud to significantly improve performance for users and provide data to users more rapidly. It is USACE policy that every District is required to use eHydro. Another application the Corps is working on that may have great value to NOAA is PLOVER, a single, authoritative 3D pipeline dataset that is nationally correlated to permits. USACE provides the dredging industry information on pipelines they know to be crossing channels and it is the industry’s responsibility to validate the information. PLOVER will also eventually be moved to the cloud for better performance. Testing by the Galveston and Mobile Districts should be completed by the end of FY2017 and USACE hopes to have it deployed nationally by the end of FY2018. Because of the information contained in it, it is not intended to be a public database.

**CAPT Rick Brennan, Chief, Hydrographic Surveys Division, NOAA**

CAPT Brennan provided an update on NOAA’s fleet replacement plan and precision navigation efforts. NOAA has received funding to begin the process of regenerating and reinvigorating their shipbuilding program. They have established an interagency agreement between NOAA and the Navy, who administered the contracts for building NOAA ships in the past. They expect to finalize requests for proposals for the preliminary design by early 2018, with the final selection in 2020. CAPT Brennan provided a recap of precision navigation from OCS’ perspective. With their current funding, OCS is moving on a couple of initiatives. One is to maintain the existing precision navigation project in Long Beach. With their new portable pilots units, the pilots there are using the data much more than they had previously and NOAA is now getting meaningful feedback. Another precision navigation project is focused on the Mississippi River, the largest port complex in the world and America’s most congested waterway. USACE surveys the river every ten years for their hydrodynamic modeling purposes. If funding permits, NOAA would endeavor to survey it every ten years also, interleaved between the Corps’ surveys. The data will be interoperable with USACE’s. NOAA intends to acquire bathymetry and shoreline infrastructure from Baton Rouge south in the next field season, providing a full rebaselined assessment of the river that can be input to navigation projects. The effort to rescheme the nautical charts will begin in New York. NOAA is building a bathymetric database for the New England region to support high-resolution navigation products. This also lays the foundation for providing gridded data products to mariners in the future.

**HSRP Q&A**

RDML Smith said eHydro is the critical foundation for future charting practices and better ways of charting channels. NOAA is also very excited about PLOVER and RDML Smith invited USACE to help OCS figure out the best way of charting that information. USACE and NOAA are jointly committed to the proper use of the data and being clear in the way it is distributed. Mr. Lillycrop said that while not all USACE surveys are conducive to the needs of NOAA and mapping, they are committed to trying to find ways to do surveys that would be useful to NOAA. USACE also has some work to do educating its workforce about the requirement to use eHydro.

Vice Chair Miller asked if NOAA was going to be using the AGOR design for new ships. CAPT Brennan said they will be using those specifications but multiple designs could be proposed that meet them. Vice Chair Miller also asked if there has been any clarification on what the end usage for the ship will be. CAPT Brennan did not believe that a ship has been named that will be replaced by the new vessel. What is clear is that the request for proposals did not meet the needs for NOAA’s hydrographic program because it did not require the capability to carry launches.

Member McIntyre said that on the Columbia River, the pilots use USACE surveys even though they are not always calculated for navigation. She is excited to hear that the agencies are working together and would like to have the data inputs streamlined and verified so pilots know what they are working with.

Chair Hanson asked the panel members to give brief updates on the disaster response underway in Florida. Member Hall asked if the money being put towards disaster relief would divert from other projects or if it was left over on contracts. CAPT Brennan said it is not new money, it is being redirected from existing priority areas.

**Public Comment**

Guy Noll commented on how autonomous navigation could help recreational boaters operate more safely. Incremental advances similar to what automobile manufacturers are doing with automatic breaking and lane tracking would be best. Good port infrastructure will be key to advancing autonomy. CAPT Brennan said that if ports could get instrumented to provide the information NOAA needs to get commerce moving, it would be a good first step. It would be even better if a network positioning system could be put in place. If some common standard for positioning was adopted, it could benefit pleasure boaters as well. RDML Smith added that Navigation Ready Nation is similar to The Weather Service’s Weather Ready Nation and he will work with staff to circulate some of the lessons learned from that exercise.

