INTERNATIONAL HYDROGRAPHIC ORGANIZATION

UNITED STATES OF AMERICA

National Report

South-West Pacific Hydrographic Commission (SWPHC)

16th Conference - Alofi, Niue

(13-14 February 2019)

Office of Coast Survey
National Oceanographic & Atmospheric Administration
http://www.nauticalcharts.noaa.gov

National Geospatial-Intelligence Agency
http://msi.nga.mil/NGAPortal/MSI.portal
https://www.nga.mil/Pages/Default.aspx

Naval Meteorology and Oceanography Command
United States Navy
http://www.navmetoccom.navy.mil
https://www.facebook.com/NavalOceanography/

HYDROGRAPHIC OFFICE/SERVICE

This National Report provides specific information pertaining to individual products and services of primary interest to the South West Pacifica Hydrographic Commission (SWPHC) Region. Three government agencies are primarily responsible for the management of U.S. domestic and international hydrographic products, services, and maintenance.

1.1 Government Agencies with hydrographic responsibilities in the SWPHC Region

1.1.1 National Oceanic and Atmospheric Administration's (NOAA) conducts hydrographic surveys and produces nautical charts and related hydrographic information within the nation's Economic Exclusion Zone (EEZ).

1.1.2 National Geospatial-Intelligence Agency (NGA) provides nautical charts and related hydrographic information globally supporting the U.S. Department of Defense (DOD) and commercial mariners. Serves as Primary Charting Authority to other SWPHC Member States.

1.1.3 The U.S. Navy conducts oceanographic, bathymetric, and hydrographic surveys worldwide to satisfy DOD and national security requirements.

For more information on NOAA, NGA, and NAVY hydrographic activities, see IHO Publication 5.

1.2 United States Open Data Policy – Managing Information as an Asset

Access to data and services, usable to the public, can help fuel entrepreneurship, innovation, and scientific discovery – all of which improve lives and contribute significantly to job creation[1] is the foundation of the U.S. Open data policy. With the exception of some data collected and/or obtained by the U.S. Navy through bilateral agreements, the open data policy has led to the public availability of most hydrographic data, products, and services produced by U.S. Hydrographic Offices (HO's) for data downloads at no cost.

2. SURVEYS

2.1 Surveys in U.S. Waters

NOAA provides nautical charts and related hydrographic information for the safe and efficient navigation of maritime commerce as well as providing basic data for engineering, scientific, and other commercial and industrial activities within the nation's 3.4 million square nautical mile EEZ (US EEZ) and along its 95,000 miles of shoreline.

NOAA is in the process of re-defining how it generates and prioritizes hydrographic survey plans in federal waters. NOAA hydrographic field units or external contractors then conduct surveys to meet these priorities. Data acquired from these surveys must meet the NOS Hydrographic Survey Specifications and Deliverables, in compliance with the NOS data specification guide; NOS reviews and updates the specifications in this guide annually.

The main component of the new hydrographic survey priorities method is the "hydrographic health model." The concept of navigational risk serves as an underlying concept for the hydrographic health model. Navigational risk is the product of the likelihood of an adverse event and the consequence of that event occurring. The model incorporates likelihood parameters such as traffic density, known hazards to navigation, and reported ship groundings to estimate the likelihood of an adverse event. To estimate the consequence of an adverse event, the model incorporates parameters such as proximity to search and rescue stations, proximity to reefs or marine sanctuaries. The model also considers the necessary quality of data to support modern traffic relative to what is currently available, explicitly recognizing that the seafloor changes over time. Seafloor changeability takes into account the frequency of storms, current speed, and accumulation of marine debris, where the quality of data in highly changeable areas decreases faster than the quality of data in less changeable areas. Using historic knowledge of seafloor changeability, the model can also approximate the future quality of survey data and assess how often an area needs resurveying.

