Office of Coast Survey

Hydrographic Survey Specifications and Deliverables

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1.0 Introduction

The Hydrographic Surveys Specifications and Deliverables (HSSD) contains the technical specifications for hydrographic survey data submitted to the Office of Coast Survey. This "revamped" version (with an initial release date anticipated in 2024) is the product of numerous subject matter experts who collaborated to modernize the HSSD in order to better support the Office of Coast Survey as a data-driven organization.

1.1 Why was the HSSD rewritten?

The initial version of the HSSD was published in 2000. Since then, technology has improved drastically - multibeam technology has evolved, and various other remote sensing mapping techniques have proliferated in the hydrographic industry. Advanced tools allow for faster processing and quality review through automation. The Office of Coast Survey has expanded data pipelines to incorporate non-traditional sources of external data, while simultaneously allowing for a more efficient model of product generation via the National Bathymetric Source (NBS). While the HSSD was revised annually based on feedback from the hydrographic community, updates were added onto a foundation that had become outdated, resulting in a version that may have begun to lack overall congruence and cohesiveness over the years.

1.2 Vision for the HSSD

The HSSD overhaul project commenced with a particular vision - to rewrite specifications to be forward-looking with respect to new and developing technology, to best facilitate automated tools, and to better integrate with the NBS and S-100 based products, including precision marine navigation products. Additionally, the HSSD will better accommodate the increasing amounts of hydrographic data obtained opportunistically from external sources, with metadata tags to denote data quality and universal data licenses to define terms of use. The revamped HSSD draws from decades of experience contained within previous versions. It is further developed by subject matter experts within the NOAA hydrographic community, while it also leverages existing knowledge from other hydrographic offices and within the larger hydrographic community.

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Objectives for the revamped HSSD

- More flexibility to accommodate hydrographic surveys acquired with new and evolving technologies (e.g. laser scanners, satellite-derived bathymetry, photogrammetry), in addition to the acoustic-based surveying that is the core proficiency of the Office of Coast Survey.
- Designed from the start to ensure hydrographic data is best fit for application to products based in the International Hydrographic Organization (IHO) S-100 framework.
- Better integration with the requirements for data ingest into the NBS, the Office of Coast Survey database for the best available bathymetry.
- More accommodating of external data submissions, a data stream critically important in achieving national and global mapping objectives.
- Utilizes universal, machine-readable data licenses to standardize and streamline data handling, and to safeguard the interests of data providers.
- Improved metadata guidance to better define coordinate reference systems (CRS) and any new CRS realizations via coordinate transformation in accordance with the Bathymetric Attribute Grid (BAG) 2.0 specification.
- Fully compliant with Section 508 of the Rehabilitation Act (29 U.S.C. § 794d).
- HTML and PDF versions supported.

In addition to ensuring safe navigation, hydrographic data acquired (and that is contributed) is a key component to a vibrant maritime economy. These data provide the scientific foundation for applications such as habitat mapping and restoration, seafood production, tourism and recreation, renewable energy, climate adaptation strategies, and coastal flood mitigation.

1.3 How to use this Document

The HSSD provides the technical specifications for hydrographic data submission to the Office of Coast Survey. Users seeking something other than technical specifications (e.g. theory, best practices, or standard operation procedures) should refer to the Office of Coast Survey **Field Procedures Manual**, **International Hydrographic Organization (IHO) publications**, or hydrographic community resources such as the **Multibeam Advisory Committee (MAC)**.

The HSSD is designed to inform providers of both Internal Source Data and External Source Data of the technical specifications for hydrographic data submission to the Office of Coast Survey.

- Internal Source Data (ISD) providers are defined as Field Units who are tasked via Hydrographic Survey Project Instructions issued by the Office of Coast Survey. **The blue text used in this document calls attention to verbiage that is specific only to ISD providers. Additionally, this text is denoted with "for NOAA ISD surveys".**
- External Source Data (ESD) providers are all other data providers that are not ISD. They include our federal partners, and other hydrographic offices; our partners in academia, the private industry, and other NOAA line offices outside of the Office of Coast Survey; as well as states, cities, parks, and ports, and more. ESD providers are encouraged to reference this document to aid in the submission of hydrographic data to the Office of Coast Survey.

Words used in this document to denote mandatory or permissive actions are defined as follows below. **For NOAA ISD surveys, strict adherence to these definitions is required, unless superseded by Project Instructions. For NOAA ISD, directions provided in the Project Instructions supersede HSSD requirements.** For ESD adherence to the below definitions, there is a caveat, as described in the Note to External Source Data Providers section.

- “Must” means the procedure or standard is mandatory.
- “Should” means the procedure or standard is recommended.
- “May” means that the procedure or standard is optional.
- “Will” means futurity of action only and does not indicate any degree of requirement for application of a procedure or meeting a standard.

1.4 Note to External Source Data Providers

External Source Data (ESD) providers may submit data to the Office of Coast Survey that was not originally intended for updates to navigational products and therefore may not comply with the mandatory procedures or standards (i.e. any statement with a "must") as described in this document. This is common. ESD that does not comply with these specifications should not preclude the providers from submitting their bathymetric data to the Office of Coast Survey. Most importantly, ESD providers should ensure their bathymetric data is accompanied by Minimum Metadata (defined in the Glossary), or if feasible, complete metadata as listed in **Reports**. Submissions lacking Minimum Metadata will preclude the Office of Coast Survey from assessing the ESD submission. For example, the Office of Coast Survey is unable to use any data without a data license.

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Upon submission, all ESD is reviewed by Office of Coast Survey hydrographers with regard to data quality indicators that describe positional and depth accuracy, type of seafloor coverage, and survey characteristics. Ultimately, a category zone of confidence (CATZOC) is assigned to the data, which is used to support safe navigation by informing mariners of charted data quality. As close as feasible adherence to the procedures or standards in this document helps the Office of Coast Survey to more rapidly qualify data submissions and enables an intensive assessment of quality metrics. For example, if complete metadata is not provided, the Office of Coast Survey may inflate positional or vertical uncertainty associated with the data due to the lack of information, which ultimately results in a degraded zone of confidence. The Office of Coast Survey errs on the side of caution when communicating data quality metrics to mariners with safety of navigation as our top priority.

ESD is a vital data stream into the Office of Coast Survey, critically important for meeting various mapping objectives. Over the years, ESD has routinely been used for application into our various products and services. ESD updates charts and models, it fills in bathymetric gaps, it identifies dangers to navigation, and it is used for planning purposes, reconnaissance, chart adequacy assessment, and more. To learn more about the many uses of ESD, or if interested in submitting bathymetric data, it is encouraged to fill out the Integrated Ocean and Coastal Mapping **engagement form** to get a conversation started. The Office of Coast Survey is very grateful to all ESD providers for their contributions.

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1.5 Quality Metric Framework

The Office of Coast Survey quality metric framework, often referenced in the **Point Cloud** and **Grids** sections, is based on the IHO Special Publication Number 101, 1st Edition. The framework remains consistent from survey specification to published product, which ensures information integrity and a streamlined workflow. The parameters within the framework align loosely to the orders prescribed by the IHO Special Publication Number 44, 6th Edition, and to the category zones of confidence (CATZOC) prescribed by the IHO Special Publication 67, 1st Edition, which together encompasses all the types of data the Office of Coast Survey receives, from NOAA ISD surveys to all varieties External Source Data (ESD) submissions. Note, ESD need not meet a specific OCS quality metric, IHO order, or zone of confidence in order to be submitted to the Office of Coast Survey. Lastly, the parameters should be considered "ungrouped", i.e. a survey may meet "Exceptional" requirements in one parameter, but only have achieved "General 2" requirements in another.

Table of OCS Quality Metric Alignment

OCS Quality Metric	IHO Order	Zone of Confidence
Exceptional	Exclusive	
Critical	Special	
General 1	1a/1b	A1
General 2	2	A2
General 3		B
General 4		C

1.6 References

Definitions for some terms in this document are derived from the following:

- ENC Product Specification S-101, Edition 1.1.0 (April 2023). International Hydrographic Organization.

- IHO Transfer Standard for Digital Hydrgraphic Data S-57, Edition 3.1 (November 2000). International Hydrographic Organization.
- Mariners' Guide to Accuracy of Depth Information in Electronic Navigational Charts (ENC) S-67, Edition 1.0.0 (September 2020). International Hydrographic Organization.
- NOAA Nautical Chart Manual Vol 1-3, Version 2022.2 (7/8/22). U.S. Department of Commerce, Office of Coast Survey.
- Regulations of the IHO for International (INT) Charts and Chart Specifications of the IHO, Edition 4.8.0 (October 2018). International Hydrographic Organization.
- Standards for Hydrographic Surveys S-44, Edition 6.1.0 (September 2020). International Hydrographic Organization.
- Universal Hydrographic Data Model S-100, Edition 4.0.0 (December 2018). International Hydrographic Organization.

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2.0 Version Control

The Hydrographic Surveys Specifications and Deliverables is updated annually by the Office of Coast Survey based on feedback received from internal and external partners. All suggestions are stored and adjudicated by a team of subject matter experts. **For NOAA ISD surveys, suggestions are provided via internal ticket system.** External Source Data providers may provide suggestions through the **Marine Chart Division's ASSIST customer service reporting system**.

Version releases and changes to externally-released versions are shown in the table below.

Table of Version Releases

Version	Date	Changes
2023.1.01	2/21/2023	Initial Draft for NOAA Internal Use Only
2023.2.01	6/30/2023	Revised Draft for NOAA Internal Use Only
2023.2.02	7/27/2023	First Draft created for External Release

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3.0 Data Stewardship

For NOAA ISD, Field Units are responsible for the stewardship of all data and products related to the project until notification is received that the Office of Coast Survey has accepted responsibility for the stewardship of the data and/or products and that the Field Unit is no longer responsible for maintaining the raw and processed data.

Stewardship of data entails safeguarding against a data breach and preserving the integrity of the data and products.

Once the Field Unit has been notified that the Office of Coast Survey has accepted responsibility for the data and/or products, the Field Unit may delete the data from their storage device.

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4.0 Raw Data

4.1 Raw Data File Naming Convention

Raw file naming conventions must adhere to manufacturer recommendations. No further naming requirements are specified by the Office of Coast Survey.

4.2 Raw Data Submission

Raw data must be submitted to the Office of Coast Survey as part of the survey submission, included in the appropriate folders as shown in **Delivery Structure**.

Examples of data types are presented in the table below. This table is not all-inclusive.

Table of Raw Data Types

Raw Data Type	Common Examples
2D Imagery	Preliminary imagery, for shoreline, structure from motion, etc.
Point Cloud	Preliminary Point Cloud data or Raw Sonar Data. Place in a folder named with the appropriate TECSOU* • ASCII XYZ • ASPRS LAS, LAZ • Kongsberg ALL, WCD, KMALL, KMWCD • Reson S7K • R2Sonic R2SC • EdgeTech JSF • Hypack HSX, 7K • QPS DB • Triton XTF • NAVO / Leidos GSF
Positioning	Base station data (exclude NOAA NGS CORS network data)
Correctors	Positioning, Attitude, and Heading • Applanix 000 • Kongsberg BIN • iXblue LOG, 22_ SVP • Seabird CNV • AML CALC, S12, CSV • OceanScience ASC • Kongsberg ASVP • CARIS SVP

* See **Delivery Structure** for TECSOU folder names

4.3 NODC Sound Speed Data Submission

For NOAA ISD, sound speed data must be submitted to NCEI following the NetCDF template format outlined on the NCEI website. Project, survey, Field Unit, and instrument fields must be populated. Each submission must only contain data from one project. In cases of projects spanning multiple years, submissions must be made yearly. The submission filename must contain the project number and

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timestamp of submission (e.g. OPR-B370-TJ-22_20220901.zip). List the submission and date of submission in the Supplementals section of the Report of Survey.

- **NOAA In-House Field Units must submit the files directly to NCEI via email attachment to NODC.submissions@noaa.gov with a CC to the OCS Project Manager.**
- **NOAA Contractor Field Units must submit the files directly to NCEI via email attachment to NODC.submissions@noaa.gov or via the S2N tool on the NCEI website. Include the COR on all relevant correspondence.**

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5.0 Point Cloud

5.1 File Formats

Point cloud data and their derived products submitted to the Office of Coast Survey must be able to be reviewed before they can be applied to Safety of Navigation products. The table below lists standard point cloud file formats that the Office of Coast Survey can review.

Table of OCS Reviewable Point Cloud Data Formats

Format
ASCII XYZ
CARIS HDCS
FQPR
GSF (version 3.09 or later)
ASPRS LAS/LAZ
QPS QPD
Input File Formats supported by CARIS HIPS & SIPS/Bathy DataBASE
File Formats supported by QPS Qimera
File Formats supported by MB-System

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5.2 Required Data & Metadata

Point cloud data submitted to the Office of Coast Survey must contain, at a minimum, the 3D position of the points and horizontal uncertainties associated with the submitted data. Some data formats, such as ASPRS LAS, require additional data fields as part of the format specification. Please refer to individual format specification documents for further details.

In addition to the metadata requirements for the survey, additional metadata is required for point cloud data submitted to the Office of Coast Survey. Some metadata are required for all point cloud data types, while some are dependent on the technique of data collection.

Table of Point Cloud Data and Metadata Types

Field	Technique	Type	Mandatory/Optional/ Conditional
X/λ	All	Data	M
Y/ϕ	All	Data	M
Z	All	Data	M
Vertical Uncertainty	Acoustic bathymetry	Data	M
Vertical Uncertainty	Lidar	Data	O
Horizontal Uncertainty	All	Data	M
Classification	Lidar submitted in LAS format	Data	M
RGB	Lidar	Data	O
Intensity	Lidar	Data	O
Geodetic Parameters (see **CRS**)	All	Metadata	M

Interpolation	All	Metadata	C

5.3 Coverage

For NOAA ISD surveys, coverage limits of the survey will be provided in the Project Instructions. Offshore surveys which do not approach the coast will end at their assigned survey limits. For nearshore surveys, the inshore coverage limit is defined by the Navigable Area Limit Line (NALL). Unless stated otherwise in the Project Instructions, the NALL by default is defined as the following:

- **The surveyed 4.0 meter depth contour referenced to chart datum. Coverage must be sufficient to fully develop the 4.0 meter depth contour. Note that in cases when this contour surrouds a feature disconnected from the contiguous mainland coastline (e.g., offshore islet or rock), the feature must be investigated utilizing appropriate hydrographic techniques and included in the feature file.**
- **The line defined by the distance seaward from the observed MHW line which is equivalent to 0.8 millimeters at the scale of the largest scale chart covering any portion of the survey area (e.g., for a 1:80,000 scale chart, this line would fall 64 meters seaward of the MHW line).**
- **The inshore limit of safe navigation for the survey vessel, as determined by the Field Unit. If kelp, rocks, breakers, or other hazards make it unsafe to approach the coast to the limits specified above, the NALL must be defined as the shoreward boundary of the area in which it is safe to survey.**

In rare instances, the Field Unit may determine that the NALL lies inshore of the limits defined in the first two bullet points above. For example, this could be the case in confined waters such as harbors or passes which are inshore of the NALL as defined above, but are regularly utilized by vessels. It could also occur in deep water ports where modern bathymetry is required along wharf faces. In these cases, the Field Unit must consult their OCS Project Manager and/or COR, prior to dedicating significant survey resources to these areas.