**Navigation Services Program Updates**

**Rich Edwing, Director, Center for Operational Oceanographic Products and Services**

Mr. Edwing presented on CO-OPS’ FY2017 accomplishments and their outlook for FY2018. They have begun the International Great Lakes Datum (IGLD) update which will include seasonal gauging and data collection. CO-OPS is now the operator of the Texas Coastal Ocean Observation Network and they have established four new Sentinels of the Coast. The transition from acoustic to microwave water level sensors is ahead of schedule with about 50 NWLON stations having been converted. The three-year Puget Sound current survey is now complete. CO-OPS has integrated The Weather Service’s model overlay into the Tampa Bay hydrodynamic model, adding specialized weather forecast information at points along the navigation channels, wave forecasting, and visibility forecasts to the existing forecast information. CO-OPS added a new PORTS in Matagorda Bay, Texas and upgraded PORTS in Charleston, Delaware Bay, and Chesapeake Bay.

CO-OPS has operationalized the Inundation Dashboard in New York City, NY, Hampton Roads, VA, and Beaufort, NC, allowing users to view past, present, and future conditions when a storm is approaching the coast. CO-OPS has released new regional sea level scenarios that marry up tide gauge and satellite information and updates the ranges of sea level rise. The Lake Erie harmful algal bloom forecast has been transitioned to GLERL for operations, it went live in July and immediately detected a bloom that was occurring. CO-OPS released a new online datums calculator that allows people to figure out their datums. They also developed a visualization tool to show the highest observed water levels.

Looking forward to FY2018. Over the next two years, CO-OPS will be installing seasonal gauges in the Great Lakes to assist with the update to VDatum and the IGLD. Due to flat funding, the planned current survey activities will be smaller than they have been in the past. Current surveys are planned for Kachemak Bay, AK, and South Texas. Five new PORTS will be installed in FY2018. The New York-New Jersey forecast model will be upgraded to incorporate a hydrodynamic model developed by The Stevens Institute. CO-OPS will be planning a concept of operations for total water modeling integration and engaging stakeholders for community modeling efforts.

**Juliana Blackwell, Director, National Geodetic Survey**

Ms. Blackwell presented on NGS’ FY2017 activities and outlined priorities for FY2018. NGS is continuing to work on their outreach and education for the scientific work they are doing. They have updated the NGS website to help orient new users. The Geospatial Summit 2017 was held in April and the presentations and summary report are available on the NGS website. 63% of the GRAV-D collection has been completed and is on track to be finished by 2022. The Aurora Centaur optionally-piloted aircraft was used for the first time for GRAV-D data collection. The aircraft performed extremely well and has the potential to increase efficiency, reduce costs, and improve data quality. NGS performed geoid slope validation surveys in Colorado to validate their airborne gravity data. In support of the Coast Guard’s navigational safety request, NGS performed a topobathy lidar survey in the Florida Keys and delivered the information to Digital Coasts. NGS was able to resolve some imprecisely positioned charting dangers. They will be making the data available for users from a variety of fields, including habitat mapping. In coordination with domestic and international partners, NGS has developed a framework for modernizing the National Spatial Reference System. For the purposes of the modernization effort, NGS is creating new reference frames for four different tectonic plates.

FY2018 priorities. NGS will host an industry day to meet with vendors from the GPS and GIS areas and elsewhere to see how to work together to get the best roll-out of the new datums. NGS will also be defining the motion parameters for the Marianas Plate, re-establishing a comprehensive CORS program, performing a socio-economic study of the Regional Advisor program, and updating the NGS ten-year Strategic Plan that they are five years into. NGS will also be involved in the joint effort performing the 3D Nation study.