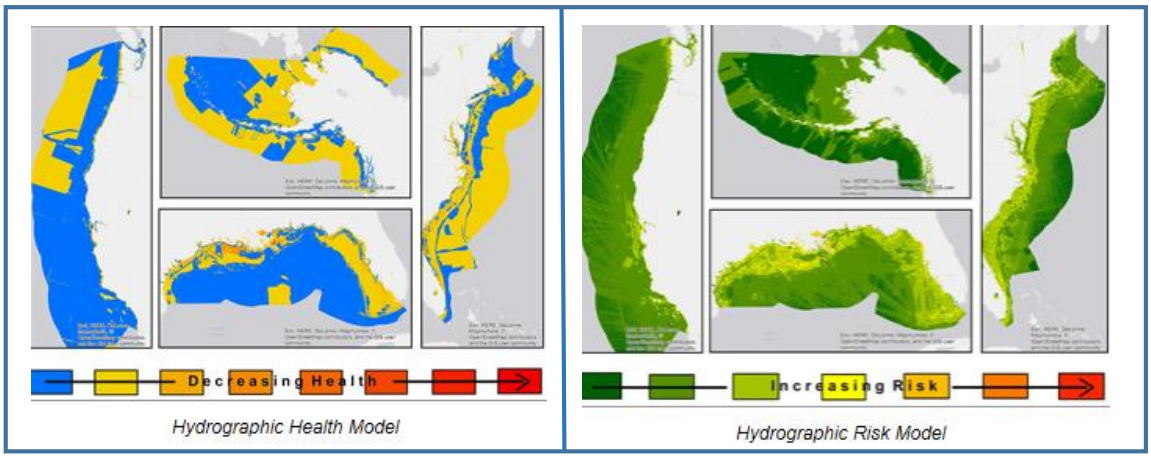


Figure 2.1: Hydrographic Health and Risk Conceptualization

The results of this model are available online in a geographic information system (GIS) interface and summarized in an annual report made available on the internet in FY18. The following website provides current information about the model and survey prioritization: https://nauticalcharts.noaa.gov/publications/national-hydrographic-survey-priorities.htmlFy

Planned surveys will be a combination of either 200% side scan sonar/ object detection multibeam coverage in regions of critical under keel clearance, or 100% side scan sonar / complete coverage multibeam surveys where there is a relaxed requirement for feature detection. At this time, there are no plans for new survey work in 2019, aside from that required by potential storm damage, for the South

Western Pacific Ocean regions where NOAA/OCS is the Agency of Responsibility.

2.2 Surveys outside U.S. Waters

The U.S. Navy conducts hydrographic surveys and outside the United States in international waters as well as in the territorial waters of partner nations through diplomatic channels and international agreements to enhance maritime commerce and security while supporting relationship and capacity building initiatives.

By U.S. Navy, Commander, Naval Meteorology and Oceanography Command Instruction 5510.1, "Disclosure of Information to Foreign Governments and International Organizations", it is USN's policy to treat all data collected through bi-lateral agreements as restricted from public release. Accordingly, Hydrographic Service or Port Authority of the respective country is the appropriate point of contact for inquiries or requests for data regarding any of these surveys.

2.3 U.S. Hydrographic Survey Platforms

1. National Oceanic and Atmospheric Administration (NOAA)

   NOAA survey platforms include six 28-foot survey boats, a research vessel, a LIDAR-capable aircraft, and private contractors and the following ships: NOAA Ship *Fairweather*, NOAA Ship *Rainier*, NOAA Ship *Thomas Jefferson*, and NOAA Ship *Ferdinand R. Hassler*.

   Additional information on NOAA's hydrographic vessels can be found online at: https://nauticalcharts.noaa.gov/about/survey-vessels.html

2. U.S. NAVY (USN)

   The Naval Oceanographic Office (NAVOCEANO), a subordinate command of the Naval Meteorology and Oceanography Command COMNAVMETOCCOM, currently has six Pathfinder Class 100-meter multi-purpose survey ships to conduct oceanographic, bathymetric, and hydrographic surveys in deep-ocean and coastal waters. Each ship carries two 10-meter hydrographic survey launches (HSLs).

   NAVOCEANO also maintains the Airborne Coastal Survey (ACS) capability with the Optech, Inc., "Coastal Zone Mapping and Imaging" LIDAR (CZMIL) system. A Basler BT-67, a refurbished DC-3, serves as the airborne system that carries the CZMIL system. NAVOCEANO's subordinate command, Fleet Survey Team (FST), employs various small craft for survey including two 9 meter Workskiff with amidships transducer moon pools and two Sea Arks, fitted with multi-beam and rapid littoral survey vehicles (RLSVs) which are personal water crafts fitted with a single beam echo sounder and side scan sonar. C-130 aircraft provide rapid deployment transportation capability for all FST craft. FST also maintains a year round stand by "Fly-Away Team" consisting of four personnel and survey gear to outfit boats of opportunity. This capability enhances standard Navy survey requirements and enables the ability to ensure the availability to maintain navigable approach corridors in support of humanitarian aid and disaster relief.

   NAVOCEANO's survey ships, ACS aircraft, and FST have all been utilized in the past to conduct

cooperative hydrographic surveys through Memoranda of Agreements (MOA) with countries in the region."

Since SWPHC15, the U.S. did not conduct any new survey work in the SWPHC regional waters.

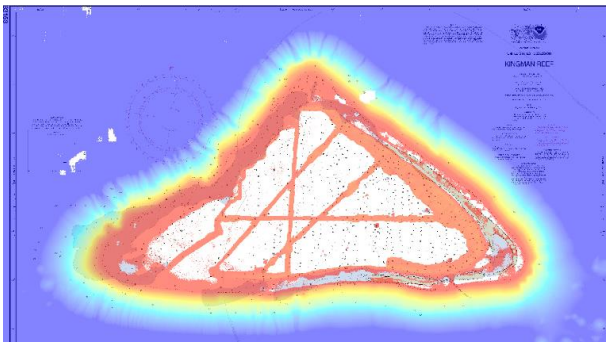


Figure 2-3 Kingman Reef

There are extensive holdings of bathymetric data available, collected for missions other than traditional hydrographic surveying. The review and application of this data will produce a substantial modernization of the data coverage on many US charts.