On some occasions, the Field Unit may be tasked with the investigation of specific items which fall inshore of the NALL as defined by the first two bullet points above. The Field Unit may also encounter unassigned natural or anthropogenic features inshore of the NALL, which are such exceptionally prominent aids to visual navigation that accurate positions for depiction on charts is required. In these cases, the Field Unit must proceed inshore of the NALL to accomplish investigation of these features, so long as this can be accomplished safely in accordance with the third bullet point above. Note that the Field Unit is not required to extend bathymetric coverage inshore of the NALL when investigating features with vertical extents above MLLW.

Verification of near shore features must not be attempted unless conditions are favorable. Near shore investigations must be deferred until conditions are favorable, even if initial assessments had indicated otherwise. Conditions at the actual survey area may be different or degrade as the day progresses. Working near shore is inherently dangerous, and all Field Units must maintain safety as the top priority when conducting operations.

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5.4 Interpolation

Point cloud data submitted to the Office of Coast Survey that includes interpolated data must include a flag for each point that indicates if the point has been interpolated or not. Note that the inclusion of interpolated data without identifying the specific data points that are interpolated will preclude the use of the data for charted sounding application but may be used for contour generation or other bathymetric modeling purposes as deemed appropriate by the Office of Coast Survey.

For NOAA ISD surveys, interpolation of point cloud data is prohibited unless authorized in the Project Instructions.

5.5 Resolution

Point cloud data submitted to the Office of Coast Survey must not be downsampled. The resolution of the point cloud data must be able to support creating a gridded product at ½ the size of the features claimed to be detected by the survey. **For NOAA ISD surveys, a required minimum feature detection size will be provided with the Project Instructions.**

5.6 Corrections

Point cloud data submitted to the Office of Coast Survey must be corrected for accurate 3D positioning of the points. If the corrections below are not applied to the data, it will substantially degrade the accuracy. This degradation will be reflected in the quality assessment and subsequent application of the data to products generated by the Office of Coast Survey.

Corrections typically account for the following categories (listed in the sequence in which they must be applied):

- Offset corrections to account for measurement equipment installation offsets, including (if applicable) angular offsets to ensure sensor reference frame alignment.
- Instrument error corrections to account for sources of error related to the measurement equipment itself.
- If the measurement equipment is located below the water surface, draft corrections to account for the depth of the measurement equipment.
- If the measurement equipment is mounted to a vessel traveling through water, dynamic draft corrections to account for the vertical displacement of the measurement equipment, relative to its position at rest, when a vessel is underway.
- If the measurement equipment utilizes sound waves, speed of sound corrections to account for the two way travel time of the sound wave through the water.
- Attitude corrections to account for the effect of vessel motion caused by waves and swell (heave, roll, pitch) and error in the vessel's heading.
- Datum corrections to account for the translation from a preliminary survey datum to the final, delivered datum.

When performing an assessment of the final reported uncertainty values for the survey, the hydrographer must account for the quality of the corrections applied to the data and ensure that the corrections applied to the data support the reported uncertainty values. For more information on corrections typically applied to hydrographic data, see the **Field Procedures Manual**.

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5.7 Cleaning

Point cloud data submitted to the Office of Coast Survey must be clean of spurious data points that cause the gridded surface to be shoaler or deeper than the reliably measured seabed by greater than the maximum allowable Total Vertical Uncertainty (TVU) at that depth.

The seafloor under charted human features (e.g. piers, anchor chains, bridges) must be left in the data and included in charted products. However, the pilings (and seawalls) supporting these structures must be rejected. Submerged pilings unattached from visible structures are obstructions that must be retained in the data.

5.8 Uncertainty

In addition to the overall horizontal and vertical uncertainty reported as part of the survey metadata, all bathymetric point cloud data derived from acoustic sensors submitted to the Office of Coast Survey must contain the uncertainty associated with the data. Uncertainty estimates may be calculated individually point-by-point, or by an assessment of the uncertainty of the data as a whole. Submitting point cloud data with an assessment of the uncertainty of the data as a whole instead of a point-by-point basis may result in the Office of Coast Survey only applying a portion of the submitted data, assessing the data with a lower grade, or being unable to use the data.

Failure to provide uncertainty values will result in the Office of Coast Survey determining the appropriate uncertainty based on an evaluation of the data and metadata provided, as well as any other factors that are deemed relevant at the sole discretion of the Office of Coast Survey.

If using a topo-bathymetric airborne lidar system, vertical uncertainty values may be provided to the Office of Coast Survey based on the **Eren et al. model (2019)** if it has been computed.

For NOAA ISD surveys, uncertainty values must be calculated individually, point-by-point utilizing a TPU model based on the Hare-Godin-Mayer model (1995 plus later improvements).

Point cloud data uncertainty must be broken down into Total Horizontal Uncertainty (THU) and Total Vertical Uncertainty (TVU) estimates and reported at the 95% Confidence Level.

The uncertainty estimates for point cloud data must account for all component uncertainties in the submitted data due to residual systematic and system-specific instrument uncertainties such as the speed of sound in water; beam-forming precision; system latency; static vessel draft; dynamic vessel draft; heave, roll, and pitch; and any other sources of uncertainty in the actual measurement process, including those associated with vertical datum correction such as tidal measurement, zoning, or translation from one datum to another. For more information on uncertainty components as well as how to determine the uncertainty values for the components, see the **Field Procedures Manual**.

Total Horizontal Uncertainty

For NOAA ISD surveys, a maximum allowable THU will be provided in the Project Instructions that may consist of a fixed and variable value. Field Units operating under these Project Instructions must ensure their data do not exceed the maximum allowable THU. Maximum allowable THU values are based on the Quality Metric Framework presented in the Introduction and the values are shown in the table below.

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Table of Maximum Allowable THU Values

OCS Quality Metric	Fixed Value	Variable Value
Exceptional	1 meter	N/A
Critical	2 meters	N/A
General 1	5 meters	5% of depth (in meters)
General 2	20 meters	10% of depth (in meters)
General 3	50 meters	N/A
General 4	500 meters	N/A

Total Vertical Uncertainty

Depth TVU

For NOAA ISD surveys, a maximum allowable depth TVU will be provided in the Project Instructions that will consist of a value that represents the portion of the uncertainty that does not vary with depth and a coefficient which represents the portion that varies with depth. These parameters will be grouped together into a single TVU group. These parameters must be used in conjunction with the formula below to determine the maximum allowable TVU.

$$TVU_{max}(d) = a + (b \times d)$$

Where:

a represents the portion of the uncertainty that does not vary with depth

b is the coefficient which represents that portion of the uncertainty that varies with depth

d is the depth

For negative depths (i.e. heights), the maximum allowable TVU cannot be less than *a*

Maximum allowable depth TVU values are based on the Quality Metric Framework presented in the Introduction and the values are shown in the table below.

Table of Maximum Allowable Depth TVU Values

OCS Quality Metric	The portion of the uncertainty that does not vary with depth (a)	The coefficient which represents the portion that varies with depth (b)
Exceptional	0.15 meters	0.0075
Critical	0.25 meters	0.0075
General 1	0.5 meters	0.01
General 2/3	1.0 meter	0.02
General 4	2.0 meters	0.05

Height TVU

For NOAA ISD surveys, a maximum allowable height TVU will be provided in the Project Instructions that will consist of a single value that represents the maximum allowable TVU for all features above the vertical reference plane. Maximum allowable height TVU values are based on the Quality Metric Framework presented in the Introduction and the values are shown in the table below.

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Table of Maximum Allowable Height TVU Values

OCS Quality Metric	Maximum Allowable Height TVU
Exceptional	0.15 meters
Critical	0.25 meters
General 1	0.5 meters
General 2/3	1.0 meter
General 4	2.0 meters

5.9 Data Quality Control

Crosslines

For NOAA ISD surveys, crosslines must be acquired and processed to the same accuracy and data quality standards as required for mainscheme lines.

Linear mileage of crosslines must be approximately 2% of the mainscheme mileage in areas where 100% or greater bathymetric coverage is required.

Linear mileage of crossline must be approximately 4% of the mainscheme mileage in areas where less than 100% bathymetric coverage is required.

Crosslines should be geographically dispersed throughout the survey area.

For crosslines acquired and processed, the hydrographer must evaluate each area of overlapping crossline and mainscheme coverage to ensure that the depth/height values from the two data sets do not differ more than the maximum allowable TVU for the depth/height. Any deviations must be investigated, the source of the error identified, and if possible, corrected. If unexplained or excessive discrepancies persist, additional crosslines must be reacquired to assist in the resolution of the issue. If deviations are not able to be corrected, they must be documented in the Report of Survey. This documentation must include a description of the deviation, any steps taken to attempt to resolve the deviation, as well as the hydrographer's understanding of the cause of the deviation.

Data Overlap

For NOAA ISD surveys, the Field Unit must ensure that overlap between junction surveys of approximately one bathymetric swath width at the nominal depth of the junction area must be acquired.

Known Temporal Changes

For NOAA ISD surveys, if there are physical changes to the detected seafloor larger than the maximum allowable TVU for the depth that occur during the course of the survey (ex. Dredging, sandwave migration/sediment transportation, etc.), Field Units must contact their OCS Project Manager to discuss the best way to proceed. If it is a response survey (ex. a survey conducted after passage of a tropical cyclone) and it is known that the detected seafloor and the features found are temporary and therefore not recommended for charting, Field Units must document their recommendations in the Report of Survey Additional Information section, highlighting which areas should be resurveyed. Field Units must also obtain confirmation with collaborating federal and local agencies (e.g. USACE, USCG) that features were removed, or ensure that this follow-up responsibility to confirm removal has been

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passed onto the regional Navigation Manager, with a CC to their OCS Project Manager on all correspondence. When applicable, this information must be included in the Report of Survey in the Supplementals section.

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6.0 Grids

6.1 File Formats

The table below lists file formats for grids derived from point cloud data that the Office of Coast Survey can review along with preferred file formats that will allow for the most efficient review timeline of the data submitted. **For NOAA ISD surveys, BAG format files must be delivered which represent the final gridded data product for the survey.**

If submitted BAGs do not contain the number of data points contributing to the depth/height solution and tracking list of user overrides, BAG submissions must be accompanied by precursor grids from processing projects.

Table of OCS Reviewable Gridded Data Formats

Format	Preferred
ONSWG BAG	**Y**
CARIS CSAR	
QPS GRD	
Esri ADF, GRD, or ASC	
ASCII XYZ	
Floating point GeoTIFF	

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6.2 Lineage

If grids submitted to the Office of Coast Survey are considered a finalized version and were derived from source grids, then the source grids must also be submitted, such that the submitted grids could be re-computed from the point cloud data. In this case, if depth thresholds have been applied, they must be applied only during the finalization stage.

6.3 Required Metadata

In addition to the metadata requirements for the survey, additional metadata is required for grids submitted to the Office of Coast Survey. Some metadata are required for all point cloud data types, while some are dependent on the technique of data collection.

Table of Grid Metadata Types

Metadata	Technique	Mandatory/Optional/Conditional
Geodetic Parameters (see **CRS**)	All	**M**
Resolution	All	**M**
Uncertainty	Acoustic Bathymetry	**M**
Uncertainty	Lidar	**O**
Vertical Uncertainty Type	All	**C**
Number of data points contributing to the depth/height solution	All	**M**
Grid Algorithm	All	**M**

6.4 Resolution

For NOAA ISD surveys, the minimum required detected feature sizes will be provided in the Project Instructions and may consist of fixed and variable values. Gridded resolutions must be ½ the size of the required detected feature sizes for the given depth ranges. Minimum required detected feature size values are based on the Quality Metric Framework presented in the Introduction and the values are shown in the table below.

Table of Minimum Required Detected Feature Sizes

OCS Quality Metric	Fixed Minimum	Variable Minimum
Exceptional	Cubic features > 0.5 meters	N/A
Critical	Cubic features > 1.0 meter	N/A
General 1	Cubic features > 2.0 meters in depths ≤ 40 meters	Features measuring > 10% of depth vertically in depths > 40 meters
General 2/3/4	Not specified	Not specified

For NOAA ISD surveys, the minimum required grid resolutions to ensure compliance with ½ the size of the required detected feature sizes are given in the tables below and must be used. At least 95% of all grid nodes must have a resolution equal to or smaller than the minimum required resolution. For grids with General 1 metrics, at least 95% of all grid nodes must have a resolution equal to or smaller than the minimum required resolution for the node depth.

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Table of Minimum Required Grid Resolution

OCS Quality Metric	Minimum Required Grid Resolution (m)
Exceptional	0.25
Critical	0.5
General 1	Depth dependent (see table below)
General 2/3/4	Not specified

Table of General 1 Minimum Required Grid Resolution

Depth Bands (m)		
Single Resolution (SR)	Variable Resolution (VR)	General 1 Minimum Required Grid Resolution (m)
0-40	0-40	1
36-80	40-80	2
72-160	80-160	4
144-320	160-320	8
288-640	320-640	16
576-1280	640-1280	32
1152+	1280+	64

As described below in Section 6.7, grids must be submitted to the Office of Coast Survey so that the metadata (including Minimum Required Detected Feature Size) does not vary within a single grid. Thus, grids (including variable resolution grids) with Exceptional and/or Critical metrics (most often used in the 0-20 meter depth range) must be submitted in a grid that is separate from grids with General 1 metrics.

6.5 Data Gaps

A gap in gridded data spanning a distance larger than the size of the features claimed to be detected by the survey is considered to be a holiday.

For NOAA ISD surveys, there must be no holidays in the grid spanning potentially significant features. To ensure there are no holidays, there must be no data gaps 3x3 grid nodes or larger at the minimum required grid resolution given per depth band in the table above. For grid resolutions offset per the given depth band in the table above, ensuring there are no data gaps equal to or larger than the data gap prescribed by the below equation will also ensure there are no holidays.

$$Data\ gap, measured\ in\ square\ grid\ nodes = floor\left(\frac{minimum\ required\ grid\ resolution\ \times 3}{grid\ resolution}\right)$$

For grid resolutions larger than then minimum required grid resolution, the result cannot be less than 1 grid node.

If gridded data submitted to the Office of Coast Survey includes interpolated grid nodes to cover data gaps, the grids must include a flag for each node that indicates if the node was interpolated or not. Note that the inclusion of interpolated grid data without identifying the specific nodes that have been interpolated will preclude the use of the data for charted sounding application but it may be used for bathymetric modeling purposes as deemed appropriate by the Office of Coast Survey.

For NOAA ISD surveys, interpolation in the grid to cover data gaps is prohibited unless authorized in the Project Instructions.

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6.6 Coverage

In some cases, 100% bathymetric coverage may not be required. The bathymetric coverage assessment must be included in the survey metadata.

If a charted sounding, or other information regarding the nature of the seafloor, suggests that the depth between survey lines is more shoal than the surrounding surveyed depths, additional survey lines may be warranted. **For NOAA ISD surveys, in depths less than 20 meters, if a charted sounding falls between two survey lines and is more shoal than the linearly interpolated depth from adjacent data by more than its maximum allowable TVU, additional survey lines must be acquired to adequately define the horizontal and vertical extents of shoals, contours, and/or significant deeps at the scale of the intended products. If this requirement results in inordinately increased survey mileage, the Field Unit should contact their OCS Project Manager to discuss the best way to proceed.**

6.7 Varying Techniques and Metadata

If multiple source techniques are used to cover a survey area, they must be submitted to the Office of Coast Survey in separate grids containing a single source technique. If survey requirements or survey techniques result in variations in the metadata as shown in **Reports**, then they must be submitted to the Office of Coast Survey in separate grids so the metadata does not vary within a single grid.