**Rear Admiral Shepard M. Smith, Director, Office of Coast Survey**

RDML Smith discussed OCS’ recent effort to change the face of surveying and charting. He briefly discussed the NOAA response to Hurricanes Harvey and Irma. He thanked the Panel for their comments on the National Charting Plan, which received 280 other comments. Many of these were in regards to a rumor that OCS was going to cancel paper chart production. This was never the intention. OCS has a suite of charts serving its purpose and they plan to maintain it until they are no longer necessary. OCS is not planning to design or lay out any new paper charts going forward. They will be announcing a new method for taking data from NOAA’s database and make something similar to a paper chart. A revised final draft of the plan should be available by the end of September.

OCS has been making great progress on externally-sourced data. 32% of the surveys that were charted were not commissioned by OCS and they hope to continue that in the coming years. Through a partnership with the Pacific Marine Environmental Laboratory and Saildrone, they deployed an unmanned system to collect single beam data for three months in the Arctic. OCS continues to refine the Hydro Health Model they use to inform some of the near-term choice for where they survey.

nowCOAST has gotten top priority billing at the Integrated Dissemination Program and is a high priority for The Weather Service. It contains a tremendous amount of information and has proven to be very popular, especially with emergency managers.

**HSRP Q&A**

Member Kelly asked if CO-OPS expects continued expansion of its products, given that every time they add a new system they are taking on maintenance and support obligations. Mr. Edwing said the PORTS program is becoming a victim of its own success. CO-OPS has seen a steep increase in the number of requests for new PORTS and upgrades to existing PORTS. CO-OPS is now at the limit of its capacity to support these systems.

**Adjournment**

The Panel stood in recess at 2:45 p.m.

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*Wednesday, September 13, 2017*

Chair Hanson reconvened the meeting at 8:29 a.m. and asked the Panel to recap the discussion from the previous days and share ideas for what to include in their recommendation letter. Issues raised included education and licensure, managing funding so that future emergency responses do not detract from routine operations, following up on previous HSRP recommendations, and the importance of visualization to convey complex data sets to nonprofessionally-trained mariners. NOAA should take a lead position in promoting oceanographic education and supporting the schools. The letter should emphasize that the issues the Panel addresses are matters of infrastructure.

**Terrestrial and Water Level Datums – The Nation’s Reference Framework**

**Juliana Blackwell** introduced geodetic datums in the context of the National Spatial Reference System (NSRS) and the critical connection that exists between terrestrial and water level datums. Vertical datums are measurements relative to something, but it is important to know what it is relative to if you are going to integrate data sets. The North American Vertical Datum of 1988 (NAVD88) approximates the sea level, or the zero starting point, for measuring elevations on land. Horizontal datums describe points on the Earth’s surface. The NSRS as it currently exists is a set of control points that create a consistent network for vertical and horizontal datums. The two primary datums in use now are North American Datum of 1983 (NAD83) and NAVD88, which were the starting points for everything that has gone into the NSRS. With the advent of GPS and all of the data collected since, we are able to provide a far more accurate positioning framework. In addition to defining and maintaining the NSRS, NGS is tasked with providing users with tools for accessing it. Ms. Blackwell briefly reviewed some of these tools, including the integrated database of published control marks, the Online Positioning User Service, and conversion tools.

The future of the NSRS is being able to support GPS access to NSRS heights. Accurate geoid models are necessary to be able to convert GPS measurements into real world measurements. The Gravity for the Redefinition of the American Vertical Datum (GRAV-D) project is underway collecting gravity information to include in the geoid model that will be the basis for the next geopotential datum. With the data that has been collected in the previous decades, we know that coordinates are going to change with the next iteration of the NSRS. The vertical shifts will be anywhere from close to zero in Florida, approximately a meter in the Pacific Northwest, and up to as much as two meters in Alaska. The North American-Pacific Geopotential Datum of 2022 will allow for a much more consistent sea level geopotential value that is standardized across the U.S. and its territories. Reference frames are being created for the four tectonic plates where the U.S. has some responsibility, the North American, Pacific, Caribbean, and Mariana Plates. In addition, they will be getting a new geopotential datum based on the GRAV-D collections. The new reference system will be time-dependent and geocentric, and closely tied to an international frame.