Kingman Reef is representative of many areas in the South West Pacific, with sparse soundings and substantial white space on the chart, that have been surveyed with modern multibeam sonars, but for purposes other than safety of navigation.

While it will take time to assess and apply these data holdings, US charts will see substantial improvements in the SWPHC region in the coming years.

2 NEW CHARTS AND UPDATES

3.1 National Charting Plan (NCP)

On November 1, 2017, NOAA released the National Charting Plan[2], a strategy to improve NOAA nautical chart coverage, products, and distribution. It describes the evolving state of marine navigation and nautical chart production, and outlines actions that will provide the customer with a suite of products that are more useful, up-to-date, and safer for navigation. It is not a plan for the maintenance of individual charts, but a strategy to improve all charts.

3.2 Electronic Navigational Chart (ENC)

Both NOAA and NGA produce ENCs within the SWPHC. NGA produces ENCs in areas where the U.S. functions as the Prime Charting Authority. ENCs are maintained by updating with new source information as it is obtained from U.S. and foreign partners as available.

ENC's are also available through the International Center for ENC's Distributors, http://www.icenc.org/Distribution.html and listed in the table below:

[2]National Charting Plan. (2017). https://nauticalcharts.noaa.gov/publications/docs/national-charting-plan.pdf

Company	Distributor Type*
Baker Lyman and Co, Inc	CED
C-MAP Norway A/S	CEVAD
ChartWorld	CEVAD
National Geospatial-Intelligence Agency (NGA)	CED
Creative Map Corp.	CED
Maris AS	CED
Primar	CED
Transas Ltd.	CEVAD
Titafin LLC (Subsidiary of Baker Lyman and Co, Inc)	CED
United Kingdom Hydrographic Office	CED
CherSoft	CED

Table 3-2 ENC Distributors and type

*** CED** - Certified NOAA ENC® Distributor - Provides NOAA ENC® data.
CEVAD - Certified NOAA ENC® Value Added Distributor - Provides NOAA ENC® data and reformatted System ENC (SENC) data.

3.4 Raster Navigational Charts (RNC) & Electronic Navigational Charts (ENC) Distribution

The U.S. provides nautical products, services, and web deliveries of digital versions of most data, which are available free to the public.

- For access to survey data: https://nauticalcharts.noaa.gov/data/hydrographic-survey-data.html
- For access to RNC Charts: https://nauticalcharts.noaa.gov/charts/noaa-raster-charts.html
- For access to ENC Charts: https://nauticalcharts.noaa.gov/charts/noaa-enc.html
- For access to the Coast Pilot: https://nauticalcharts.noaa.gov/publications/coast-pilot/index.html

As of April 2014, NOAA no longer produces lithographic paper charts with traditional print cycles for new editions. NOAA applies updates to paper charts on a weekly basis and makes them available for download as Print-on-Demand (POD) products or in paper form from one of 17 NOAA-certified chart-printing agents. (See Annex A for NOAA certified chart printing agents).

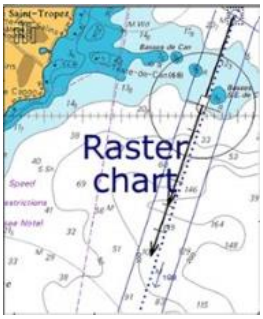
U.S. ENCs are available as free downloads from the internet. Mariners who wish to download ENCs directly and use the data to fuel ECDIS or ECS may do so. ENCs may be obtained directly from the web at www.nauticalcharts.noaa.gov. ENCs are also available through the International Center for ENC's Distributors via the following website http://www.ic-enc.org/Distribution.html.

3.5 Digital Nautical Chart (DNC)

The U.S. produces many DNCs in SWPHC waters. The DNC, produced by NGA, is an unclassified, vector-based, digital database containing maritime significant features essential for safe marine navigation. The DNC uses the Vector Product Format, which is a NATO standard for digital military map and chart data. Additional details can be located at http://msi.nga.mil/NGAPortal/DNC.portal.

DNC consists of libraries in a variety of scales for complete worldwide coverage. SWPHC data is included in DNC regions 3, 13, 14, 15, and 16. NGA maintains DNCs with new source information from the U.S. and foreign primary charting authorities. The DNC product carries a Limited Distribution classification and is not available for public sale or download except for those that are within U.S. territorial waters or in areas where source data restrictions allow their release. However, host nations can acquire DNC products with coverage in their territorial waters through formal bilateral exchange agreements.