6.8 Grid Uncertainty

The uncertainty value for the grid node must be reflective of the survey system as a whole, including all instrument, measurement, and environmental uncertainty sources, and represent the hydrographer's best understanding of the Total Vertical Uncertainty of the final depth estimate presented for the grid node. These uncertainty values may consist of an a priori and a posteriori calculation or explicitly empirical values (e.g. based on a standard deviation of vertical depths).

Failure to provide uncertainty values will result in the Office of Coast Survey determining the appropriate uncertainty based on an evaluation of the data and metadata provided, as well as any other factors that are deemed relevant at the sole discretion of the Office of Coast Survey.

If using a topo-bathymetric airborne lidar system, vertical uncertainty values may be provided to the Office of Coast Survey based on the **Eren et al. model (2019)** if it has been computed.

For NOAA ISD surveys, final uncertainty values must be based on a TPU model based on the Hare-Godin-Mayer model (1995 plus later improvements), and 95% of all the uncertainty values reported in the grid nodes must not exceed the maximum allowable TVU as defined in Point Cloud.

In some rare cases, it may be appropriate for External Source Data providers to use standard deviation-based values for the final reported uncertainty. Field Units electing to use standard deviation-based values for the final uncertainty reported in the submitted grids must ensure that the sample size of independent measurements is no less than 3 independent measurements. Examples of independent measurements include any combination of two or more of the following, but are not limited to:

- Different vessels.
- Different measurement sensors.
- Different days.
- Different water level stages.
- Different datum separation models.
- Different GNSS orbits.

External Source Data providers who have questions about the appropriate uncertainty method to apply may direct their questions to the **Office of Coast Survey's ASSIST portal**, utilizing the Questions & Comments tab.

The hydrographer must examine the submitted grids and explain any areas of unusually high or low uncertainty.

Vertical Uncertainty Type

Grids submitted to the Office of Coast Survey that include uncertainty must include metadata about how uncertainty was determined.

For NOAA ISD surveys, the BAG Uncertainty Type must be populated with "Product_Uncert" per the BAG Format Specification Document.

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6.9 Density

For NOAA ISD surveys, at least 95% of all grid nodes must be populated with at least 5 soundings.

6.10 User Overrides

There may be occasions when the chosen gridding algorithm has produced a result that does not reflect the conditions throughout the entirety of the survey area. In such cases, the hydrographer may choose to override individual grid nodes produced by the gridding algorithm with a user override (commonly referred to as a designated sounding, or golden sounding) to force the grid to better portray the conditions.

As a rule, the sounding designation process should be exclusive and utilized only when the hydrographer feels it is the only tool available to accurately portray the conditions in the survey area. If a hydrographer chooses to designate a sounding, the selected sounding must represent the most reliable least depth of the feature in question. For more information on guidelines for selecting designated soundings, please see the **Field Procedures Manual**.

If the hydrographer has overridden the gridding algorithm, a tracking list of those overrides must be included in the grid which includes a description of the position of the modified grid node, the original elevation, and uncertainty values.

6.11 Algorithms

Grids submitted to the Office of Coast Survey must include metadata about the gridding algorithm used to calculate grid values. The table of gridding algorithms below is based on IHO Special Publication Number 102, 2nd Edition.

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Table of Gridding Algorithms

Algorithm	Preferred
Basic Weighted Mean	
Shoalest Depth	**Y**
Shoalest Depth true position	**Y**
TPU Weighted Mean	**Y**
CUBE (**reference**)	**Y**
Nearest Neighbor	
Natural Neighbor	
Polynomial Tendency	
Spline	
Kriging	

For NOAA ISD surveys, the gridding algorithm/population method must be CUBE unless the Project Instructions indicate otherwise.

Grid Algorithm Parameters

When using the CUBE algorithm, the maximum propagation distance must be no more than the grid resolution divided by the square root of 2.

Variable resolution surface requirements and recommendations for grids submitted to the Office of Coast Survey are presented in the tables below.

Table of VR Ranges Parameters

Estimation Method	**Ranges**	
Range Estimation Method	Percentile	**Recommendation**
Range Percentile	50	**Recommendation**
Input Band	Depth	**Recommendation**
Keep Partial Bins	True	**Recommendation**
Maximum Grid Size	128 meters	**Recommendation**
Minimum Grid Size	4 meters	**Recommendation**

Table of VR Calder-Rice Density Parameters

Estimation Method	**Calder-Rice Density**	
Finest Resolution	0.1 meters	**Recommendation**
Points Per Cell	15	**Recommendation**
Keep Partial Bins	True	**Recommendation**
Maximum Grid Size	128 meters	**Recommendation**
Minimum Grid Size	4 meters	**Recommendation**
Coarsest Resolution	64 meters	**Recommendation**
Area Estimation Method	Swath	**Recommendation**
Supergrid Size	64 meters	**Recommendation**

Table of VR Population Method Parameters

Population Method	**All**	
Input Band	Depth	**Requirement**
Primary Band	null	**Requirement**
Vertical Uncertainty Band	Depth TPU	**Requirement**
Horizontal Uncertainty Band	Position TPU	**Requirement**
Disambiguation Method	Density and Locale	**Requirement**
Bounding Polygon Type	Buffered	**Requirement**
Keep Up To Date	True	**Requirement**
Display Bias	Highest	**Requirement**
Use CHGF Mean Distance	null	**Requirement**

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7.0 Features

For surveys that have claimed to detect features, a file containing the 2D position, depth/height (if applicable), and a description of the features must be submitted to the Office of Coast Survey.

For NOAA ISD surveys, any point feature derived from point cloud data must have the least depth of the feature measured.

The 2D positions of the features in the feature file must match the 2D positions of the point cloud data from which they have been derived by less than the reported horizontal uncertainty for the survey or one grid-node buffer, whichever is the least. The one grid-node buffer means that the grid node depth that corresponds to a feature must be either the node that is closest to the feature, or one of the 8 nodes surrounding that node.

The depth/height value of the features in the feature file must match the depth/height value of the point cloud data from which they have been derived down to the centimeter level.

7.1 File Formats

The table below lists file formats for feature files that the Office of Coast Survey can review along with preferred file formats that will allow for the most efficient review timeline of the data submitted. If OGC Geopackage format files are submitted, they must be accompanied by precursor feature files from processing projects. **For NOAA ISD surveys, OGC Geopackage format files must be delivered.**

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Table of Feature File Formats

Format	Preferred
OGC Geopackage (reference)	Y
CARIS HOB	
QPS QNC	
IHO S-57*	
Comma-delimited text	

* Note that IHO S-57 requires a horizontal coordinate reference system of the geographic WGS 84 CRS (EPSG:4326) that references the ensemble WGS 84 datum. The use of ensemble datums is discouraged for products delivered to the Office of Coast Survey.

7.2 Required Metadata

In addition to the metadata requirements for the survey, additional metadata is required for feature files submitted to the Office of Coast Survey.

Table of Feature File Metadata Types

Metadata	Mandatory/Optional
Geodetic Parameters (see CRS)	M

7.3 Feature File Attribution

All features included in a feature file must include a description of the feature that, at a minimum includes a description of the type of real-world feature that is represented by the feature in the feature file. Failure to include a description of the features in the feature file will result in the Office of Coast Survey either determining the most representative feature classification from the submitted data or encoding the feature as an obstruction (i.e., S-57 OBSTRN) if the submitted data is not conclusive.

For NOAA ISD surveys, IHO S-57 and NOAA Extended attribution types are required per the Feature Attribute Encoding Guide.

Table of Feature File Attribution Requirements

Attribution	Mandatory/Optional
Feature Description	**M**
IHO S-57 Attribution	**O**
NOAA Extended S-57 Attribution	**O**

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7.4 New Features

Features discovered as part of the survey that were previously unknown must include attribution that indicates the feature is newly discovered. Features discovered more than one disproval search radius away from what could be reasonably expected to be the same feature must be treated as a new feature. If a feature is discovered within the disproval search radius but represents a different feature than the charted feature, the feature must be treated as a new feature. Further guidance on the inclusion of newly discovered features in the feature file is below.

- All new anthropogenic features (e.g., obstructions, wrecks, etc.) that at least meet the minimum size of the features claimed to be detected by the survey must be included in the feature file. All new anthropogenic features with a measured least depth must be appropriately represented in the submitted grid(s).
- All new, submerged (i.e. always underwater) natural features that at least meet the minimum size of the features claimed to be detected by the survey must be appropriately represented in the submitted grid(s) but must not be included in the feature file. Exception: all named rocks within the survey area must be appropriately represented in the surface and included in the feature file.
- Features with any horizontal dimension greater than 8.0 mm at the scale of the largest scale overlapping chart must be treated as area features and delineated appropriately. Features with lesser horizontal dimensions must be positioned and attributed as point features.
- All new, natural or anthropogenic features that are exposed at tidal datum (i.e. partly submerged at high water, covers and uncovers, awash, or always dry) and that pose a danger to surface navigation must first be considered for reporting as a Danger to Navigation and also included in the feature file.

7.5 Feature Disprovals

If a charted feature is not detected in the field, a formal disproval must be undertaken. To remove a feature from the chart, either point cloud or 200% side scan sonar data must be acquired, processed, and reviewed covering the entire feature disproval search radius to the same or better standard to be able to detect features of the size of the features claimed to be detected by the survey. The point cloud

or 200% side scan sonar data must provide conclusive evidence of absence throughout the disproval search radius.

For NOAA ISD surveys, feature investigation requirements will be provided.

Feature Disproval Search Radii

Radii are assigned based on the scale of the largest scale chart covering the area. The entire search radius must have the required coverage for a feature to be removed from the chart, with the exceptions as described below. If the search radius extends beyond the limit of the survey and no sign of the feature was detected, the feature may be re-attributed or repositioned to indicate that either it is no longer visible given the water level effect (for example, changing from covers and uncovers to always underwater for a feature not detected via imagery at low tide but for which no sounding data was acquired at that location), or was not observed at the given position (ex. change the 2D position to inshore of the area of seafloor coverage if not detected via imagery or sounding data throughout the portion of the search radius where seafloor coverage was obtained). In the case that 100% seafloor coverage cannot be obtained due to the search radius extending nearshore, but there is clearly no visual evidence of the feature, the hydrographer may recommend for its removal.

Table of General Feature Disproval Search Radii

Chart Scale	Disproval Search Radius
Larger than 1:20000	**100 meters**
1:20000 to 1:40000	**150 meters**
Smaller than 1:40000	**200 meters**

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Unverified Charted Features (UCF)

Charted features without a verified position and/or depth (i.e., features labeled as Existence Doubtful (ED), Position Approximate (PA), Position Doubtful (PD), Reported (Rep) or without a least depth or depth unknown) have different disproval search radius requirements due to the uncertainty surrounding them. In the case the feature disproval radius extends beyond the safe limit of navigation, the hydrographer must fill the radius only up to the limit of safe navigation. As with non-UCF features, UCFs may be re-attributed or repositioned but may not be marked for deletion without 100% point cloud coverage or 200% side scan sonar coverage of the search radius, unless the search radius extends nearshore and there is clearly no visual evidence of it.

Table of Feature Disproval Search Radii for UCF

Chart Scale	UCF Disproval Search Radius
Larger than 1:20000	**125 meters**
1:20000 to 1:40000	**250 meters**
Smaller than 1:40000	**500 meters**

For NOAA ISD surveys, positional UCFs will be assigned radii. UCFs with a correct position but unverified depth and without assigned radii do not need the full radius to be ensonified if found to be in their charted position relative to chart scale.

Charted Wellheads

If a charted wellhead is not found, in cases where 100% side scan sonar with concurrent multibeam is used as the primary coverage technique, a 50 meter search radius is required to disprove the feature using either point cloud or 200% side scan sonar.

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8.0 2D Imagery

8.1 2D Imagery Data File Formats

2D imagery data submitted to the Office of Coast Survey must be delivered in standardized formats to ensure consistency in the review of the data as well as the generation of products intended to be used by the public.

All 2D imagery data submitted to the Office of Coast Survey must contain georeferencing information.

For images where the georeferencing is not expected to be different on a pixel-by-pixel basis, a Joint Photographic Experts Group (JPEG) formatted file must be submitted using the Exchangeable Image File (EXIF) format version 2.2 or later for encoding the georeferencing metadata.

For images that represent a 2D gridded product, an OGC compliant, floating-point Geographic Tagged Image File Format (GeoTIFF) must be submitted.

The table below lists standard imagery file formats that the Office of Coast Survey can review along with examples of when they might be used.

Format	Example Scenarios
JPEG with EXIF metadata	• Shoreline photography from a still camera • Shoreline photography stills from a video camera • Physical seabed sample photography stills from a video camera
OGC GeoTIFF	• Orthoimagery captured from a UxS • Orthoimagery captured concurrently with lidar • Mosaic generated from Side Scan Sonar • Mosaic generated from MBES Backscatter

Table of OCS Reviewable 2D Imagery Data Formats

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8.2 GeoTIFF Required Metadata

In addition to the metadata requirements for the survey, additional metadata is required for GeoTIFFs submitted to the Office of Coast Survey.

Metadata	Mandatory/Optional
Geodetic Parameters (see **CRS**)	M

Table of GeoTIFF Metadata Types

8.3 Acoustic Intensity Sensors

For NOAA ISD surveys utilizing a towed acoustic intensity sensor, such as side scan sonar, Field Units must operate the sensor with a towfish height above the bottom (altitude) of 8 percent to 20 percent of the range scale in use. These Field Units also have a maximum allowable range scale of 100 meters.

Contacts

For surveys utilizing side scan sonar and that have claimed to detect features, contacts must be picked that have computed target heights (based on side scan sonar shadow lengths) that meet or exceed the minimum size of the features claimed to be detected by the survey. Contact locations and target heights must be included in the processing project, or submitted in a SSS contacts file generated in the same file format and required metadata as described in **Features**, and attributed as described below. Note, only horizontal geodetic parameters are applicable to the SSS contacts file. The SSS contacts file is not required if the contact locations and target heights are included in the processing project.

Table of SSS Contacts Required Attribution

Field	Mandatory/Optional/Conditional
X/λ	**M**
Y/ϕ	**M**
Computed target height	**M**
IHO S-57 Attribution	**O**

For Field Units who have submitted an S-57 attributed SSS contacts file to the Office of Coast Survey, the following **NOAA extended attributes** must be used per the legend and table below.

(m)	**Mandatory**
(c)	**Conditional**
(r)	**Restricted**

Table of SSS Contacts S-57 Attribution

Object	Attributes	
	Acronym	**Description**
$CSYMB (Cartographic Symbol)	cnthgt **(m)**	Contact height
	remrks **(c)**	Provides additional information about contacts not captured elsewhere in digital data

Data Gaps

If the effective range scale of the sensor is reduced due to external factors, then the representation of the swath coverage should be reduced accordingly. For example, changes in the water column or inclement weather may distort the outer half of a 100-meter range scale. In this case, only 50 meters of effective range could be claimed.

The claimed size of features able to be detected by the survey must be based on the primary means of detecting features. If acoustic intensity sensors are a primary means of detecting features, the size of a holiday is determined by the inability to detect features of the size claimed to be detected by the survey in the acoustic intensity data. If acoustic intensity sensors are an ancillary means of detecting features,

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the size of a holiday is determined by the inability to detect features of the size claimed to be detected by the survey in the point cloud data.