Ms. Blackwell discussed combining ellipsoidal and orthometric heights. Topography and bathymetry are measured relative to different reference datums. To combine the elevations and the depths seamlessly, we need to know the relationship between the two. A tool such as VDatum allows users to link the vertical datums and blend them together so that they are referenced to a common datum. Surveying on the ellipsoid decouples the tide measurements from surveying, reducing vertical uncertainty. It requires advanced topography of the sea surface that extends offshore and requires validation against existing hydrosurvey techniques.

**Rich Edwing** presented on water level datums. NOS is the authoritative source for these high-accuracy national reference systems. Tidal datums are mathematically standardized reference elevations defined by a certain phase of the tide (e.g. Mean Higher High Water, Mean Low Water). Tidal datums are derived from continuous observations over time at specific tide stations. They are referenced and preserved by fixed and stable points on land. They are local references and should not be extended into areas with different oceanographic characteristics. Mr. Edwing discussed how tidal datums are calculated.

Tidal epochs are the arithmetic mean of the water level phases observed over an 18.6-year lunar nodal cycle. They are computed and published as the National Tidal Datum Epoch. The 210 NWLON stations around the U.S. provide vertical controls. Comparing the information from short-term stations with long-term stations significantly reduces the uncertainty of short-term observations. 324 NWLON stations are needed to provide full vertical control; 114 gaps in the network have been identified and need to be addressed. CO-OPS has been establishing partnerships with USGS, NPS, and others to help fill some of these gaps. The NSRS provides a common vertical reference for local tidal datums and enhances the value of tidal datums for partners. Mr. Edwing reviewed two new datum products: the tidal zoning database and the Tidal Datums Calculator.

**HSRP Q&A**

Member Lockhart asked if the Tidal Datum Calculator is available to the public. Mr. Edwing said they expect a public release by the end of September.

Member Saade asked why Mean High Water and Mean Higher High Water are both tracked and if they confuse users. Mr. Edwing said it may not be necessary for the navigation community, but there are users who require both. NOAA Fisheries and the Corps have Clean Water Act applications and have asked for even more tidal datums to help enforce some of their regulations. Ms. Blackwell noted that legal coastal boundary lines are often determined by states using either MHHW or MHW.

**HSRP Updates**

**3D Nation Survey Update**

**Ashley Chappell, Coordinator, Integrated Ocean and Coastal Mapping, NOAA,** provided the update on the 3D Nation Requirements and Benefits Study, refreshing the National Enhanced Elevation Assessment (NEEA) for ocean and coastal elevation data. The NEEA study conducted from 2011 to 2013 found that 602 mission-critical activities need significantly better data than what is currently available. This led to the establishment of the 3D Nation program, an interagency program led by USGS. 3D Nation is in the midst of an 8-year program to acquire high-quality lidar data across the U.S. The National Coastal Mapping Strategy 1.0 called for a NEEA-like study to understand the costs and benefits of comprehensive ocean and coastal mapping and its contribution to the 3D Nation vision of a seamless elevation dataset from mountains to ocean. Using a survey with follow up, the study seeks to calculate the benefits and extended benefits to users of high-quality elevation data. In the fall and winter of 2017, they will be implementing the survey, working with federal agencies, states, academia, and industry to find out how much 3D data contributes to all of their programs. Surveys should be finished in FY2018. HSRP members were asked to assist in identifying participants, encouraging participation, and to take the survey themselves. The valuation will provide justification for increased acquisition of elevations data.