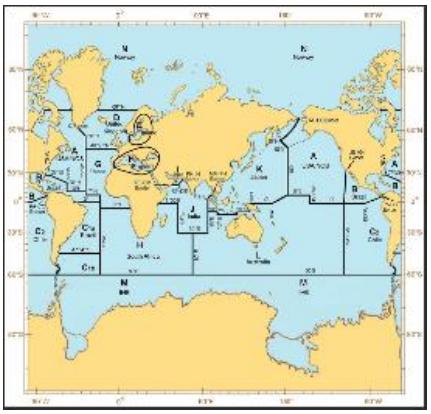
3.6 Raster Navigational Charts (RNC) and Paper Charts



The NOAA RNC® is a geo-referenced, digital image of NOAA navigational charts. Because the images are geo-referenced, the end user can display a vessel's position on the chart image if a computer-based navigation system and a global positioning system (GPS) are connected. RNCs, developed under the IHO S-61 product specification, are unique to NOAA. NGA does not produce RNCs. There are no NOAA RNC® products in SWPHC waters.

NGA produces approximately 350 paper or "Standard Nautical Charts" (SNC) for the SWPHC region. Most of these charts are not available for public sale. However, partners may request these charts as outlined in the associated bilateral agreement. The only charts that NGA distributes to the public are those where NGA serves as the primary charting authority. These charts are in areas where the U.S. conducts the surveys, compiles, and issues charts, and there is no fully functioning national authority or NGA has specific authority (e.g. Trust Territory of the Pacific).

3.7 International (INT) Charts



The U.S produces INT charts within the SWPHC region, primarily over U.S. Trust Territories and builds its chart schema and DNC library limits from these INT schema, if practical.

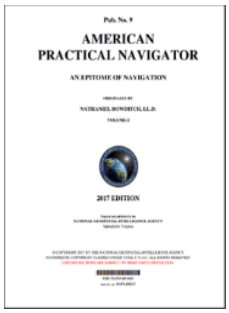
NEW PUBLICATIONS AND UPDATES

4.1 New Publications

None for comment.

4.2 Updated Publications

Bowditch Vol 1



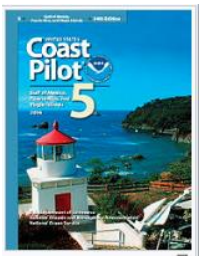
The **American Practical Navigator**, or as most mariners refer to it, "Bowditch" was first published in 1802. It describes in detail the principles and factors of navigation, including piloting, electronic navigation, celestial navigation, mathematics, safety, oceanography and meteorology. It also contains various tables used in typical navigational calculations and solutions, including the formulas used to derive the tabular data. The publication of the updated 2017 edition of the **American Practical Navigator** returned this publication to a two-volume format.

NGA plans to issue a new 2019 edition of the **American Practical Navigator** in the first quarter of 2019.

The new 2019 edition will be available for download as complete PDF documents from the NGA website.

4.2.1. The following publications receive continuous updates in accordance with SOLAS:

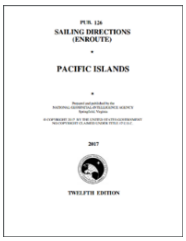
U.S. Coast Pilot



The **United States Coast Pilot** consists of a series of nine regionally- focused nautical volumes. Each volume covers a variety of useful information important to navigators for coastal and intra-coastal waters and the U.S. portion of the Great Lakes. U.S. Coast Pilot now offers completely updated every week.

Coast Pilot # 7 (2019) contains information for the U.S. west coast, Hawaii, and the Pacific, including Trust Territories of the Pacific Islands.

U.S. Sailing Directions



NGA publishes a 42-volume set that contains 37 Enroute volumes, 4 Planning Guide volumes, and 1 volume combining both types. Planning Guides describe general features of ocean basins and country-specific information such as firing areas, pilotage requirements, regulations, search and rescue information, ship reporting systems, and time zones; routes describe features of coastlines, ports, and harbors. NGA updates the Sailing Directions with new data obtained from sources such as pilots and Sailing Directions from other countries. Sailing Directions (Planning Guide) and Sailing Directions (Enroute) receive frequently updates. In early 2005, NGA discontinued production of these publications in printed form; now editions exist in digital form only. NGA issues new editions after source data requires extensive revision of an existing text. Between editions, NGA updates Sailing Directions via a binary patch process referred to as Publication Data Update (PDU).

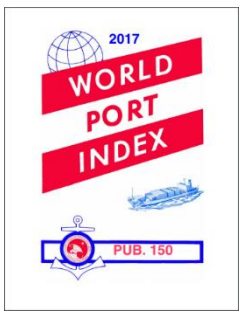
One volume (200) comprises the Planning Guide and Enroute for Antarctica. This consolidation allows for a more effective presentation of material on this unique area.