For NOAA ISD surveys, no holidays may exist in the imagery (generated from acoustic intensity) spanning potentially significant features.

Intensity Coverage

For NOAA ISD surveys, coverage limits of the survey will be provided in the Project Instructions. For nearshore surveys, the inshore coverage limit is defined by the NALL (NALL), unless stated otherwise in the Project Instructions.

Acoustic intensity sensors must be operated such that a feature of the size claimed to be detected by the survey can be reliably detected by the system and the hydrographer has the ability to detect the feature during data processing. If the claimed detected feature size includes a height or elevation, the system must be capable of detecting that height or elevation from a shadow length measurement and the processing must include the ability for the hydrographer to be able to detect the feature.

When acoustic intensity sensors identify potentially significant features, point cloud data must be collected over those features to obtain precise 3D positioning information.

If a Field Unit is utilizing an acoustic intensity sensor that has the ability to measure backscatter strength as a function of the true angle of ensonification, such as multibeam echosounder backscatter, efforts must be made to avoid acoustic saturation of the data.

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8.4 Acoustic Intensity Quality Control

If a Field Unit is utilizing an acoustic intensity sensor that has the ability to measure a swath of bathymetry concurrently, such as multibeam backscatter, the final bathymetry and full-time series backscatter must be submitted to the Office of Coast Survey in **Generic Sensor Format (GSF) version 3.09** or later. The GSF files must be accompanied by answers to the questions below that are derived from Figure 5-1 of the **Backscatter measurements by seafloor-mapping sonars report by the GeoHab Backscatter Working Group**. Include the answers in the Quality Control Procedures of the **Reports** submitted to the Office of Coast Survey. Failure to include the information will result in the Office of Coast Survey assuming a low data quality or not being able to accept the backscatter data.

- Was the backscatter calibrated? If so, was it an absolute or relative calibration?
- Do the echo sounder(s) have the dynamic range to accommodate the survey area without changes in sonar settings? If no, was the echo sounder(s) calibrated to itself across system settings?
- Will the intended acquisition configuration allow the echo sounder(s) to become saturated or nonlinear? If yes, was a technique applied to prevent system saturation?
- Were environmental variables a likely influence to the acoustic backscatter measurement? If so, was a technique applied for collecting environmental information to compensate for environmental effects?
- Did the acquisition output have a workflow that allows for post processing of backscatter data and full utilization of the data collected?

For NOAA ISD surveys, these GSF files must contain the processing parameters record and swath bathymetry ping records at a minimum so that a normalized mosaic used for preliminary segmentation may be developed with further processing at a later date if needed.

8.5 Acoustic Intensity Products

Features

Features detected by intensity sensors with computed heights (based on shadow lengths, etc.) of at least the minimum size claimed to be detected by the survey must have corresponding data from a point cloud data sensor collected at the same or better claimed-feature detection size, from which the most shoal depth over the feature must be obtained (i.e. the least depth is known). When a feature is identified with both 2D Imagery and Point Cloud data techniques, the corresponding feature included in the Feature File must be attributed with values representing the most reliable source of information with the least uncertainty about the horizontal and vertical positioning, which in most cases will be point cloud data.

Mosaics

Acoustic intensity mosaics representing the seafloor coverage obtained by the survey must be provided to the Office of Coast Survey.

The pixel resolution of the mosaic must be ½ the size of the features claimed to be detected by the survey. If features have not been claimed to be detected by the survey, the pixel resolution of the image must be 1 meter. Areas of no data must have a value of "-9999".

For NOAA ISD surveys, a required minimum feature detection size will be provided with the Project Instructions.

For surveys where side scan sonar has been used to provide more than 100% seafloor coverage, separate mosaics in GeoTIFF format must be delivered to the Office of Coast Survey for each 100% coverage obtained by the survey, grouped by each acoustic frequency.

For surveys where multibeam backscatter has been collected, separate mosaics in GeoTIFF format of the seafloor coverage obtained, grouped by each acoustic frequency and by survey system, must be delivered to the Office of Coast Survey.

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9.0 Physical Seabed Samples

For NOAA ISD surveys, if Field Units have been tasked with collecting physical seabed samples, the character of the bottom must be determined, particularly in harbors, designated anchorages, and other areas where vessels may anchor.

In general, sampling the surface sediment layer is usually adequate to define the bottom characteristics for charting. Clamshell bottom snappers or similar physical seabed samplers should be used to obtain as large a sample as possible. **For NOAA ISD surveys, if a more detailed study of the ocean floor is required, the Hydrographic Survey Project Instructions will specify the type of sampler to use.**

For NOAA ISD surveys, if a Field Unit is assigned to conduct seabed samples, the Field Unit should review the sampling plan provided within the Project Instructions to the survey data acquired. The Field Unit should contact their OCS Project Manager to discuss modifying the sampling plan if the data suggest more appropriate locations for the seabed samples (e.g., depth at specified sampling location is > 80 m, backscatter data indicate homogeneous bottom type, etc.). The survey data will often better differentiate varying bottom characteristics within the survey area when compared to the sample plan provided. This may increase or decrease the sample density but should closely maintain the same number of samples per survey as originally assigned.

In areas where seabed samples are not required but where the general trend of the newly surveyed depths significantly differs from charted depths, the Field Unit must contact their OCS Project Manager as appropriate to determine if seabed samples are necessary and to define the sample density.

The hydrographer must record the position of each sample obtained. In addition, each sample must be described and attributed in the Feature File. Refer to the **Feature Attribute Encoding Guide** for more details on physical seabed sample encoding.

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10.0 Data License

For NOAA ISD surveys, no action is required. After data submission, NOAA will assign onto the data a Creative Commons Zero 1.0 Universal Public Domain Dedication (CC0-1.0) license, which effectively waives any potential copyright and related rights in the data worldwide. This provides legal assurance to all users that they may freely access and use the data, for any purpose. The final gridded bathymetry will be publicly released under the CC0 license.

To remove any ambiguity about how data may be used, and to safeguard the interests of data providers, a license must be assigned onto data prior to submission. The machine-readable data license also facilitates automated data handling and improves communication to end users. The license options are provided below. To license data, the license identifier and URL must be included in the metadata that accompanies the data submission.

Table of License Names and URLs

License Identifier and URL	Note	Preferred
CC0-1.0	Public Domain Dedication	Y
PDDL-1.0	Public Domain Dedication	Y
CC-BY-4.0	Requires Attribution	Y
CC-BY-NC-4.0	Requires Attribution; Non-commercial use only	
CC-BY-SA-4.0	Requires Attribution and ShareAlike*	
CC-BY-ND-4.0	Requires Attribution; No Derivatives permitted*	
CC-BY-NC-SA-4.0	Requires Attribution and ShareAlike*; Non-Commercial use only	
CC-BY-NC-ND-4.0	Requires Attribution; Non-commercial use only; No Derivatives permitted*	
Restricted**	No public distribution; for Internal Use Only*	

* Restriction prohibits NOAA from applying the data towards the creation of any products (e.g. ENC, Precision Marine Navigation, etc.)

** License has no dedicated URL but the terms are listed under "Internal Use Only" on the Office of Coast Survey web page.

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11.0 Units

Data delivered to the Office of Coast Survey must adhere to standard unit of measurement reporting. The goal of reporting units in a standard way is to understand the units the data were recorded in and allow automated conversion/transformation from one unit to another if needed by the Office of Coast Survey or downstream users of published data products.

Three different classifications of deliverables require different unit reporting standards:

- Data files that have been recorded in file formats that specify the recorded units of measurement.
- Data products which include required metadata population.
- Prose Reports.

For data files that have been recorded in file formats that specify the recorded units of measurement, Field Units must adhere to the manufacturer's recommendations where they exist.

Where metadata is required to be populated by a Field Unit, standard units of measurement must be used.

A table of standard units is included for reference.

Standard SI base unit prefixes may be used where appropriate.

For prose reports, Field Units may include units of measurement that may not be captured in the standard formats included for the required metadata population. Examples include, but are not limited to Mile Marker and Shots.

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Name	Unit	Unit Abbreviation	See Note	Reference	Base Unit Prefixes Available
length	meter, metre	m	1	ISO 80000-3:2019. EPSG	Y
length	foot	ft	1	EPSG	N
length	US survey foot	ftUS	1	EPSG	N
length	nautical mile	NM	1	EPSG	N
length	statute mile	mi	1	EPSG	N
length	US survey mile	miUS	1	EPSG	N
width, breadth	meter, metre	m	2	ISO 80000-3:2019. EPSG	Y
height, depth, altitude, elevation	meter, metre	m	3	ISO 80000-3:2019. EPSG	Y
height, depth, altitude, elevation	foot	ft	3	EPSG	N
height, depth, altitude, elevation	US survey foot	ftUS	3	EPSG	N
height, depth, altitude, elevation	fathom	f	3	EPSG	N
thickness	meter, metre	m	2	ISO 80000-3:2019. EPSG	Y

diameter	meter, metre	m	2	ISO 80000-3:2019. EPSG	Y
radius	meter, metre	m	2	ISO 80000-3:2019. EPSG	Y
distance	meter, metre	m	4	ISO 80000-3:2019. EPSG	Y
area	square meter, square metre	m^2		ISO 80000-3:2019. EPSG	Y
volume	cubic meter, cubic metre	m^3		ISO 80000-3:2019. EPSG	Y
angular measure	radians	rad		ISO 80000-3:2019. EPSG	Y
phase angle	radians	rad		ISO 80000-3:2019. EPSG	Y
duration	seconds	s	5	ISO 80000-3:2019. EPSG	Y
period duration, period	seconds	s	6	ISO 80000-3:2019. EPSG	Y
duration	year	*none*		EPSG	
velocity	meters per second, metres per second	$m\ s^{-1}$		ISO 80000-3:2019. EPSG	Y
frequency	hertz	Hz		ISO 80000-3:2019. EPSG	Y
wavelength	meter, metre	m		ISO 80000-3:2019. EPSG	Y
mass	kilograms	kg		ISO 80000-4:2019. EPSG	Y
temperature	Celsius	°C	7	ISO 80000-5:2019. EPSG	N
underwater acoustic levels	decibel	dB		ISO 18405:2017	Y

Notes

1 Length does not need to be measured along a straight line.

2 Quantity is non-negative.

3 Quantity is usually signed. The sign expresses the position of the particular point with respect to the reference line or surface and is chosen by convention.

4 A metric space might be curved. An example of a curved metric space is the surface of the earth.

5 Duration is often called time.

6 A periodic event is an event that occurs regularly with a fixed time interval.

7 The symbol °C for the degree Celsius must be preceded by a space.

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11.1 Precision

Data delivered to the Office of Coast Survey must adhere to standard measures of precision when reporting values. The table below presents the required minimum and maximum values for reported precision for data delivered to the Office of Coast Survey.

Name	**Minimum**	**Maximum**
Decimal degrees	6 decimal places	none

Degrees, decimal minutes	4 decimal places	none
Degree, minutes, seconds	2 decimal places	none
Projected coordinates	1 decimal place	none
Height/Depth/Altitude/Elevation	2 decimal places	2 decimal places
Uncertainty	2 decimal places	2 decimal places

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12.0 Coordinate Reference Systems

All data and corresponding products submitted to the Office of Coast Survey must include metadata to describe the critical elements of the associated coordinate reference system (CRS) definitions. The well-known text representation (WKT) of the relevant geodetic, vertical, or compound CRS must be used, in accordance with the provisions of **International Organization for Standardization (ISO) 19111:2007 and ISO 19111-2:2009, developed in collaboration with the Open Geospatial Consortium (OGC)**. The CRS WKT 2015 or later specification ("WKT2") is preferred. The WKT2 bound CRS syntax may be used for the CRS metadata as required, to facilitate the interrelationship of a new CRS realization associated with data (bound CRS' source CRS) to that of an established geodetic CRS (bound CRS' target CRS) via a given coordinate transformation. For example, metadata for NOAA VDatum geoidal-tidal based CRS realizations can be described in WKT via the bound CRS syntax. An example of a bound CRS that meets the requirements of this specification is provided by the Open Navigation Surface Working Group (ONSWG) as part of the **BAG 2.0 metadata specification**. **ISO Geodetic Registry (ISOGR)** or **EPSG** codes included within the WKT are helpful, if available. Standalone EPSG codes as a replacement for WKT are not acceptable.

Element	Mandatory/Conditional/Optional	See Note
Coordinate Reference System Name	**M**	
Length Units	**M**	
Axis Direction	**M**	
Epoch	**C**	1
Geoid	**C**	2
Ellipsoid/Spheroid	**C**	3
Projection	**C**	4

Notes

1 If a dynamic coordinate reference system is used

2 If a geoid-based vertical coordinate reference system is used

3 If a geodetic reference frame is used

4 If a projected coordinate reference system is used

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To identify the accuracy of the reference frame precisely through metadata, CRS having a datum ensemble should not be used for products delivered to the Office of Coast Survey; instead, select the appropriate reference frame member from the ensemble to encode in the WKT metadata.

For NOAA ISD surveys, WKT CRS metadata will be provided to the Field Unit with the Project Instructions and shall serve as the CRS requirements for the project.

13.0 Reports

The Reports section describes the metadata and written reports that must be provided to the Office of Coast Survey so that the data can be properly assessed. These reports may take the form as specified in those sections as either written prose reports, **IHO compliant** metadata, or via Pydro, a freely available, open-source tool **published** by the Office of Coast Survey that includes XML reporting.

13.1 Metadata

For any data submission provided to the Office of Coast Survey, metadata fields are required to perform an assessment of the data. Failure to include this information may result in the Office of Coast Survey either assessing the data with a lower grade or being unable to use the data.

The tables below present the required metadata that must be provided to the Office of Coast Survey as well as acceptable formats for providing this information to the Office of Coast Survey. Metadata must be provided that is representative of the entire survey, and other metadata must be representative of each bathymetric grid that is submitted to the Office of Coast Survey.

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Table of Survey-specific Metadata

Name	Format	Mandatory/Conditional
Project Unique ID*	IHO S-100 Dataset abstract	**C**
Project Name*	IHO S-100 Dataset abstract	**C**
Survey Unique ID	IHO S-100 Dataset title	**C**
Survey Name*	IHO S-100 Dataset abstract	**M**
Time Zone Offset from UTC	+-hhmm (or 'Z' for UTC)	**M**
Start Date	IHO S-101 Date Start	**M**
End Date	IHO S-101 Date End	**M**
Responsible Party	IHO S-100 Point of Contact (Individual or Organization)	**M**
Contact Information	IHO S-100 Contact Information	**M**
License Identifier	String (see **Data License**)	**M**
License Deed	URL (see **Data License**)	**M**

* Project ID and Name fields marked Conditional may be provided for datasets where those fields are applicable. **For NOAA ISD surveys, these fields are required.**

Table of Grid-specific Metadata

Name	Format	Mandatory/Conditional
Horizontal Coordinate Reference System and Units	See also **CRS** requirements	**M**
Vertical Coordinate Reference System and Units	See also **CRS** requirements	**M**
Technique of vertical measurement	IHO S-101 TECSOU	**M**
Features Detected	IHO S-101 Significant Features Detected	**M**
Least Depth of Features Detected	IHO S-101 Least Depth of Features Detected	**M**
Feature Detection Ability Assessment (size in meters) Fixed	IHO S-101 Size of Features Detected	**M**

Feature Detection Ability Assessment (% of depth) Variable	IHO S-102 Size of Features Detected	**M**
Seafloor Coverage Assessment	IHO S-101 Full Seafloor Coverage Achieved	**M**
Bathymetric Coverage Assessment	IHO S-102 Bathymetric Coverage Achieved	**M**
Vertical Uncertainty Fixed	IHO S-101 Uncertainty Fixed	**C**
Horizontal Uncertainty Fixed	IHO S-101 Uncertainty Fixed	**C**
Vertical Uncertainty Variable	IHO S-101 Uncertainty Variable Factor	**C**
Horizontal Uncertainty Variable	IHO S-101 Uncertainty Variable Factor	**C**
Interpolated Data Present	Y/N	**M**

Bathymetric data derived from acoustic sensors must provide those uncertainty fields marked as conditional. Topo-bathymetric data derived from lidar sensors should provide uncertainty fields marked as conditional if it has been computed.