**Update on the Florida Topographic/Bathy Lidar Study**

Member Maune provided an update on the Florida Statewide Lidar Assessment. The assessment demonstrated that by combining the efforts of federal, state, and non-governmental entities in the NEEA, costs are lower and benefits are higher than if they survey independently. If Florida acted alone, it would justify Quality Level 5 data updated every 6-10 years; by acting together, the NEEA justified Quality Level 2 data updated every 6-10 years. The study identified 30 different standard business uses and asked survey participants to self-select their topo and bathy lidar quality levels and update frequencies required for mission-critical areas, as well as the estimated annual financial benefits if they received higher quality levels and other clarifying questions. In the final analysis, Quality Level 1 topographic lidar, updated every 2-3 years, is the best alternative statewide when considering net benefits for Florida. Counties, Regional Planning Councils, or Water Management Districts can pay higher costs on a case-by-case basis for Quality Level 0. Quality Level 0B topobathymetric lidar, updated every 4-5 years, is the best alternative statewide when considering net benefits. In the majority of cases bathy lidar would not work inland due to the turbidity of the waters.

Member Saade asked if the NGS survey of the Florida Keys met the recommended Quality Level standards. Member Maune said he believed it did.

**Update on Implementation of Externally Sourced Data**

CAPT Brennan provided the update on OCS’ efforts harvesting externally sourced data (ESD). There was a large increase in ESD between 2003 and 2011, mostly from the data collected around the northern Hawaiian Islands. This year, 35% of OCS-processed surveys will be from ESD. Data discovery is a full-time effort that requires a specialized skillset and should not be a collateral duty. OCS utilized 258 externally sourced surveys, consisting of 18,000 square nautical miles within the U.S. EEZ and 683,000 outside of the U.S. EEZ. A large number of these surveys came from academia and the Navy. NOAA divisions outside of OCS also contribute, including NCCOS who has consistently mapped to OCS standards.

RDML Smith asked what level of effort is associated with the process between the discovery of ESD and getting the data onto a chart. CAPT Brennan said it depends on how well the survey meets OCS’ specifications. Though some ESD requires a lot of effort to convert into something useful, the data transformations and validation efforts are worth it when they are in a high-value area. Ms. Chappell added that data may not make it to the chart but could have other uses for OCS.

Member Shingledecker noted that USACE is not on the list of contributors of ESD. CAPT Brennan said that OCS considers USACE data authoritative within the channels so it goes straight to the charts, bypassing OCS’ ESD process.

Member Brigham asked how Coast Guard operations could be better integrated into this effort. There seems to be a great opportunity as the Coast Guard plans its new buoy tender fleet. CAPT Brennan said that, where outfitted, the Coast Guard has been able to provide valuable data. RDML Smith added that there is some value from random track lines but OCS is concentrating their efforts on calibrated systems used by trained observers from other applications, because these will have the highest value. It is important to temper expectations on whether real survey efforts can be replaced with happenstance lines of opportunity. CAPT Armstrong discussed UNH’s project constructing a “trusted system” that includes an echosounder, GPS, and a data processing concept that is initially intended for mega-yachts but could eventually have an application for Coast Guard cutters.

**HSRP Emerging Arctic Priorities Working Group Updates**

**Lawson Brigham, HSRP Arctic Priorities Working Group Chair,** introduced and moderated the panel reviewing Arctic Marine Transportation System infrastructure gaps and outlook, Extended Continental Shelf surveys, and the Arctic Maritime Spatial Data Infrastructure Project.

Senator Angus King, Maine, provided remarks via video message about the importance and challenges of opening up the Arctic. As a matter of policy for Congress and the administration, the U.S. should move forward with acceding to the UN Convention on the Law of the Sea (UNCLOS) treaty. By not doing so, the U.S. is standing outside of the international structure for settling maritime disputes.

**Introduction on the Committee on Foreign Relations Study on Arctic Infrastructure**

**Lawson Brigham** presented on the Council on Foreign Relations Task Force Report from March 2017 on the U.S. strategy in the Arctic. The study states that the U.S. needs to bolster its infrastructure and assets in the Arctic to safeguard its strategic interests, defend its national borders, protect the environment, and maintain its scientific and technological leadership. The report ranks as the highest goal for the U.S. in the Arctic securing rights to 386,000 square miles of subsea resources on the Extended Continental Shelf by ratifying UNCLOS. Other priorities include: funding up to six icebreakers operated by the Coast Guard; improving telecommunications, energy, and other infrastructure in Alaska to support a sustained security presence and economic diversification; deepening work with all Arctic states on confidence building and cooperative security measures; supporting sustainable development for the people of the Arctic; and sustaining robust research funding to understand the profound changes in the region and their impacts on the globe. The Task Force made extensive recommendations for Congress and the presidential administration.