Information for the SWPHC region is contained in following Sailing Directions:

Sailing Directions #	Name	Type	Edition Date
120	Pacific Ocean and Southeast Asia	Planning	2018 Edition
126	Pacific Islands	Enroute	2017 Edition
127	East Coast of Australia and New Zealand	Enroute	2017 Edition
175	North, West, and South Coasts of Australia	Enroute	2017 Edition
171	East Africa and the South Indian Ocean	Enroute	2018 Edition

Figure 4-2 Sailing Directions Volumes covering SWPHC Regional Waters

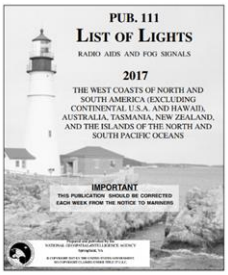
World Port Index



World Port Index **(Pub150)** is a publication maintained by NGA. It contains the location and physical characteristics as well as the facilities and services offered by major ports and terminals worldwide.

Digital updates are available to the public and posted at the NGA Maritime Safety website.

List of Lights / Radio Aids and Fog Signals



The **NGA *List of Lights, Radio Aids and Fog Signals*** and their digital updates are available to the public.

One volume of the NGA List of Lights covers the SWPHC region:

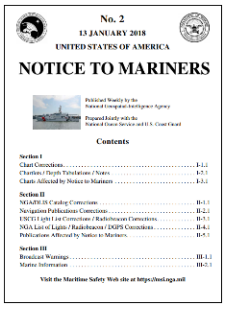
NGA List of Lights Publication 111	Edition Date
(W. Coast N & S America (excluding USA), Australia, Tasmania, NZ, and Islands in the N/S Pacific Ocean	2018 Edition

5. MARITIME SAFETY INFORMATION (MSI)

5.1 Existing infrastructure for transmission

Maritime Safety Information (MSI) is navigational and meteorological warnings, meteorological forecasts and other urgent safety-related messages broadcast to ships in accordance with the International Convention for the Safety of Life at Sea, 1974, as amended. Another component of MSI is the U.S. Notice to Mariners, which provides timely information for the correction of all U.S. Government navigation charts and publications from a wide variety of sources, both foreign and domestic. Information published in Notice to Mariners provides for the correction of unclassified nautical charts, the unclassified NGA/DLA Catalog of Hydrographic Products, United States Coast Pilots, NGA List of Lights, U.S. Coast Guard (USCG) Light Lists, and other related nautical publications produced by NGA, NOAA, and the USCG.

Notice to Mariners



The U.S. Coast Guard issues **Local Notices to Mariners** for NOAA charts, while NGA issues Notices to Mariners for NGA charts in the SWPHC region.

Local Notice to Mariners are updated weekly and available for download in several formats. Mariners can download applicable Notices from the web at www.atlanticarea.uscg.mil/Our-Organization/District-7/ and https://www.atlanticarea.uscg.mil/Our-Organization/District-8/.

The **U.S. Notice to Mariners** are posted at the NGA Maritime website.

5.3 Navigation Warnings

The NAVAREA coordinator is the authority charged with coordinating, collating,

and issuing navigational warnings for a designated NAVAREA within the IMO/IHO World-Wide Navigational Warning Service (WWNWS).

SWPHC waters primarily lie within NAVAREA X (Australia is Regional Coordinator, NAVAREA XIV (New Zealand is Regional Coordinator) and NAVAREA XI (Japan is Regional Coordinator).

World Wide Navigational Warning Service (WWNWS)