Metadata may be provided to the Office of Coast Survey via text file or through the use of Pydro.

For NOAA ISD surveys, metadata must be provided using the XML reporting schema provided with Pydro.

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13.2 Equipment List

For each dataset submitted to the Office of Coast Survey, information about the equipment used to collect the dataset is required to be submitted alongside the data. For each type of equipment listed below, the minimum required information for that equipment is provided.

Equipment Type	**Minimum Required Information**
Control Point	• Type of Control Point Equipment • Manufacturer • System Name • Model Number • Serial Number • Calibration Date
Platform	• Hull/ID Number (if available) • Platform Name
For each platform include the following:	
Positioning System	• Manufacturer • System Name • Model Number • Serial Number • Calibration Date
Depth/Height Sensor	• Sensor Type (see below) • Manufacturer • System Name • Model Number • Serial Number • Frequency (if applicable) • Field Calibration Date (if applicable) • Accuracy Check Date (if applicable)

Sound Speed Sensor (if using an acoustic system)	• Manufacturer • System Name • Model Number • Serial Number • Frequency (if applicable) • Calibration Date • Accuracy Check Date (if applicable)
Depth/Height Sensor Type Examples • Echo sounder • Side scan sonar • Multibeam • Diver • Lead line • Wire drag • Laser • Electromagnetic Sensor • Photogrammetry • Satellite imagery • Leveling	

For NOAA ISD surveys, equipment information must be provided using the XML reporting schema provided with Pydro.

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13.3 Quality Control Procedures

All data submitted to the Office of Coast Survey must include a description of the quality control methodology used by the Field Unit. Failure to include this information may result in the Office of Coast Survey either assessing the data with a lower grade or being unable to use the data if the assessment is unable to determine if adequate quality control procedures were in place.

Field Units must describe the methodology used to maintain data integrity, from raw data to final products. Describe all quality assurance methods and procedures. Discuss the methods used to complete crosslines comparisons, statistical analysis, directed editing, designated sounding selection, holiday identification, uncertainty assessment, and grid difference review. Describe any factors that affect the survey's adequacy and accuracy. If applicable, include methods for establishing proof of acoustic imagery swath coverage and the methods and criteria used for detecting and selecting features. If data are interpolated, include a description of the parameters used in the interpolation. Note that the inclusion of interpolated data without identifying the specific data points that are interpolated will preclude the use of the data for charted sounding application but may be used for contour generation or other bathymetric modeling purposes as deemed appropriate by the Office of Coast Survey.

For Field Units submitting multibeam backscatter, see **2D Imagery** for reporting requirements for multibeam backscatter quality control based on the Backscatter measurements by seafloor-mapping sonars report by the GeoHab Backscatter Working Group.

For NOAA ISD surveys, Field Units must include an evaluation of overlap for each junction and a summary of each junction's relative agreement of depths with respect to the maximum allowable TVU. Junctions with adjoining sheets of the current project only need to be described in one of the two data submissions.

For NOAA ISD surveys, quality control procedure documentation must be provided using the XML reporting schema provided with Pydro.

13.4 Control Point Establishment

If horizontal or vertical control points are established by the Field Unit, a written description of the processes and procedures used to establish, maintain, and quality control the control point data must be provided to the Office of Coast Survey. At a minimum, this description must include:

- The type of control point established (i.e., horizontal or vertical).
- The position of the established control point.
- The dates the control point was in operation.
- The horizontal and vertical (if applicable) uncertainty associated with the position of the control point.
- The process by which the control point data was applied to the data.

For NOAA ISD surveys, additional required information must include:

- **Vertical Control**
  - **A list of unusual tidal, water level, or current conditions.**
  - **The height and time corrections, and zoning, if different from that specified in the Hydrographic Project Survey Instructions.**
  - **Ellipsoidal benchmark positioning techniques and procedures.**
- **Horizontal Control**
  - **The latitude and longitude to at least the nearest 1/100 of a second.**
  - **The station elevation.**
  - **The geodetic station name and year it was established.**
  - **Briefly describe the methods and adequacy of positioning system confidence check.**

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13.5 Environmental Compliance

For NOAA ISD surveys, a list of all trained marine mammal observers (e.g., all officers, deck, and survey personnel) who are required to view the Marine Species Awareness Training video (produced by the U.S. Navy) must be provided to the Office of Coast Survey. The viewing of this video is considered sufficient to declare a crew member a "trained observer." The observation of marine mammals should be conducted in conjunction with both ship and small boat operations and the Marine Species Awareness Training must be completed prior to the start of the field season. A list of trained marine mammal observers and the date each observer viewed the training video (including new personnel who arrive mid-project) must be provided to the Office of Coast Survey Environmental Compliance Coordinator (ocs.ecc@noaa.gov) with a CC to the OCS Project Manager and/or COR, as appropriate. List the submission and the date of submission in the Supplementals section of the Report of Survey.

Marine mammal observations must be recorded in the provided PDF form (included in the Project Instructions). Digital photographs of observations must be taken, if possible. The marine mammal observation log and associated photographs must be submitted to pop.information@noaa.gov and ocs.ecc@noaa.gov (with a CC to the OCS Project Manager and/or COR) at the end of each project.

Sea turtle sightings must be recorded in the provided PDF form (included in the Project Instructions) for each project and must be sent to sea.turtle.sightings@noaa.gov, with a CC to ocs.ecc@noaa.gov and the OCS Project Manager and/or COR.

In the event of an unauthorized incidental "take," the Field Unit must contact the OCS Project Manager and/or COR immediately (with a CC to the HSD OPS Branch Chief at hsd.chief.ops@noaa.gov and ocs.ecc@noaa.gov).

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14.0 Survey Findings

14.1 Report of Survey

The Report of Survey is required to accompany survey data submission. The Report of Survey may be written prose with sections as described below, or it may be composed via Pydro, a freely available, open-source tool **published** by the Office of Coast Survey that includes XML reporting.

Uncertainty Sources

Failure to provide uncertainty values will result in the Office of Coast Survey determining the appropriate uncertainty based on an evaluation of the data and metadata provided, as well as any other factors that are deemed relevant at the sole discretion of the Office of Coast Survey.

If using a topo-bathymetric airborne lidar system, a vertical uncertainty model may be provided to the Office of Coast Survey based on the **Eren et al. model (2019)** if it has been computed.

Error Sources

All data submitted to the Office of Coast Survey must include a description of any unresolved errors in the provided dataset that exceeds maximum allowable uncertainties as described in **Point Cloud**. A description of any attempts to resolve the errors may also be included.

Unusual conditions

If the Field Unit experiences any unusual conditions that will affect the assessment of the data or would assist in planning future surveys in the area, these must be noted in the Report of Survey.

Additional information

Additional information may include recommendations for additional work, observations on the weather, observations of significant changes to shoreline or shoreline construction, or any other information that the Field Unit believes would assist in planning future surveys in the area.

PI Modifications

For NOAA ISD surveys, it is required to list a record of any modifications to the Project Instructions (ex. changes memos, waivers) and the date the change was made.

Supplementals

For NOAA ISD surveys, it is required to list the supplemental records, reports, and data files that were sent during survey, and the date they were sent. Supplementals include the Coast Pilot Report, Danger to Navigation Report(s), Charted Feature Removal Report(s), Seep and Pipeline Report(s), list of Trained Marine Mammal Observers, Final Survey Outline, and NCEI Sound Speed Data. Do not list Progress Reports in this section.

14.2 Coast Pilot Report

For NOAA ISD surveys, verification of Coast Pilot information referred to as a Coast Pilot Review must be conducted for each assigned survey area. Additionally, information relating to the general

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operations area (e.g., areas frequently transited and facilities utilized during in-ports) should be reviewed and verified or updated to whatever extent practicable.

A Coast Pilot Field Report will be provided by the Office of Coast Survey. This report may contain specific questions about items in the Coast Pilot that require field verification or clarification. In addition, this report may contain the actual paragraphs from the Coast Pilot that are affected by the survey area.

Coast Pilot is updated weekly. Updated Coast Pilot books can be downloaded from the Coast Pilot website. The hydrographer must first download the latest edition of Coast Pilot and compare it against the information contained in the Coast Pilot Field Report. In the event of a conflict between the two sources, the review must be completed using the information in the downloaded Coast Pilot.

The Field Unit must use either the latest edition of the Coast Pilot downloaded from the Coast Pilot website, or the Coast Pilot Field Report, whichever is the latest version.

A Coast Pilot Review Report must be submitted following the completion of operations within a project area, and no later than at the time of submission of the first survey for that project. If an updated edition of the Coast Pilot was used, this must be noted. In this report, the hydrographer must respond to each question posed in the Coast Pilot Field Report. If the hydrographer is not able to address a specific question, that must also be noted. In addition, the hydrographer must make reasonable attempts to verify the text of the actual Coast Pilot paragraphs that are affected by the survey during field operations. Updates must be made as follows:

- **Deletions to the existing text must be shown as strikethroughs.**
- **Recommended revisions, including any new information that would be beneficial to the mariner, must be shown in red text.**
- **Existing text that has been reviewed and verified to be correct during Field Unit operations must be changed to green text.**
- **Existing text that could not be verified or refuted during operations must remain in black.**

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The consolidated Coast Pilot Review Report must be submitted in a PDF and must include answers to the specific questions, updates to the actual paragraph text, and the original Coast Pilot Field Report. This file must be named per the file naming convention presented in Delivery Structure.

Field Units must submit this file via email to ocs.ndb@noaa.gov and coast.pilot@noaa.gov with a CC to the OCS Project Manager and/or COR. List the submission and date of submission in the Supplementals section of the Report of Survey.

14.3 Danger to Navigation Report

All features with depths of 20 meters or less in navigable waters may be considered potential Dangers to Navigation (DTON) and subject to reporting. Potential DTONs should be evaluated in the context of the largest scale chart of the area and with detailed knowledge of vessel traffic in the area, including usual and seasonal routes.

For NOAA ISD surveys, as soon as practicable after discovery, the hydrographer must report all DTONs to the appropriate authority. Timeliness is a critical issue in reporting DTONs. Should additional dangers be discovered during the processing of the survey, they must be immediately reported.

Reporting DTONs to NOAA

External Source Data providers may report DTONs through the **Marine Chart Division's ASSIST customer service chart reporting system**.

NOAA Field Unit Reporting

For NOAA ISD surveys, Field Units must submit all NOAA DTONs via email directly to Marine Chart Division's (MCD) Nautical Data Branch at email address ocs.ndb@noaa.gov, with a CC to the OCS Project Manager, HSD Operations Branch Chief at hsd.chief.ops@noaa.gov or NSD Navigation Response Branch Chief at chief.nrb.ocs@noaa.gov as appropriate, the Chief of the applicable Hydrographic Branch, the applicable Regional Navigation Manager and ocs.nbs@noaa.gov.

- **The email subject line must adhere to the following convention:**
  - **<registry number> DTON ##**
  - **e.g., H12345 DTON 03**
- **The body of the email must list the following metadata in the following order:**
  - **General Locality**
  - **Sub-locality**
  - **Project Number**
  - **Registry Number**
  - **Field Unit**
- **The feature file:**
  - **May contain point, line, or area features.**
  - **Must adhere to the naming convention presented in Delivery Structure.**
  - **Must include NOAA Field Unit DTON recommendations and be generated as described in Features.**
  - **Must be attributed in accordance with the Feature Attribute Encoding Guide.**
- **At least one chartlet image portraying the feature least depth sounding and position with the largest-scale ENC as the background must be compressed in a single zip file and included with the naming convention presented in Delivery Structure.**
- **Images of sonar data (e.g., multibeam or side scan imagery) must not be included.**
- **Attach the feature file and accompanying multimedia zip file to the email.**

List each submission and date of submission in the Supplementals section of the Report of Survey.

NOAA Contractor Unit Reporting

Contractors must submit all NOAA DTONs via email to the OCS Project Manager and/or COR and the appropriate Hydrographic Branch (ahb.dton@noaa.gov or phb.dton@noaa.gov) stated in the Hydrographic Survey Project Instructions.

Contractor DTON recommendations must be submitted as a feature file attributed in accordance with the Feature Attribute Encoding Guide. The feature reporting must adhere to the same requirements as NOAA Field Unit Reporting with the exception:

- **Submit sonar images of multibeam and side scan sonar images as supporting data. All images and chartlets must be submitted in a multimedia zip file.**

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Reporting DTONs to Non-NOAA Source Authorities

NOAA is not the source authority for some charted features such as controlling depths in federal channels, Aids to Navigation (ATONs), bridge heights, and pipelines. The reporting procedures for these types of dangers are described in this section.

Federal USACE Channels

The U.S. Army Corps of Engineers (USACE) is a source of controlling depths in federal channels on NOAA charts. If surveying within a USACE maintained channel, the hydrographer must conduct a comparison of survey depths with the DRVAL1 attribute found in the ENC's DRGARE feature object in all maintained channels. **For NOAA ISD surveys, when survey sounding(s) or obstructions located in the channel are found to be shoaler than the controlling depth of that channel, then the hydrographer must immediately report these results to the OCS Project Manager and/or COR with a CC to the HSD Operations Branch Chief at email hsd.chief.ops@noaa.gov or NSD Navigation Response Branch Chief at chief.nrb.ocs@noaa.gov, as appropriate. The OCS Project Manager and/or COR will inform the Navigation Manager via email with a CC to CAB.Chief@noaa.gov and ocs.nbs@noaa.gov. List each submission and date of submission in the Supplementals section of the Report of Survey.** The **Navigation Manager** must address the issue with the USACE, USCG, and communicate the findings to the local Pilots.

Aids to Navigation (USCG)

The **U.S. Coast Guard (USCG) Local Notice to Mariners** and the **USCG Light List** are the sources of charted Aids to Navigation on NOAA charts.

Class 1 and Class 2 Aids to Navigation

If any type of aid to navigation that is listed in the USCG Light List and the USCG considers as Class 1 and Class 2 is found to be uncharted, missing, or repositioned, the hydrographer must report it to the USCG using the **USCG Navigation Center's Online ATON Discrepancy Report Form**. **For NOAA ISD surveys, a PDF copy of the report submitted to the Navigation Center (select "printer friendly version") must be emailed to the OCS Project Manager and/or COR and Navigation Manager. List each submission and date of submission in the Supplementals section of the Report of Survey.**

Class 3 Aids to Navigation

If any private navigation aid that the USCG considers as Class 3, and not included in the USCG Light List, is found to be uncharted, missing, or repositioned, the hydrographer must report it through the **Marine Chart Division's ASSIST customer service chart reporting system**.