Member Brigham reviewed the HSRP September 2015 Arctic Report issues identified by the working group, and stated that they are still relevant today and may need to be readdressed by the Panel. The working group believed that the only way to get the Arctic charted is to have a specific appropriations line item calling for hydrography, charting, and associated geoid/environmental measurements. Hydrography and charting should be the highest priority for any new Arctic Strategy within NOAA.

**U.S. Extended Continental Shelf Mapping in the Arctic**

**CAPT Andy Armstrong** provided an overview of the 14-year bathymetric mapping program in the Arctic whose goal has been to determine the U.S. entitlement to the continental shelf beyond 200 nautical miles. Though the U.S. has not ratified UNCLOS, much of it is considered by the U.S. to be established international law. Article 76 of UNCLOS redefined the continental shelf of a coastal state and is a mechanism for states to identify the limits of their extended continental shelf (ECS). He reviewed the formulas for determining entitlements. The JHC has been leading the U.S. bathymetric mapping effort in collaboration with several partners under the guidance of the State Department. They believe they have finished the bathymetric mapping needed for determining the Arctic ECS. In the course of mapping, the team made several other discoveries of interest, including large seamounts, indications of hydrocarbon resources, and fundamental new insight on the presence of ice shelf during the glacial period. Diminishing ice has allowed them to consider new mapping approaches in the Arctic and assemble compelling evidence that the foot of the continental slope is actually much further out than expected, which will have significant impact on where the ECS limits are. The team mapped 129,000 square miles of the seafloor in the Arctic, greatly improving our knowledge of the seafloor. Enough data was collected that OCS can begin thinking about new charts in the Arctic.

There are five nations with potential entitlement to ECS in the Arctic Ocean. Overlapping claims are taking place under a fairly amicable diplomatic interaction. The Commission on the Limits of the Continental Shelf reviews the submissions and endorses those with valid supporting data. The U.S. and Canada have significant overlapping entitlements and have not even agreed on the EEZ in this area. All of the data acquired is available on the JHC website.

**International Hydrographic Organization (IHO) Arctic Maritime Spatial Data Infrastructure Project and NGA Arctic Support**

**Keith Dominic, Chief, Maritime Navigation Division and Arctic Source Lead, National Geospatial-Intelligence Agency,** presented. Marine Spatial Data Infrastructure (MSDI) is an infrastructure that promotes interoperability of data at all levels (e.g., national, regional, international) and supports a wider, non-traditional user-base of marine data typically used for navigation. Users from academia or industry can access data without having to refer to nautical charts. The goal is to have users provide information back into the database, improving its overall utility. All of the IHO Regional Hydrographic Commissions are moving towards this model. The Arctic Regional Hydrographic Commission formed an Arctic Regional MSDI Working Group (ARMSDIWG) that NGA currently chairs and held their first meeting in April of 2017. One of the initial focus areas for ARMSDIWG is the Arctic Voyage Planning Guide, harmonizing all of the Arctic states’ individual planning guides, so all of the information required to navigate the Arctic is available in one place.

Two years ago, NGA established an Arctic website to push out all of their public information. They have three public websites up: Wildlife Tracking, Hurricane Support, and Arctic Support. Mr. Dominic reviewed some of the 23 data sets available for download from the Arctic website. NGA, NSF, the University of Minnesota, and other stakeholders partnered to create the first-ever publicly available, high-resolution, satellite-based elevation data map of the Arctic. Another function of NGA is to find world-wide navigational warnings to provide to the Navy and make them available on NGA’s website.