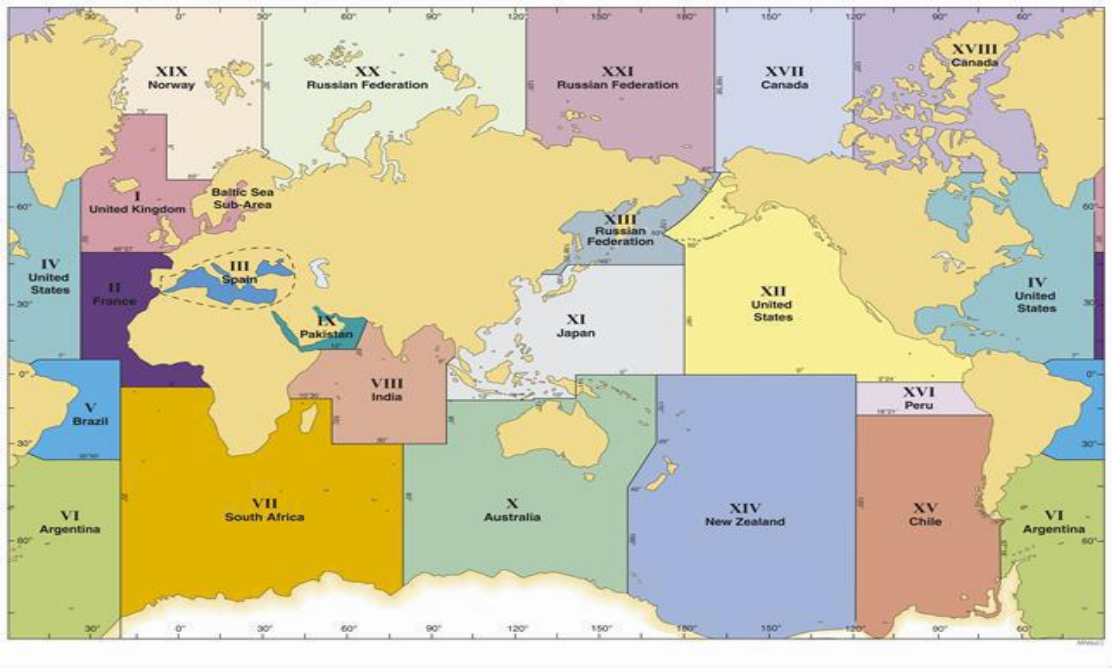


Figure 5-3 NAVAREAS for coordinating and promulgating navigational warnings under the WWNWS program

6. C-55

The aim of IHO Publication C-55 is to present a clear picture of the worldwide coverage of surveys and nautical charts and of the extent of effective organizations for the timely promulgation of navigational safety information. The following tables outline the survey and nautical chart coverage in the **Palau** where the U.S. is Primary Charting Authority:

6.1 Hydrographic Coverage Available:

Hydrographic Surveying	A	B	C
Depths < 200m	28%	52%	20%
Depths > 200m	0%	39%	61%

A = percentage which is adequately surveyed
B = percentage which requires re-survey at larger scale or to modern standards
C = percentage which has never been systematically surveyed

It is worth noting that the current C-55 estimates only take into consideration the currently charted

hydrography. As mentioned earlier in this report under Coverage of New Surveys, there are extensive data holdings currently under review that should substantially change these figures in the near future.

6.2 Nautical Chart Coverage Available:

Coverage of charts published by the U.S. in the SWPHC region (Palau) where:

A = percentage covered by INT series, or a paper chart series meeting the standards in M-4
B = percentage covered by Raster Navigational Charts (RNCs) meeting the standards in S-61
C = percentage covered by ENCs meeting the standards in S-57

Purpose/Scale	A*	B	C
Offshore passage/Small	100%	0%	100%
Landfall and Coastal passage/Medium	50%	0%	50%
Approaches and Ports/Large	100%	0%	100%
Percentage of Group A showing depths in metres	100%		
Percentage of Group A referenced to a satellite datum	N/A		

6.3 Maritime Safety Information Available:

The following describes the current Maritime Safety Information provided by Palau

Maritime Safety Information	Type	Notes
Local Warnings	Yes	Small Craft Only
Coastal Warnings	Yes	Small Craft Only
NAVAREA Warnings	No	Reports to XI
Information on ports or harbors	No	Small Craft Only

7. CAPACITY BUILDING

7.1 Offer of and/or Demand for Capacity Building

The United States is an active participant in the IHO Capacity Building Sub-Committee (CBSC). The US supports the IHO Maritime Safety Information (MSI) training course as well as provides support to nations through on site and remote guidance and advice as they grow their hydrographic capacity.

7.2 Training offered

Training opportunities are available at various institutions in the United States. Two “Category A” certified hydrographic programs are available through:

- The University of Southern Mississippi (USM)
- The University of New Hampshire (UNH)

7.3 NGA

Category-B Competence Training for Nautical Cartography - NGA commenced training with an IHO/ICA/FIG IBSC approved portable S-8 Category B Nautical Cartography class in 2017. NGA teamed

up with IIC Technologies to provide training to analysts with a comprehensive 20-week instructor led course and a six-week final project. Each session will run for one to three weeks at a time over the course of two years.

7.4 NOAA

Category-B Competence Training for Nautical Cartography -- the IBSC approved the NOAA program for Category B in Cartography in March of 2017. Eleven students graduated from the first class during the period of August 2017 through August 2018. The second class began in August 2018 with 12 students, including foreign national student from the Nigerian Navy that is now participating in this one-year competence-training program. An announcement for the third class (August 2019 until August 2020) will be in early 2019.

7.5 U.S. NAVY

COMNAVMETOCCOM offers a six-month Category "B" International Hydrographic Management and Engineering Program and mobile training via its Naval Meteorology and Oceanography Professional Development Center in Gulfport, Mississippi. Additionally, COMNAVMETOCCOM's mobile training, Category "A", and Category "B" programs qualify for Security Cooperation assistance.

8. OCEANOGRAPHIC ACTIVITIES

8.1 General Bathymetric Chart of the Oceans and Seabed 2030

The United States participates with the IOC-IHO Guiding Committee for GEBCO, and hosts the IHO Data Centre for Digital Bathymetry at NOAA's National Centers for Environmental Information (NCEI).