Report the private aid to navigation using the 'Report an Error' tab, providing the reporting person's email address, attributing the geographic location of the discrepancy, selecting the type of user, describing the error, selecting the product type, attributing the observation date, and attaching any images or documents. The ASSIST system will respond with an email from **ocs.customersupport@noaa.gov.** **For NOAA ISD surveys, that email must be sent to the OCS Project Manager and/or COR, and the Navigation Manager. List each submission and date of submission in the Supplementals section of the Report of Survey.**

Bridge Heights (USCG)

The USCG is a source of bridge heights on NOAA charts. If a bridge height is found to be inaccurate or missing from a chart during field work, the hydrographer must inform the local **USCG District's Bridge**

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Program via email with the pertinent information. **For NOAA ISD surveys, CC the OCS Project Manager and/or COR and the Navigation Manager. List each submission and date of submission in the Supplementals section of the Report of Survey.**

For NOAA ISD surveys, information regarding bridge heights sent to USCG must also be sent to the Marine Chart Division (MCD) Nautical Data Branch via email as follows:

- **The body of the email must list the following metadata in the following order:**
  - **General Locality**
  - **Sub-locality**
  - **Project Number**
  - **Registry Number**
  - **Field Unit**
- **A feature file of the bridge**
  - **Must be generated as described in Features and attributed in accordance with the Feature Attribute Encoding Guide.**
  - **Must include vertical clearance of the bridge.**
  - **For bridges that open or lift, the opened and closed vertical clearance of the bridge must also be included.**

For NOAA Field Units, the feature file must be submitted to the Nautical Data Branch at ocs.ndb@noaa.gov, with a CC to the OCS Project Manager and/or COR with the naming convention presented in Delivery Structure.

For Contractors, the feature file must be submitted to the OCS Project Manager and/or COR and the appropriate Hydrographic Branch stated in the Hydrographic Survey Project Instructions (ahb.dton@noaa.gov or phb.dton@noaa.gov) with the naming convention presented in Delivery Structure.

List each submission and date of submission in the Supplemental section of the Report of Survey.

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14.4 Charted Feature Removal Request

Charted features that are determined not to exist and that have a significant impact on navigation should be expeditiously removed from the chart, if sufficiently disproved. In particular, this includes disproved “Position Approximate” wrecks and obstructions that are located in major shipping corridors. The Charted Feature Removal Request (commonly known as an Anti-DTON) is similar to a Danger to Navigation Report, except it is used to remove a charted feature that represents a hazard, which does not exist, rather than add a newly found hazard. This process should be used sparingly, usually by responding to a request from local pilots or other authorities that a charted feature is a hindrance to operations. If the removal of a feature is not time-critical, do not use the Charted Feature Removal Request (Anti-DTON).

For NOAA ISD surveys, if local authorities request the hydrographer to investigate a feature that has not been assigned, contact the OCS Project Manager and/or COR for a determination of the search criteria. Once the hydrographer meets the search criteria and determines the feature does not exist, they must prepare the Charted Feature Removal Request and follow the same submission procedure and format requirements as Dangers to Navigation.

14.5 Seep and Pipeline Reports

For NOAA ISD surveys, seeps and unburied charted and uncharted pipelines must be reported to the appropriate federal or state contact listed in the Project Instructions, with a CC to the OCS Project Manager and/or COR and the Navigation Manager.

For possible seeps, the body of the email must include:

- **The location of the seep (latitude/longitude).**
- **The distance from the charted feature.**
- **The date and time of observation.**
- **The depth (if appropriate).**
- **An image.**

Sample text for seep:

Subject: Possible Seep 1

Body: A NOAA Contractor surveying in the Gulf of Mexico has discovered a possible seep. The feature has a form and morphology typical of ascending gas or bubble plumes and was found at latitude XXX/ longitude XXX on January 1, 2017 at 0902 UTC. This feature is X meters from the (un)charted wellhead.

For unburied pipelines, the information shall be conveyed in an Excel spreadsheet, attached to the email. The Excel spreadsheet must have the following columns in this order:

- **Starting Latitude**
- **Starting Longitude**
- **Ending Latitude**
- **Ending Longitude**
- **Bearing**
- **Length (meters)**
- **Height Above Seafloor (meters)**
- **Survey Sheet**
- **Date of Discovery**
- **Comments**

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A zip file of any related 2D/3D images from the multibeam echo sounder or side scan sonar data acquired over each exposure shall also be attached to the email.

Charted or uncharted pipelines that are elevated at least 1 meter off the bottom between depths of 0 and 20 meters and 10% off the bottom in depths greater than 20 meters may pose a hazard to surface navigation and may be considered as a DTON.

Uncharted exposed or elevated pipelines that are not considered DTONs must be reported to the Marine Chart Division (MCD) Nautical Data Branch. This reporting may include some of the same pipelines reported to the federal or state contact.

NOAA Field Units must submit all uncharted, non-dangerous, exposed pipelines via email directly to Nautical Data Branch as follows:

- The body of the email must list the following metadata in the following order:
  - General Locality
  - Sub-locality
  - Project Number
  - Registry Number
  - Field Unit
- Screen captures of side scan sonar images, multibeam images, or chartlets (if applicable) of the exposed pipeline.
- A feature file of the pipeline.
  - Must be generated as described in Features and attributed in accordance with the Feature Attribute Encoding Guide.
  - Must also include any features connected to the pipeline that provide insight into the pipeline's type.

The feature files and images must be submitted to the Nautical Data Branch at ocs.ndb@noaa.gov, with a CC to the OCS Project Manager and/or COR with the naming convention presented in Delivery Structure.

Contractors must submit non-dangerous exposed pipelines via email to the OCS Project Manager and/or COR and the appropriate Hydrographic Branch stated in the Hydrographic Survey Project Instructions (ahb.dton@noaa.gov or phb.dton@noaa.gov) with the naming convention presented in Delivery Structure.

List each submission and the date of submission in the Supplementals section of the Report of Survey.

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14.6 Potentially Sensitive Data Findings

For NOAA ISD surveys, a preliminary feature file summarizing all uncharted wrecks and uncharted anthropogenic obstructions in the hydrographic survey must be submitted as soon as practicable after all features are identified in the survey.

- The preliminary feature file must only contain uncharted wrecks and uncharted anthropogenic obstructions.
- Features that are already charted in a different position must not be submitted, with the exception of any DTONs that were submitted during survey operations and subsequently charted.
- Wrecks and anthropogenic obstructions that were submitted as DTONs must be included in the preliminary feature file.

NOAA Field Units and Contractors must submit all potentially sensitive data findings via email to the Hydrographic Branch at feature.reporting@noaa.gov, with a CC to the OCS Project Manager and/or COR.

The email subject line must adhere to the following convention:

- <registry number> Feature Report ##
- e.g., H12345 Feature Report 03
- The body of the email must list the following metadata in the following order:
  - General Locality
  - Sub-locality
  - Project Number

    - **Registry Number**
    - **Field Unit**
- **The preliminary feature file:**
    - **May contain point, line, or area features.**
    - **Must adhere to the naming convention presented in Delivery Structure.**
    - **Must be generated as described in Features.**
    - **Must be attributed in accordance with the Feature Attribute Encoding Guide. For timeliness, preliminary attribution that differs from the attribution in the final feature file is acceptable.**
- **At least two images are required per feature and may include multibeam subset images or side scan contact images.**
- **If side scan sonar data was collected, a side scan image is required.**
- **Images must include the approximate dimensions (length, width, and height) in meters.**
- **Images must be compressed in a single zip file with the naming convention presented in Delivery Structure.**
- **Attach the feature file and accompanying multimedia zip file to the email.**

List each submission and the date of submission in the Supplementals section of the Report of Survey.

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15.0 Survey Progress

15.1 Weekly Progress Reports

For NOAA ISD surveys, Field Units must submit regular progress reports to keep the Office of Coast Survey apprised of ongoing fieldwork and data processing. The Field Unit must submit a weekly progress report and updated coverage grid or GeoTIFF beginning on the first day of project mobilization through project data submission to the Office of Coast Survey.

Report submission guidelines:

- **Must be submitted no later than the Field Unit's local close-of-business time on Monday to the project Google Drive folder identified by the Office of Coast Survey.**
- **The reporting week is defined as Sunday to Saturday.**
- **The report may be sent monthly, due the first Monday of the month, once vessel demobilization has occurred and no further data acquisition will occur on the project.**
- **If there is a planned extended break in operations, the Field Unit may pause submissions as long as they communicate the start and projected end of the break to the OCS Project Manager and/or COR via email, and receive approval to pause submissions from the OCS Project Manager and/or COR.**

The progress report must contain:

- **Survey start and end dates.**
- **Linear nautical miles and square nautical miles.**
- **Survey processing progress including cumulative percentage complete.**
- **A brief narrative summarizing all activities of the past week and anticipated activities for the next week. This shall include all activities related mobilization/de-mobilization, data acquisition and processing, and any issue which could impact requirements or milestones (e.g. significant delays due to weather or equipment failures).**

With the weekly progress report, submit an up-to-date coverage grid or GeoTIFF depicting cumulative data acquisition coverage with the following specifications:

- **A single band, gray scale 32-bit depth floating point raster, at 8 meter or 16 meter grid resolution projected to the project's NAD83 UTM zone.**
- **Z-values must be positive down, in meters, and areas of no data must have a value of -9999.**
- **Acceptable raster file formats include BAG, CSAR, and TIFF. Side scan sonar coverage maps may be submitted in TIFF format.**
- **Naming convention must follow: OPR-X###_XX_##_<year><month><day>.<bag/csar/tiff> (e.g., OPR_A123_KR_21_202110720). If the project coverage is split up into disparate regions or spatial constraints hinder a single project level coverage submissions, use 'xofx' designations as appropriate (e.g., OPR_A123_KR_21_20210720_1of2_.tiff).**

The publicly available Pydro tool “Scribble” facilitates semi-automated report compilation to a spreadsheet. NOAA Field Units tasked with Project Instructions issued by the Office of Coast Survey must use Scribble for weekly progress report submission.

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15.2 Final Progress Report

The purpose of the final progress report is to provide a graphic and a one-page summary of the project accomplishments. At the Office of Coast Survey's discretion, the report or portions of the report may be shared internally or externally.

For NOAA ISD surveys, the Field Unit must submit the final progress report within 30 days of completion of fieldwork to the assigned OCS Project Manager and/or COR with a CC to progress.sketches@noaa.gov. The final progress report must be submitted to the Google Drive location specified by the OCS Project Manager and/or COR.

Final Progress Report Contents:

- **Project graphic - Graphic showing final data coverage, the project sheet limits, and appropriate chart.**
- **Project Metadata and Statistics - For each survey of the project list the Survey Start Date, Survey End Date, Total SNM, Total LNM, and Total Number of Addressed Unverified Charted Features.**
- **Recommendations and Notes - This may include recommendations for future surveys in the area, interesting findings or acquisition strategies, and/or unique challenges.**

The final progress report must be submitted as a PDF following the naming convention presented in the Delivery Structure section. A template may be provided by the OCS Project Manager or COR.

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15.3 Survey Outline

For NOAA ISD surveys, after completion of all fieldwork for a given survey sheet, the hydrographer must provide a survey outline that shows the extent of hydrography completed for the registered survey (e.g., H number). This outline must bound the extent of continuous survey data judged by the hydrographer to be adequate to supersede the chart.

Careful attention should be paid to the nearshore area to ensure that features and bathymetry inshore of the NALL are not included. The survey outline need not include all discrete features contained in the feature file deliverable (e.g., a rocky area or ledge may extend inshore of the survey outline). Also, the Survey Outline should not inscribe high water features positioned inshore of the NALL (e.g., Aids to Navigation).

The only exception to this is coverage acquired pursuant to the investigation of assigned items from the Office of Coast Survey, which should be inscribed by the Survey Outline and lidar surveys. The survey outline for a lidar survey must be coincident with the MHW line.

The final survey outline must normally be a single, enclosed polygon bounding the final surveyed area as described above. In cases where this area includes an unsurveyed region (e.g., an island), the survey outline file will also include an interior limit (i.e., 'donut hole') following the NALL around this area. In cases where the survey includes a detached surveyed area (e.g., an assigned item with a search radius that does not intersect the main body of the survey), the final survey outline file must include a separate polygon for the detached area.

The final survey outline must be submitted as either an S-57 attributed feature in OGC Geopackage format or as a shapefile. The outline must be included as the S-57 Feature Object Class M_COVR. The outline must not be included in the feature file. The M_COVR feature must be attributed in accordance with the Feature Attribute Encoding Guide.

To submit the outline in shapefile format, the submission must be in the coordinate reference system defined by the Field Unit as part of Geodesy requirements and include the following file formats (compressed in a single zip file):

- **.shp - containing feature geometry.**
- **.shx - containing positional index of the feature geometry.**
- **.dbf - containing feature attributes.**
- **.prj - containing coordinate system and projection information.**

The shapefile Attribute Table must be populated with the Platform, State, Scale, and category of coverage.

Final survey outlines must be submitted via email survey.outlines@noaa.gov with a CC to the OCS Project Manager and/or COR. List the submission and date of submission in the Supplementals section of the Report of Survey. The final survey outline must also be included in the final data submission to the Office of Coast Survey in the Report folder.

The final survey outline should be submitted as soon as practical after completion of fieldwork. If the outline has not been submitted within 30 days of completion of fieldwork, the hydrographer must contact the OCS Project Manager and/or COR to explain the delay and provide an estimate for delivery. Any large differences (± 10%) between the total square nautical miles reported in the Final Progress Report and the area defined by the survey outline should be explained in the cover email.