**HSRP Q&A**

Chair Hanson asked Member Brigham where the U.S. stands in terms of Arctic research. Member Brigham said that the U.S. is the world’s leader in Arctic research and probably has the best data. Where the country is lacking is in practical investment in hydrography, geoid and oceanographic measurements, as well as investments in icebreakers and survey vessels. The missing link for the U.S. in the Arctic is the economic connection. He encouraged the HSRP to keep the Arctic working group going in order to influence NOAA’s Arctic policies as much as possible.

Member Maune asked if NGA’s and NOAA’s bathy data are interoperable. Mr. Dominic said the agencies do share data, but NGA is typically looking outside of the US EEZ since the Navy is their primary customer. They do use NOAA data within U.S. waters.

Mr. Edwing asked if there is a part of the Arctic that no country has a claim to. CAPT Armstrong said the places that are not under the sovereign jurisdiction of one of the coastal states are in what is categorized as The Area, the resources of which are managed by a body that is part of the UNCLOS. Within the EEZ the coastal state has an extensive list of rights to the water column and resources therein. In the ECS, the sovereign rights are limited to the resources of the seafloor and the subsea. There is some concern in the research community is that UNCLOS gives coastal states control over marine research in the ECS, so access could become more restricted.

**Public Comment**

Jason Creech asked if there is anything that could be done to get some of the externally sourced surveys closer to being equal and requiring less validation and evaluation by OCS. CAPT Brennan said the work of the IOCM and other collaborations are valuable. OCS is actively reaching out to other communities to provide expertise and personnel when acquisition is done, as well as trying to ensure that the people doing the mapping understand OCS’ requirements on both the quality of data and how it is to be documented. Vice Chair Miller said that assistance in setting up the systems would be very valuable.

Guy Noll asked about opportunities for industry to build off of the VDatum tool. Ms. Blackwell said the transformation parameters NGS has made available through their tools are things they hope vendors will use in any value-added products and services. This is one of the reasons for the Industry Day. Mr. Edwing agreed and added that it is helpful to know what manufacturers are considering so they can make those connections. RDML Smith said that Google and Esri have requested access to VDatum transformations at a more fundamental level so that superbatches of data sets could be transformed without going through a NOAA service. Some of NOAA’s software developers think this may be possible and he invited Esri to work with NOAA to outline what they envision. Mr. Noll said that in order to tie into the modernized NSRS by 2022, industry needs to get started developing products.

Rear Admiral Gerd Glang, IIC Technologies, congratulated Chair Hanson for eight years serving on the Panel. He also thanked Member Brigham and the rest of the HSRP for the great work they have accomplished, especially over the last two years. RDML Smith added his thanks to Member Perkins for his engagement over the last eight years.

Member Saade presented a map demonstrating the rapid expansion of off-shore wind farms on the east coast of America. The importance of site characterization makes geophysical surveys and geotech essential.

**Other HSRP Topics**

**Finalize Technology Working Group Issue Paper and Recommendations**

Vice Chair Miller presented the revised Research and Development Benefits to NOAA and U.S. Industry issue paper and asked for comments. There being none, the Panel voted unanimously to accept the issue paper.

**Finalize HSRP Consensus Recommendations for OCS Autonomous Systems Roadmap Draft**

Member Miller led the discussion on the HSRP consensus comments on OCS’ Autonomous Systems Roadmap draft. The HSRP voted unanimously to accept the consensus comments on the OCS document.

**HSRP Recommendation Letter**

Vice Chair Miller reviewed the draft recommendation letter and asked Panel members for their comments. The Panel wanted to express their appreciation to CAPT Van den Ameele for his work and his presentations to the HSRP and the Technology Working Group, but it was decided not to include this in the letter. The Panel was advised against inviting the Administrator or Acting Administrator to the next meeting in the letter and that a second invitation letter would be drafted for that once the confirmation takes place. The Administrator will also be invited to the PORTS ceremony in Miami just prior to the meeting.

The recommendations were meant to emphasize the infrastructure aspect of the issues at hand. Due to the length of the letter, Vice Chair Miller was looking for suggestions on what could be removed. She will send the draft to members to provide their comments on. The issue papers will be attached as an addendum. Member Brigham said that he would like congressional staffers and others to read the letter; there is a much larger group of stakeholders interested in these matters than just the chain of command.

