ENCWG3 xx-x

Paper for Consideration by ENCWG3

NOAA's Re-scheme plan using six bands

Submitted by: USA (NOAA)
Executive Summary: The USA (NOAA) is currently in its first steps to standardize NOAA's Electronic Navigation Chart (ENC) suite. This letter provides clarification to the reason using a six usage band suite in an ENC-First environment rather than the three usage band approach proposed in the S-10x documentation. Additional information regarding the new NOAA suite is that its compilation scales will utilize a binary scale system with metric depth units to allow the use of standard charting products, while supporting web services and marine display systems that are not compliant to IHO standards.
Related Documents: IHO S-57 and NOAA's National Charting Plan
Related Projects: The 28th International Cartographic Conference

Introduction / Background

Current scheme (or footprints) of NOAA ENCs are based on the footprints of the raster charts from which they were derived. As a result, changing current ENC coverage to incorporate additional survey data outside of the existing bounds is complex and poses a challenge. In addition, the scale ranges chosen for the ENC navigational usage bands differ from the International Hydrographic Organization's (IHO) recommendations. As part of the "ENC first" effort, an ENC re-scheming approach was developed to provide a seamless, tiled coverage that can easily be segmented or extended based on geographic location, available data and scale. In this new regular gridded ENC coverage approach, only a limited number of chart scales are used (down from the current 131 unique scales). The outcomes that are expected from the re-scheming approach are improved charting products that include changes to chart formats, scales, data compilation, and symbology. This report, provides more details on the current challenges with the ENC products and cartographic rules to provide a seamless, tiled coverage that can easily be segmented or extended based on geographic location, available data and scale. The six usage bands and their twelve compilation scales conform to IHO S-57 and most of IHO S-101 ENC format specifications. The re-scheme plan also conforms to international standards (e.g., depth units, contours, and sounding distribution) and IHO S-58 ENC Validation Checks.

Discussion

In recent years, modern navigational systems have become more sophisticated, and recreational boaters have joined professional mariners in using electronic chart displays. Marine and coastal users of all types are expecting more precision in the charted positions of features, higher resolution of depth information on electronic charts, and the greater timelines and ease of access to charts and chart updates. In an effort to improve its charting products and enhance production and accuracy, NOAA identified several key issues that needed to be addressed in its current nautical chart products and their distribution.

- Too many alarms on caution areas are shown in the electronic chart display and information system (ECDIS).
- Dangerous and non-dangerous wrecks are not always well differentiated in ECDIS.
- Uncertainty values associated with 'reported,' 'existence doubtful,' and 'position approximate' dangers are not well defined.
- Limited description of depth areas in key locations – more detail is needed.
- Current ENC chart suite contains 1,182 irregularly shaped ENC cells compiled at 131 different scales that result with many discontinuities between neighboring cells on the same scale band.
- Current symbology is mainly good for SOLAS mariners, but not good for recreational mariners.

In early March of 2017, Office of Coast Survey (OCS) / Marine Chart Division (MCD) invited the public to provide comments on a draft of the National Charting Plan by July 1st, 2017. The National Charting Plan (NCP) is a strategy to improve NOAA nautical chart coverage, products, and distribution. Its structure includes two parts: the first part describes the current set of NOAA nautical chart products and their distribution, and second part describes some of the steps proposed to improve those products, including changes to chart formats, scales, data compilation, and symbology. Overall, the NCP publication was accepted by the public, where the main concern was on the specifics regarding NOAA's raster chart production. This public acceptance included the use of metric units instead of English units.

When MCD started designing a new scheme for the NOAA ENC© suite, use of the IHO's recommended scales for each usage band, based on radar ranges (Table 1), was considered. Ultimately, MCD decided to adopt a binary scale system in which each successively smaller scale is half of the preceding scale. Usage of binary scales will simplify the display of charts in different systems and web-services. Also, generalization rules are simpler when the scales are linearly aligned with each other. The twelve compilation scales selected for use by NOAA are based on the most common chart scales in the NOAA ENC suite (i.e., 1:10,000, 1:20,000, 1:40,000, and 1:80,000). As a result, fewer charts will need to be recompiled and rescaled to the new standard compilation scales. The current use of 131 scales will be reduced to the 12 shown in Table 1.

Table 1 NOAA's scale ranges (Usage Bands) and compilation scales

Navigational Purpose	Code	IHO Recommended Scale Ranges	NOAA Compilation Scales
Overview	1	< 1:1,499,999	1:5,120,000 1:2,560,000
General	2	1:350,000 – 1:1,499,999	1:1,280,000 1:640,000
Coastal	3	1:90,000 – 1:349,000	1:320,000 1:160,000
Approach	4	1:22,000 – 1:89,999	1:80,000 1:40,000
Harbor	5	1:5,001 – 1:21,999	1:20,000 1:10,000
Berthing	6	≥ 1:5,000	1:5,000 1:2,500

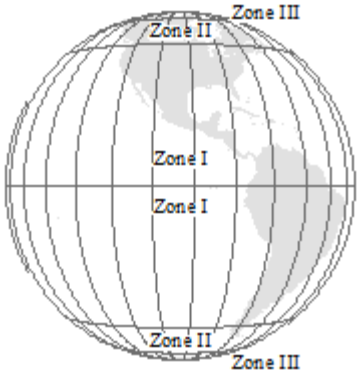
All re-schemed ENC cell boundaries follow lines of longitude and latitude and will appear rectangular in a Mercator projection. Areas of large coverage (i.e., small-scale cells) are quartered, and quartered again, and

again, into progressively smaller and smaller sized (but larger scale) component cells (Table 2). Cell dimensions are defined for each usage band based on its largest compilation scale. Cell sizes were computed to accommodate the IHO restriction for ENC file sizes not exceeding 5 Mb. To account for the convergence of lines of longitude at the poles, the widths (latitudinal extent) of ENC cells are extended for cells beyond 48˚ and again for cells beyond 64˚ (Table 3).