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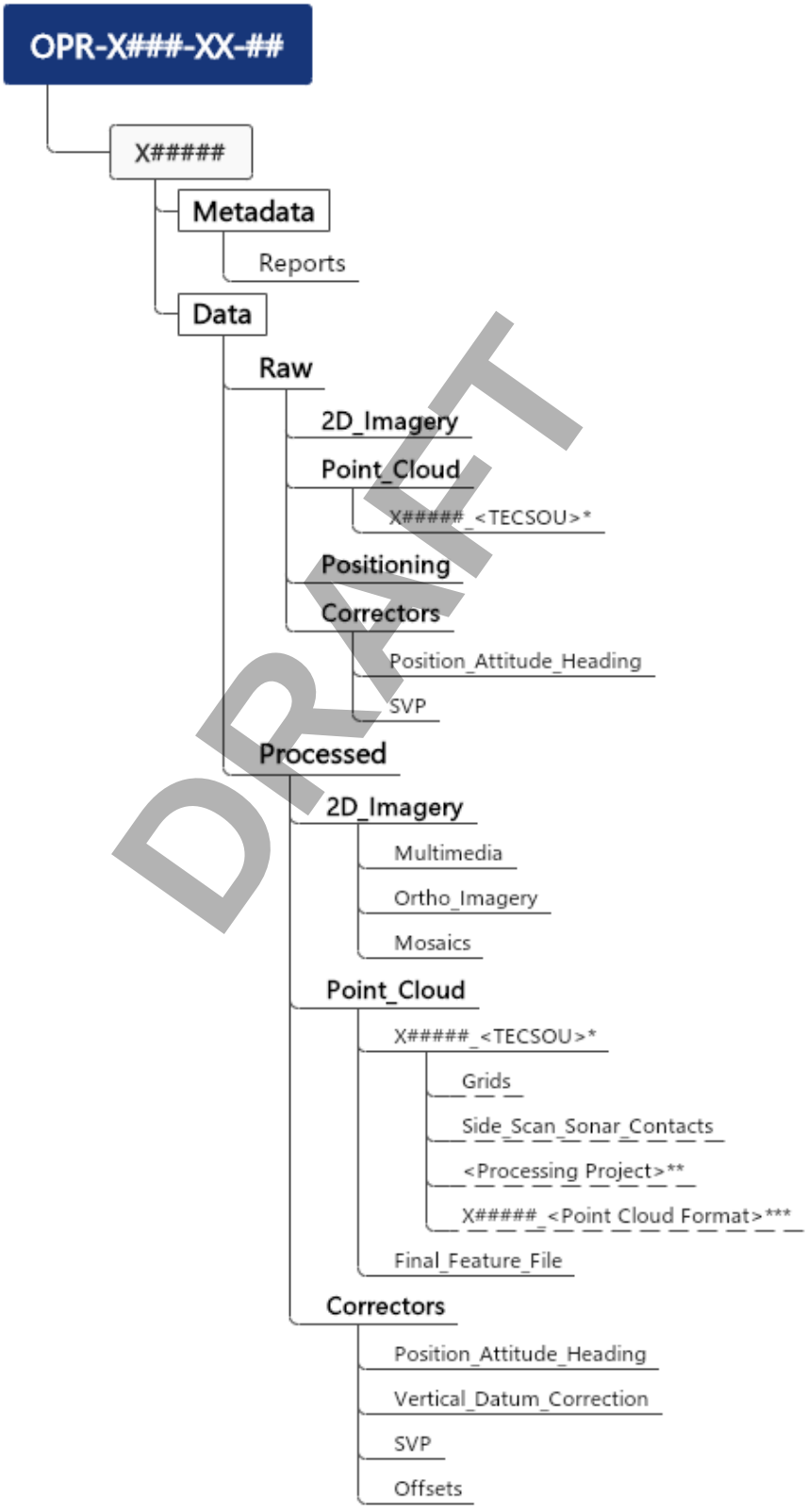
16.0 Delivery Structure

For NOAA ISD surveys, survey submissions must be sent to the processing branch listed in the Project Instructions.

16.1 Folder Structure

For NOAA ISD surveys, the folder structure must be as shown below.



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- Dashed lines indicate the folders are conditional.

- The top level is Project Unique ID (e.g. OPR-A123-KR-22).
- Survey Unique ID (e.g. H12345) is used in different parts of the folder structure.

* See the below table for TECSOU folder names for the contents of Point Cloud.

** Processing project names and sub-folders must adhere to manufacturer recommendations (e.g. HDCS_Data for CARIS). If a single processing project is submitted and it contains data derived from more than one TECSOU, it must be placed at the level above this one (i.e. Processed/Point_Cloud).

*** For point cloud data submitted that is not part of a processing project. The folder name must contain the point cloud format (e.g. H12345_GSF).

Table of TECSOU Folder Names

TECSOU	Folder name example
Found by echo sounder (TECSOU = 1)	H12345_VB
Found by side scan sonar (TECSOU = 2)	H12345_SSS
Found by multibeam (TECSOU = 3)	H12345_MB
Found by laser (TECSOU = 7)	H12345_LI
Found by photogrammetry (TECSOU = 10)	H12345_PH
Found by satellite imagery (TECSOU = 11)	H12345_SDM
Found by levelling (TECSOU = 12)	H12345_LV

16.2 Naming Conventions

For NOAA ISD surveys, the file naming conventions must be in accordance with the requirements listed in this section.

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Metadata/Reports

- The reports required for submission to the Office of Coast Survey (Metadata, Equipment List, Quality Control Procedures, Control Point Establishment, and Report of Survey) as described in **Reports** and **Survey Findings** are each included within the Survey Metadata XML form available in Pydro, a freely available, open-source tool **published** by the Office of Coast Survey that includes XML reporting.

Naming Convention	Example
<Survey Unique ID>_Survey_Metadata.xml	H12345_Survey_Metadata.xml
<Survey Unique ID>_Outline.shp	H12345_Outline.shp

Supplemental Survey Findings Reports

- Submitted directly and not included in Folder Structure

Naming Convention	Example
<Project Unique ID>_Coast-Pilot-Review-Report.pdf	OPR-A123-KR-22_Coast-Pilot-Review-Report.pdf
<Survey Unique ID>_DTON_##.gpkg	H12345_DTON_01.gpkg
<Survey Unique ID>_DTON_##_Multimedia.zip	H12345_DTON_01_Multimedia.zip
<Survey Unique ID>_Pipeline_##.gpkg	H12345_Pipeline_01.gpkg
<Survey Unique ID>_Bridge_Clearance.gpkg	H12345_Bridge_Clearance.gpkg
<Survey Unique ID>_Feature_Report_##.gpkg	H12345_Feature_Report_01.gpkg
<Survey Unique ID>_Feature_Multimedia.zip	H12345_Feature_Multimedia.zip
<Project Unique ID>_<YYYY><MM><DD>_<#of#>.<bag/csar/tiff>	OPR_A123_KR_10_20230730_1of1.tiff

<Project Unique ID>_Final_Progress_Report_<YYYY><MM><DD>.pdf	OPR_A123_KR_Final_Progress_Report_20230830.pdf

Data/Raw

- Raw file naming conventions must adhere to manufacturer recommendations.
- No further naming requirements are specified by the Office of Coast Survey.
- See **Raw Data** for common raw data file type examples.

Data/Processed/2D_Imagery/Multimedia

- The Multimedia directory must not contain sub-folders.
- See images section in **Feature Attribute Encoding Guide** for feature image requirements.
- No further naming requirements are specified by the Office of Coast Survey.

Data/Processed/2D_Imagery/Ortho_Imagery

- No naming requirements are specified by the Office of Coast Survey.

Data/Processed/2D_Imagery/Mosaics

Naming Convention	Example
<Survey Unique ID>_SSSAB_<Resolution>_<frequency>kHz_<#of#>.tiff	H11000_SSSAB_1m_455kHz_1of2.tiff
<Survey Unique ID>_MBAB_<Resolution>_<frequency>kHz_<#of#>.tiff	H12000_MBAB_1m_3101_400kHz_2of3.tiff

Data/Processed/Point_Cloud/X#####_<TECSOU>/Grids

Naming Convention	Example
<Survey Unique ID>_<Sounding Type>_<Resolution>_<Vertical Datum>_<#of#>*	H11000_MB_50cm_MLLW_1of2.bag H11000_MB_1m_MLLW_2of2.bag H12000_MB_VR_LWD_1of1.bag H13000_VB_4m_MLLW_1of1.bag H14000_LI_2m_MLLW_1of2.bag H14000_LI_2m_MLLW_2of2.bag

* The trailing number in #of# must be the total number of grids associated with the Survey Unique ID.

Data/Processed/Point_Cloud/X#####_SSS/Side_Scan_Sonar_Contacts

- Not required for submission if contact locations and computed target heights are captured within the processing project.

Naming Convention	Example
<Survey Unique ID>_SSS_Contacts	H12345_SSS_Contacts.gpkg

Data/Processed/Point_Cloud_Final_Feature_File

Naming Convention	Example
<Survey Unique ID>_FFF	H12345_FFF.gpkg

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Data/Processed/Point_Cloud/Correctors

- No naming requirements are specified by the Office of Coast Survey.
- Only include files directly applied to the final processed data.
- The table below is not all-inclusive.

Expected Files	Common Examples
Position and Motion files	• Applanix SBET and SMRSMG • Kongsberg BIN
Vertical Datum Correction Files	Separation Model • ASCII XYZ • GeoTIFF • ONSWG BAG • CARIS CSAR Water levels and tide files • CARIS TID • Zoned Tide ZDF • TCARI TC
SVP files	• Kongsberg ASVP • CARIS SVP
Offsets	• Vessel file*

* Not required for submission in this location if offsets are captured within submitted data file(s) or the processing project.

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17.0 Feature Attribute Encoding Guide

For Field Units who have submitted a feature file to the Office of Coast Survey, the following S-57 attribution must be used per the legend below. In addition to S-57 attribute standards are **NOAA extended attributes**.

(m)	**Mandatory**
(c)	**Conditional**
(r)	**Restricted**

17.1 Assigned/New/Update/Disproved Features

The following rules are applicable to all Assigned (i.e. asgnmt = Assigned), New, Update, and Disproved features (i.e. descrp = New, Update, or Delete).

Attribute	Description	
descrp (m)	Description **(m)**	Portrays the field charting action.
	New **(m)**	New features or new position.
	Update **(m)**	Modification to attribution, geometry, and/or feature object class. Exception: change of geometry for line and area.
	Delete **(m)**	Disprovals or erroneous features.
	Retain **(m)**	Addressed items that are represented properly on the chart. Include a remark for information purposes as necessary.
	Not Addressed **(m)**	For assigned items that were not addressed, include remark describing why the feature was not addressed.

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17.2 Disproved/Retained/Not Addressed Features

Disproved, Retained, and Not Addressed features (i.e. descrp = Delete, Retain, or Not Addressed) will always maintain their original SORDAT and SORIND and other associated attribution. Remarks may be used as-needed. If the feature is recommended for deletion (i.e. it is Disproved) based on criteria or reasoning other than what is required in Section 7.5 in **Features**, Remarks should be provided.

Attribute	Description	
remrks (c)	Remarks **(c)**	Provides additional information about features that is not captured elsewhere in digital data (e.g. S-57 attribution)

17.3 New/Updated Features

The following rules are applicable to all New and Update features (i.e. descrp = New or Update).

Attribute	Description	
SORIND (m)	Source Indication **(m)**	Information about the source of the object
• Country Code: US • US Authority code: US for the Office of Coast Survey • Source: graph • ID code: registry number • Example: US,US,graph,H12345 Note: there must not be any spaces after comma separated values in the SORIND.		
SORDAT (m)	Source Date **(m)**	The last day of survey acquisition formatted as YYYYMMDD

• For DTON Report submissions, SORDAT must be the date the feature was surveyed. • For feature file submissions, SORDAT must be the last day of survey acquisition.		
OBJNAM (c)	Object Name **(c)**	Include for named features that are retained or relocated
remrks (c)	Remarks **(c)**	Provides additional information about features that is not captured elsewhere in digital data (e.g. S-57 attribution)
• Do not include exact geographic positions (latitude and longitude), least depths, etc.		
sftype (c)	Special Feature Type **(c)**	Indicates a feature with special designation
	ATON **(c)**	ATON investigations
	DTON **(c)**	Dangers to Navigation
	Maritime Boundary **(c)**	Maritime Boundary investigations
	Lidar investigation **(c)**	Lidar investigations
	Unverified Charted Feature **(c)**	Unverified Charted Feature
images (c)	Images **(c)**	Images associated with a feature (e.g. MBES or SSS screen captures, or digital photos)
• Images are required for DTONs, maritime boundary points, wrecks, and non-foul obstructions (not foul area/ foul ground). • Images associated with wrecks and non-foul obstructions must include the approximate dimensions (length, width, and height) in meters. • Images for DTONs must include one chartlet image portraying the feature least depth sounding and position with the largest-scale ENC as the background. • Unless specified in the attribution guide, images should not be included unless there is something unique or significant about the feature. • The required format for all images is JPEG with EXIF metadata or GeoTIFF. See **2D Imagery**. • Images must have a unique identifier name. However, it is permissible to reuse the same image for different cartographic features, when applicable. • Multiple images for one feature must be semicolon delimited. • All images may reside in a prescribed location to permit viewing within a processing software, but copies of all images (and photos) must be placed in the Multimedia folder. • Do not include images in the S-57 PICREP attribute.		
asgnmt (c)	Assignment Flag **(c)**	Indicates assignment status of items delivered to the field by the OCS Project Manager and/or COR
	Unassigned **(c)**	Not Assigned
	Assigned **(c)**	Assigned
	For Info Only **(c)**	For information only
invreq (c)	Investigation Requirements **(c)**	Specific investigation requirements defined by the OCS Project Manager and/or COR

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New vs Update Encoding

The following are typical examples of how to encode New vs Update for features.

- Charted point feature is found in new position via multibeam, lidar, vessel-mounted laser scanning, or any remote sensing system capable of generating a georeferenced point cloud at a resolution able to support creating a gridded product at 1/2 the size of the features claimed to be detected by the survey:
  - descrp = Delete for the charted feature.
  - descrp = New for surveyed feature (derived from grid or point cloud).
- Charted point feature is found via visual observation or handheld laser range finder, within 10 meters of the charted feature:

    - descrp = Update (populate surveyed height/depth of feature, not position; update other attribution accordingly, if different).
- Charted point feature is found via visual observation or handheld laser range finder, greater than 10 meters from the charted feature:
    - descrp = Delete for charted feature.
    - descrp = New for surveyed feature (derived from visual observation or handheld laser range finder).
- Charted line or area feature geometry has changed, and less than half the node coordinates are affected:
    - descrp = Update; then manually edit the geometry.
    - If the new area extents border the edge of bathymetry, instead of manually editing the geometry, the hydrographer may use recomd = edit the geometry to extents of bathymetry.
- Charted line or area feature geometry has changed, and more than half the node coordinates are affected:
    - descrp = Delete for charted feature.
    - descrp = New for surveyed feature.
    - If the new area extents border the edge of bathymetry, instead of manually creating new geometry, the hydrographer may use recomd = edit the geometry to extents of bathymetry.

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17.4 NOAA Discretionary Attribution

The following is a list of additional NOAA Extended Attributes that may be used by Field Units, but must be removed prior to submitting to the Office of Coast Survey.

Attribute	Description	
acqsts (r)	Acquisition Status **(r)**	A tracking tool used during data processing that ensures features are fully investigated as necessary
	Investigate **(r)**	Indicates that further field examination and analysis are required
	Resolved **(r)**	Indicates that field examination and analysis is complete
cnthgt (r)	Contact Height **(r)**	Contact height of side scan sonar contacts
keywrd (r)	Keyword **(r)**	Customized word used for processing or querying data
prkyid (r)	Primary Key ID **(r)**	Provides a means for manual correlation. The primary key ID can be populated for the secondary feature with the primary feature's Database key ID
prmsec (r)	Primary/Secondary Status **(r)**	Indicates the status of the feature during feature or contact correlation
	Primary **(r)**	Principal feature that can be associated with one or more secondary features
	Secondary **(r)**	Indicates that the feature is correlated to the primary
	Pending **(r)**	Indicates that further analysis or examination is required
userid (r)	User ID **(r)**	Provides a unique identifier

17.5 Other Common Features by Acronym

The following table includes mandatory and conditional S-57 Attribution requirements for the most common features found in a feature file as well as some specific guidance in the note sections for each feature class. If a Field Unit has a question regarding attribution for a feature class not listed, contact the OCS Project Manager and/or COR for guidance.

Note: The following is only for New and Updated Features (descrp = New or Update). Features that are disproved, retained or not addressed will maintain the original S-57 attribution.

Obstructions (OBSTRN)

All new/updated obstructions must have a VALSOU or a HEIGHT with the following exceptions:

- If it is too dangerous to obtain the least depth/height.
- For line/area objects where least depth cannot be determined.
- If the object is a Foul Ground.

The attribution logic is shown in the table below.