The GEBCO GC XXXIV meeting in November 2017 established Seabed 2030 as a project for the Guiding Committee (GGC). Seabed 2030 (https://seabed2030.gebco.net/) aims to bring together all available bathymetric data to produce the definitive map of the world ocean floor, at the best possible resolution within practical limits, by 2030. The seafloor data and GEBCO grid will be publicly available, under the concept of collect once, use many times. The Seabed 2030 project builds on more than 100 years of GEBCO's history in global seafloor mapping. The project seeks to encourage both data collectors and data managers of governmental, academic and private interests to work together to improve the quality of publicly available data and grids of the ocean floor.

The Seabed 2030 project has great potential to create partnerships and cooperation between interested parties, significantly improving our understanding of the sea floor and empower sustainable ocean management in the coming century.

8.2 Crowdsourced Bathymetry

Crowdsourced bathymetric data enables the identification of areas where nautical charts are inadequate

and highlights the need to conduct hydrographic surveys. Through effective program parameters on data gathering, collection, and dissemination, the collected data can fill gaps on charts nautical charts. The key to successful CSB efforts are volunteer observers who operate vessels-of-opportunity in places where charts are poor or where the seafloor is changeable and hydrographic assets are not easily available.

The U.S. provides financial support for the IHO-initiated project to develop a global database for crowdsourced bathymetry hosted by the IHO Data Centre for Digital Bathymetry (IHO DCDB). The IHO DCDB, co-located with NOAA's NCEI, is building the infrastructure necessary to provide archiving, discovery, display, and retrieval of global crowdsourced bathymetry data from mariners around the world.

Designed to tap into the enthusiasm for mapping the ocean floor, this program enables trusted mariners a means to contribute data they collect while underway which will ultimately fill the gaps in our current bathymetric coverage. The U.S. is an active participants in the IHO Crowd-Sourced Bathymetry Working Group (CSBWG), and together, with other CSBWG members, they have written a CSB Guidance Document for nonprofessional mariners who wish to collect and contribute CSB data to the IHO DCDB. This document provides volunteer collectors with information about CSB, the installation and use of CSB data loggers, data quality issues, and instructions for submitting the data to the IHO data repository.

9. OTHER ACTIVITIES

9.1 Marine Spatial Data Infrastructures (MSDI) Progress

The U.S. holds active roles in supporting the work of several international MSDI-focused working groups:

- IHO MSDIWG
- UN-GGIM Marine Geospatial Information Working Group (MGIWG)
- Open Geospatial Consortium Marine Domain Working Group (Marine DWG)

National Marine Spatial Data Infrastructures (MSDI) Progress

The Federal Geospatial Data Committee (FGDC) is an organized structure of federal geospatial professionals that provide executive, managerial, and advisory direction and oversight for geospatial decisions and initiatives across the United States federal government. FGDC works collaboratively with federal, state, and local governments, non-Federal collaborates, communities, constituents, and professional bodies providing the enabling foundation of standards, data catalogs, partnerships, and tools that make up the National SDI (NSDI). For more information visit: https://www.fgdc.gov/.

Related to MSDI is the U.S., “MarineCadastre.gov. This is an integrated marine information system that provides data, tools, and technical support for ocean planning.” The team for MarineCadastre.gov continually works “to increase access to data through data and map services. The services are designed to

deliver data without replication and directly from the source." MarineCadastre.gov supports complementary efforts: Digital Coast, Data.gov, and Geoplatform.gov (a FGDC initiative).

U.S. chart data is provided in GIS formats via an application called ENC Direct to GIS. This application allows users to request chart data in shapefile format through a geospatially-enabled viewer. In addition, OGC distributes Theme Layers via compliant Web Services. Theme Layer development accounts for suggestions from the IHO MSDIWG on core MSDI data layers. In order to ensure consistency across products and increase application stability, redevelopment efforts for this application and its applicable Theme Layers ensue with a delivery date planned for 2019.

The U.S. is supporting and organizing a project – the Marine Spatial Data Infrastructures - Concept Development Study (MSDI-CDS) – along with the Open Geospatial Consortium (OGC) on behalf of the IHO and international marine communities. The aim of this project is to assess the current state of data/product management and exchange technologies used in the marine domain. A technical report capturing the knowledge gained from the CDS will provide the foundation for development of a potential future pilot that will in turn advance the state of Spatial Data Infrastructures (SDIs) supporting marine data across the globe. The first MSDI-CDS workshops took place in October 2018 with the intent to gather information and help focus the effort for the future.