Table 2. ENC Cell dimensions in decimal degrees

Navigational Purpose	Compilation Scales	Height (˚)	Width Zone I (˚)	NOAA Zone II (˚)	NOAA Zone III (˚)
Overview	1:5,120,000 1:2,560,000	19.2	19.2	38.4	76.8
General	1:1,280,000 1:640,000	4.8	4.8	9.6	19.2
Coastal	1:320,000 1:160,000	1.2	1.2	2.4	4.8
Approach	1:80,000 1:40,000	0.3	0.3	0.6	1.2
Harbor	1:20,000 1:10,000	0.075	0.075	0.15	0.3

Table 3. ENC Cell width dimension zones

Zone	Latitude	
III	64˚N - 80˚N	
II	48˚N - 64˚N	
I	0˚ - 48˚N	
	Equator	
	0˚ - 48˚S	
II	48˚S - 64˚S	
III	64˚S - 80˚S	

The S-57 ENC naming convention used around the world consists of eight characters. The **first two characters** are the production code, as listed in IHO S-62. NOAA's code is "US". **The third** character is the usage band number, as shown in Table 1.

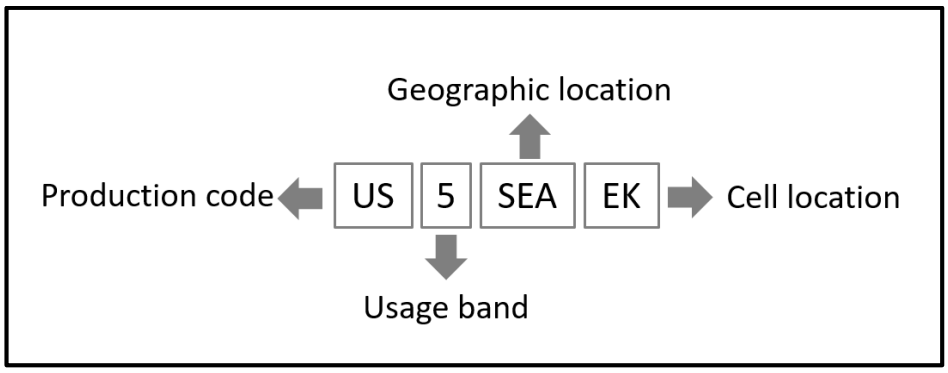


Figure 1 Naming structure for re-schemed ENC cells.

The fourth, fifth, and sixth characters represent the geographic location of the cell. There are two types of three-letter naming conventions that will be used. Each is described below:

- **Standard state coverage –** ENC cells not covering a principle port will be named by state. In these cases the fourth and fifth characters identify the US state and the sixth character represents a zone within the state.

- **Principle ports** – In order to differentiate the US Principle Ports from the rest of the re-schemed ENC cells at the same scale band, a three-character port identifier is obtained from the UN/LOCODE Code List 2017-1 for each port (current version was published in July 2017): http://www.unece.org/cefact/locode/service/location.html.

The seventh and eighth characters are the cell location with respect to a given reference. The southwestern corner of the ENC cell grid is the center of origin ("AA"), where the seventh character represents distance from the center of origin in latitude and the eighth character represents distance from the center of origin in longitude.

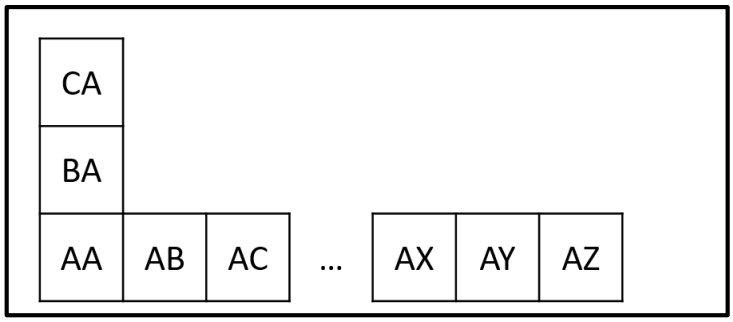


Figure 2 Naming structure of the last two characters to describe the cell's location with respect to the center of origin ("AA"), which is the southwestern corner of a grid of ENC cells describing a given geographic location (i.e., Principle Port or a zone within a state).

Justification and Impacts

The outcomes that are expected from the re-scheming approach are improved charting products that include changes to chart formats, scales, data compilation, and symbology. The resulting re-schemed ENCs bordering ENCs from neighboring states will provide a positive impact on the mariner's transition between the states, such as depth contours following the metric units. Also, usage of binary dependent scales will simplify the display of charts in different systems and web-services and simplify generalization rules of features transitioning between the scales.

Action Required of ENC WG / S-100 WG / S-101 PT

The ENC WG, S-100 WG, and S-101 PT are invited to:

a. Note this information