The Panel agreed with the content of the draft and made recommendations on formatting.

**Other Topics**

RDML Smith said the next meeting will likely be in Miami to coincide with their PORTS dedication. The Washington, D.C. area will serve as a back-up location. They expect to hold the fall 2018 meeting in Alaska. A mid-Atlantic port, such as Philadelphia, will be the site for a meeting in near future. The Panel agreed that staff should move forward with this plan for budgeting purposes.

**Closing Remarks and Adjournment**

The Panel gave their final thoughts on the meeting. Chair Hanson challenged the Panel to aim higher as they go forward. The meeting was adjourned at 2:26 p.m.

**HSRP VOTING MEMBERS IN ATTENDANCE:**

Lawson W. Brigham, PhD Distinguished Fellow, Center for Arctic Policy Studies, University of Alaska Fairbanks

Lindsay Gee Consultant

Kim Hall Principal & Founder, Brizo Maritime Consulting, LLC

William Hanson, Chair Vice President of US Business Development, Great Lakes Dredge & Dock Company

Edward J. Kelly , PhD Executive Director, Maritime Association of the   
 Port of NY/NJ

Carol Lockhart President, Geomatics Data Solutions, LLC

David Maune, PhD Associate Vice President and Senior Remote Sensing Project Manager, Dewberry Consultants

Anne McIntrye Pilot, Columbia River Pilots

Joyce E. Miller, Vice Chair Director of Seafloor Data Services, Hawaii Mapping Research Group Research Group, University of Hawaii School of Ocean and Earth Science and Technology (retired)

Edward J. Saade President, Fugro (USA) Inc. & Regional Director Americas - Marine

Susan Shingledecker Vice President and Director, Environmental Programs, BoatU.S. Foundation for Boating Safety and Clean Water

Gary Thompson Chief, North Carolina Geodetic Survey

**HSRP NON-VOTING MEMBERS IN ATTENDANCE:**

Andy Armstrong Co-Director, Center for Coastal and Ocean Mapping,   
 Joint Hydrographic Center, University of New   
 Hampshire

Juliana Blackwell Director, National Geodetic Survey, NOAA

Richard Edwing Director, Center for Operational Oceanography Products   
 & Services, NOAA

Larry Mayer, PhD Co-Director, Center for Coastal and Ocean Mapping, Joint Hydrographic Center, University of New Hampshire

**DESIGNATED FEDERAL OFFICIAL:**

RDML Shepard M. Smith Director, Office of Coast Survey, NOAA

**NOAA STAFF PRESENT:**

Glenn Boledovich Policy Director and Chief of Policy, Planning and Analysis, NOS

Captain Rick Brennan Chief, Hydrographic Surveys Division

Ashley Chappell IWG-OCM

Greg Dusek CO-OPS

Carl Kammerer NOS/OCS

Lynne Mersfelder-Lewis HSRP Program Coordinator

Jim Rice NOS/PCAD

Erica Towle NOS/OCS

Captain E.J. Van Den Ameele NOS/OCS

Lt. David Vejar NOS/OCS

**SPEAKERS AND ATTENDEES:**

Patrick Carroll Office of Representative Carol Shea-Porter

Eric Cole Woolpert

Thomas Chance Chief Executive Officer, ASV Global

Doug Cockhort TDY

Keith Dominic Chief, Maritime Navigation Division and Arctic Source Lead, National Geospatial-Intelligence Agency

Jeff Donze Esri

Claire Eaton University of New Hampshire

Scott Ferguson University of Hawaii

Will Festerling Joint Hydrographic Center, University of New Hampshire

RDML Gerd Glang Director, IIC Technologies

Kerry Holmes Office of Senator Maggie Hassan

Jeff Lillycrop Technical Director, Engineer Research Development Center

Doug Lockhart Vice President and General Manager, Teledyne CARIS, Inc.

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