9.1 Earth Gravity Model (EGM) Update

The Earth Gravity Model (EGM) is being updated to reflect the variance in gravity based on the uneven mass distributions found across the irregularly shaped Earth. This gravity difference can effect air, land, and sea navigation if there is no instrument compensation to account for the difference in gravity across the Earth's surface. This model is also important in establishing Mean Sea Level (MSL), which is a component of the World Geodetic System (WGS) system. The next EGM is scheduled for release in 2020. After the 2020, subsequent releases will be on a 10-year development and release cycle.

9.2 World Magnetic Model (WMM) Update

The World Magnetic Model (WMM) helps define the difference between true north and magnetic north. Safe navigation across the Earth's surface requires the application of this correction. This model changes over time because of magma changes in the Earths molten iron core. Historically, the shift in the WMM has been consistent over time. However, in recent years the shift has accelerated leading to the need to create an out-of-cycle update to the WMM in 2019. This accelerated shift has the greatest effect on navigation in the northern latitudes of the Earth. Accurate compass headings are essential for a wide range of positioning and navigation system applications that use the Earth's geomagnetic field, including most aircraft, ships, submarines and GPS receivers. The U.S. plans to release the regular 5-year release of the WMM in 2020 as well.

ANNEX A

NOAA CERTIFIED RASTER CHART (PAPER CHART) PRINTERS

Company	Phone Number	Additional Services*
The Copy Shop	770-682-6600	
Frugal Navigator	509-426-4472	FO
Weilbach A/S	+45 33 34 35 60	
Marine Press	514-866-8342	UO
Eagle Enterprises Safety Solutions	800-478-2331	
Bluewater Books & Charts	954-763-6533	WP
Richardson's Maptech (Edgewater Marine Ind., LLC)	508-990-9020	WP
East End Blueprint and Reprographics Services, LLC	631-726-2583	
Pacific Publishers	912-472-4373	WP
TrakMaps	1-877-861-8725	WP
My Nautical Chart	401-499-3842	
The Map Shop	800-532-6675	WP, BC, UO
OceanGrafix	877-562-4278	WP, UO, FO, BC
Map House	Coming Soon	
Maritime Services Ltd.	888-387-8667	
Stanfords	+44 (0)20 7836 1321	
Milwaukee Map Service, Inc. (Meacham Enterprises)	800-525-3822	
East View Geospatial	877-856-6705	BC, FO, UO, WP
William & Heintz Map Corporation	800-338-6228	FO
Captains Charts – Tiger Printing Group, LLC	215-799-0500	UO, WP
Hyannis Marina	508-790-4000 x 2	
Paradise Cay Publications	707-822-9063	WP, FO, BC
Datema Nautical Safety	+31 (0)596 63 52 52	
Granville Printing	203-254-3090	

Additional Services:
Book Chart (**BC**), Folio Charts (**FO**), User Overlays (**UO**), Waterproof Charts (**WP)**

ANNEX B

US IHO Representation (2018)

Acronym	Name	NGA Rep.	NOAA Rep.	NAVY Rep.
IRCC	Inter-Regional Coordination Committee	Keith Dominic	John Nyberg	
HSSC	Hydrographic Services and Standards Committee	Albert Armstrong	Dr. Neil Weston	Rodney Ladner
S-100WG	S-100 Working Group	Josh Clayton	Julia Powell	David Brazier
ENCWG	S-101 ENC (S-101) Working Group	Eric Lee	Megan Bartlett	
S-102 subWG	S-102 Sub Working Group	Dave Armstrong	Julia Powell	
ENCWG (S-101)	ENC	Albert Armstrong	Megan Bartlett	
NIPWG	Nautical Information Provision	Mike Kushla	Tom Loeper	
NCWG	Nautical Cartography	Sean` McGurgan	Colby Harmon	
DQWG	Data Quality	Chris Petrof	Sean Legeer	
MSDIWG	Marine Spatial Data Infrastructure	Sebastian Carisio	Patrick Keown	
TWLCWG	Tides & Water Levels and Surface Currents	Doug Roush	Kurt Hess Peter Stone	
HDWG	Hydrographic Dictionary	Albert Armstrong		
ABLOS	Advisory Board on Law of the Sea	Steve Keeting		
WWNWS	World Wide Navigational Warning Service	Chris Janus		
CBSC	Capacity Building Sub-Committee			Calvin Martin
WEND	World Wide ENC Database	Gerry Walter	John Nyberg	
IBSC	Int'l Board on Standards of Competence for Hydrographic Surveyors and Nautical Cartographers		Andy Armstrong	
GEBCO	General Bathymetric Charts of the Ocean	Russ Ives		Ray Sawyer
CSBWG	Crowd Sourced Bathymetry Working Group	Whitney Anderson	Jennifer Jencks	
SCRUM	Sub Committee on regional undersea mapping	Russ Ives		
TSCOM	Technical Sub Committee on Ocean Mapping	Russ Ives		
SCUFN	GEBCO Sub Committee on Undersea Feature Names	Trent Palmer		