Obstruction (OBSTRN)	w/ VALSOU	w/ HEIGHT	w/o VALSOU and HEIGHT	CATOBS = Foul Area	CATOBS = Foul Ground
VALSOU	**(m)**	**(r)**	**(r)**	**(r)**	**(r)**
HEIGHT	**(r)**	**(m)**	**(r)**	**(r)**	**(r)**
WATLEV*	**(m)**	Always Dry (WATLEV = 2) **(m)**	**(c)**	**(c)**	Always underwater/ submerged (WATLEV = 3) **(m)**
QUASOU*	**(m)**	**(r)**	**(r)**	**(r)**	**(r)**
TECSOU*	**(m)**	**(r)**	**(r)**	**(r)**	**(r)**
CATOBS	**(c)**	**(c)**	**(c)**	Foul Area (CATOBS = 6) **(m)**	Foul Ground (CATOBS = 7) **(m)**
NATSUR	**(c)**	**(c)**	**(c)**	**(c)**	**(c)**
images	**(m)**	**(m)**	**(m)**	**(r)**	**(r)**

* See below attribution for WATLEV, QUASOU, and TECSOU

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Wellhead Obstructions (CATOBS = 2) Guidance

- If a wellhead is found and considered a danger to navigation, develop the feature, submit it as a DTON, and include it in the feature file.
- If a wellhead is found and merits individual cartographic representation, develop the feature and submit it in the feature file. Note: if the wellhead is deeper than 20 m then it is unlikely to merit individual cartographic representation.
- If wellhead is found and does not merit cartographic representation, do not investigate it as a feature. Include it in the feature file with “descrp = delete” and “remrks=wellhead addressed as represented in the surface”.
- If the charted wellhead is not found, in cases where 100% side scan sonar with concurrent multibeam is used as the primary coverage technique, a 50 m disproval search radius is required. Include in the feature file with descrp = delete.

Rocks (UWTROC)

Rocks appropriately represented in the submitted grid(s) must not be included in the feature file, except for named rocks, which must be included in the feature file. New/updated rocks surveyed outside of the grid(s) must be included in the feature file and have a VALSOU, unless the feature is too dangerous to obtain the least depth. Note, baring rocks do not use HEIGHT; instead they become islets. See WATLEV attribution for guidance.

If several assigned rocks are found to be part of an inshore rocky area, the hydrographer may elect to delineate the area as Foul Area (OBSTRN area with CATOBS = “6” Foul Area) and forgo investigating each individual rock (i.e., descrp=Not addressed, remrks= “Rock is part of foul area”). Pending safe conditions, the hydrographer must address any rocks that they feel are navigationally significant within the foul area.

Rock (UWTROC):	**w/ VALSOU**	**w/o VALSOU**
VALSOU	**(m)**	**(r)**
WATLEV*	**(m)**	**(c)**
QUASOU*	**(m)**	**(r)**
TECSOU*	**(m)**	**(r)**

* See below attribution for WATLEV, QUASOU, and TECSOU

Wrecks (WRECKS)

All new/updated wrecks must have a VALSOU or HEIGHT unless the feature is too dangerous to obtain the least depth.

Wreck (WRECKS):	**w/ VALSOU**	**w/ HEIGHT**	**w/o VALSOU and HEIGHT**
VALSOU	**(m)**	**(r)**	**(r)**
HEIGHT	**(r)**	**(m)**	**(r)**
CATWRK	**(m)**	**(m)**	**(m)**
WATLEV*	**(m)**	Always Dry (WATLEV = 2) **(m)**	**(c)**
QUASOU*	**(m)**	**(r)**	**(r)**
TECSOU*	**(m)**	**(r)**	**(r)**
images	**(m)**	**(m)**	**(m)**

* See below attribution for WATLEV, QUASOU, and TECSOU.

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Additional Features

Object	**Attributes**	
	Acronym	**Description**
COALNE (Coastline)	CATCOA **(m)**	Category of Coastline
LNDARE (Land area) *Point, line, or area objects*	Used to characterize islets	
• Islets with a horizontal distance greater than 2.0mm at the largest scale overlapping chart must be delineated as an area feature. • Must be accompanied by LNDELV point object where elevation is 10m or less, denoting the highest point of the feature. • LNDARE point objects accompanied by LNDELV point objects must share 2D geometry. • See below WATLEV attribution for vertical height requirements.		
LNDELV (Land elevation)	ELEVAT **(m)**	Elevation
• Elevation is relative to the shoreline plane of reference (SPOR), typically MHW.		
MORFAC (Mooring/ Warping facility)	CATMOR **(m)**	Category of mooring/warping facility
	BOYSHP **(c)**	Buoy shape
	COLOUR **(c)**	Color
	COLPAT **(c)**	Color pattern

	CONDTN **(c)**	Condition
	NATCON **(c)**	Nature of construction
	STATUS **(c)**	Status
• If a MORFAC is found to be submerged, the object must be classified as an OBSTRN with CATOBS = 1 (Snag/ Stump).		
PILPNT (Pile)	CATPLE **(c)**	Category of pile
	CONDTN **(c)**	Condition
• If a PILPNT is found to be submerged, the object must be classified as an OBSTRN with CATOBS = 1 (Snag/ Stump).		
SOUNDG (Sounding)	TECSOU **(m)**	Technique of sounding measurement
	QUASOU **(m)**	Quality of sounding measurement
• Only soundings for DTONs or other significant shoals may be included in the feature file. • See below attribution for QUASOU.		
SBDARE (Seabed area) *Point objects*	NATSUR* **(m)**	Nature of Surface
	NATQUA* **(c)**	Nature of Surface - Qualifying Terms
	COLOUR* **(c)**	Color

* Multiple characteristics, colors, and qualifiers may be used. See **Seabed Sample Encoding**.
• A complete description of a physical seabed sample consists of: one adjective describing the grain size or consistency; one adjective designating the color; and one noun naming the class of bottom material. If the sample consists almost entirely of one constituent, only one noun must be used. If the sample consists of two or more constituents, the nouns for the primary constituents must be used and arranged in order of their predominance. For example, if a sample of fine black sand contains a smaller portion of broken shells and a couple of pebbles, the bottom characteristic must be attributed as follows:
  • NATSUR: sand, shells, pebbles
  • NATQUA: fine, broken, -
  • COLOUR: black, - , -
• Sediments are typed according to the size of the particles. See Sediment Size Classification in **Seabed Sample Encoding**. A measurement of careful estimation by eye is satisfactory. Technically there are two classes of material finer than sand. These are silt and clay. For practical purposes, silt and clay are classified under the general term of mud.
• The return of an empty sampler is not a sufficient reason to label the bottom as hard or soft. If a physical seabed sample was attempted but no sample was recovered, the NATSUR will be categorized as Unknown.		

SBDARE (Seabed area) *Line and area objects*	NATSUR **(m)**	Nature of Surface
	WATLEV **(m)**	Water Level Effect - reefs, ledges, and rocky seabed areas
	NATQUA **(c)**	Nature of Surface = Qualifying Terms
• Use NATSUR = rock for rocky seabed areas and ledges. • SBDARE line or area objects may be used to characterize areas with numerous discrete submerged rocks (rather than encoding individual rock features) and/or areas of the seafloor that are rocky in nature. The extents of the area must be delineated and characterized as SBDARE (seabed area), and the attribute NATSUR (nature of surface) encoded as rock.		
SLCONS (Shoreline construction)	CATSLC **(m)**	Category of shoreline construction
	CONDTN **(c)**	Condition
	WATLEV **(c)**	Water level effect
M_COVR (Coverage) *Used for Survey Outline Only*	CATCOV **(m)**	Category of Coverage
	INFORM **(m)**	Information
	NINFOM **(m)**	Information in national language
• INFORM must be populated with the following information separated by semi-colon in this order: Platform; State; Scale (ex., FH; MD; 20,000).		

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- NINFOM must be populated with the technique of sounding measurement (e.g. Lidar, MBES, VBES, SSS, etc.). If more than one technique was used, separate the techniques by semi-colon (ex., MBES; SSS).

17.6 Attribution Guidance

TECSOU and QUASOU Attribution

Technique of Measurement for Features with VALSOU	TECSOU Attribution	QUASOU Attribution
VBES (single beam) alone	'1' found by echo sounder	'1' depth known
Side scan sonar alone	'2' found by side scan sonar	'9' value reported (not confirmed)
Multibeam alone	'3' found by multibeam	'6' least depth known*
Full coverage SSS with partial bathymetric coverage	'3' found by multibeam, with metadata reflecting lack of full coverage	'6' least depth known*
Diver depth	'4' found by diver	'6' least depth known
Lidar alone	'7' found by laser	'6' least depth known*
Laser scanner alone	'7' found by laser	'6' least depth known*
Depths on features using structure from motion	'10' found by photogrammetry	'2' depth unknown
Depths on features using range finder or visual estimation	'12' found by leveling	'6' least depth known*

* If point cloud data was obtained over a feature but the least depth of the feature was not captured, QUASOU can be attributed as '1' Depth Known.

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WATLEV Attribution

Rocks, obstructions and wrecks may be classified as always underwater, awash, or covers and uncovers. Obstructions and wrecks may also be classified as always dry.

- A bare rock extends more than 0.1 meter above the shoreline plane of reference (SPOR), typically Mean High Water (MHW).
- A rock, which covers and uncovers is exposed at some stage of tide from 0.1 meter above MHW to 0.1 meter above chart datum.
- An awash rock lies less than 0.1 meter above chart datum to 0.1 meter below the chart datum.
- A submerged (always underwater) rock is deeper than 0.1 meter from the chart datum.

Classification	Always Underwater	Awash	Covers and Uncovers	Always Dry
Elevation (VALSOU or Height)	> 0.1m below chart datum (e.g., MLLW or LWD+)	< 0.1m above chart datum (e.g., MLLW) to 0.1m below chart datum (e.g., MLLW)	0.1m ≥ chart datum (e.g., MLLW) to 0.1m SPOR (e.g., MWH)	> 0.1m SPOR (e.g., MHW)
S-57 Object	UWTROC OBSTRN WRECKS	UWTROC OBSTRN WRECKS	UWTROC OBSTRN WRECKS	LNDARE & LNDELV* OBSTRN** WRECKS**
WATLEV Value	3	5	4	2

- Vertical coordinate system is positive up for elevations and positive down for depths.

* A rock becomes an islet at 0.1 meters above SPOR (e.g. MHW). LNDARE point or area objects are used to characterize islets. Elevation for islets is encoded using the object LNDELV, with attribute ELEVAT, and is shown relative to the SPOR.

** When the depth of an obstruction or wreck is greater than 0.1 meters above MHW, HEIGHT attribution is required rather than VALSOU. As with ELEVAT, heights are shown relative to SPOR (e.g., MHW).

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18.0 Seabed Sample Encoding

For Field Units who have submitted a feature file containing seabed samples to the Office of Coast Survey, the following S-57 attribution must be used per the legend below.

(m)	**Mandatory**
(c)	**Conditional**
(r)	**Restricted**

18.1 Sediment Size Classification

Type	Term	Grain Size (mm)
Clay		< 0.002
Silt		0.002 - 0.0625
Sand	fine	0.0625 - 0.25
	medium	0.25 - 0.5
	coarse	0.5 - 2.0
Gravel		2.0 - 4.0
Pebbles		4.0 - 64.0
Cobble		64.0 - 256.0
Boulder		> 256.0
Stone		4.0 - 256.0+

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18.2 NATSUR/NATQUA Attribution

Attribute	Description	
NATSUR (m)	Nature of Surface **(m)**	
	'1' mud **(m)**	Soft, wet earth.
	'2' clay **(m)**	Particles less than 0.002mm; stiff sticky earth that becomes hard when baked.
	'3' silt **(m)**	Particles of 0.002 - 0.0625mm; when dried on hand will rub off easily.
	'4' sand **(m)**	Particles of 0.0625 - 2.0mm; tiny grains of crushed or worn rock.
	'5' stone **(m)**	A general term for rock fragments ranging in size from pebbles and gravel to boulders or a large rock mass.
	'6' gravel **(m)**	Particles of 2.0 - 4.0mm; small stones with coarse sand.
	'7' pebbles **(m)**	Particles of 4.0 - 64.0mm; small stones made smooth and round by being rolled in water.
	'8' cobbles **(m)**	Particles of 64.0 - 256.0mm; stones worn round and smooth by water and used for paving.
	'9' rock **(m)**	Any formation of natural origin that constitutes an integral part of the lithosphere. The natural occurring material that forms firm, hard, and solid masses.
	'11' lava **(m)**	The fluid or semi-fluid matter flowing from a volcano. The substance that results from the cooling of the molten rock.
	'14' coral **(m)**	Hard calcareous skeletons of many tribes of marine polyps.
	'17' shells **(m)**	Exoskeletons of various water dwelling animals.
	'18' boulder **(m)**	A rounded rock with diameter of 256mm (25.6cm) or larger.
• List in order of most predominant first, comma delimited.		
NATQUA (c)	Nature of Surface - qualifying terms **(c)**	
	'1' fine **(c)**	Falls within the smallest size continuum for a particular NATSUR term.

	'2' medium **(c)**	Falls within the moderate size continuum for a particular NATSUR term.
	'3' coarse **(c)**	Falls within the largest size continuum for a particular NATSUR term.
	'4' broken **(c)**	Fractured or in pieces.
	'5' sticky **(c)**	Having an adhesive or glue like property.
	'6' soft **(c)**	Not hard or firm.
	'7' stiff **(c)**	Not pliant; thick, resistant to flow.
	'8' volcanic **(c)**	Composed of or containing material ejected from a volcano.
	'9' calcareous **(c)**	Composed of or containing calcium or calcium carbonate.
	'10' hard **(c)**	Firm; usually refers to an area of the seafloor not covered by unconsolidated sediment.

- Must accompany NATSUR. Cannot occur alone.
- Listed in the same order as the NATSUR attributes which they are associated with, and must be comma delimited. For any NATSUR that has no NATQUA qualifier, its place in the list must be left empty and held by a comma.

COLOUR (c)	Color **(c)**	
	'1' white **(c)**	
	'2' black **(c)**	
	'3' red **(c)**	
	'4' green **(c)**	
	'5' blue **(c)**	
	'6' yellow **(c)**	
	'7' grey **(c)**	
	'8' brown **(c)**	
	'9' amber **(c)**	
	'10' violet **(c)**	
	'11' orange **(c)**	
	'12' magenta **(c)**	
	'13' pink **(c)**	

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18.3 NATSUR/NATQUA Allowable Attribute Combinations

NATSUR	NATQUA									
	'1' fine	**'2' medium**	**'3' coarse**	**'4' broken**	**'5' sticky**	**'6' soft**	**'7' stiff**	**'8' volcanic**	**'9' calcareous**	**'10' hard**
'1' mud					o	o	o	o	o	o
'2' clay					o	o	o			o
'3' silt					o	o	o			o
'4' sand	o	o	o			o		o	o	o
'5' stone								o	o	
'6' gravel								o	o	
'7' pebbles								o	o	
'8' cobbles								o	o	
'9' rock								o	o	
'11' lava								o		
'14' coral				o						
'17' shells				o					o	

'18' boulder								o	o	

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19.0 NOAA Extended Attributes Schema

NOAA extended attributes provide further flexibility than can be obtained via the S-57 attribute standards. The following extended attributes are global to all S-57 object classes.

Table of NOAA extended attributes parameters

Acronym	Name	Description	IEC/ ISO8211 ID	Type
acqsts	Acquisition status	Status of acquisition	2007	(E)numeration
asgnmt	Assignment status	Indicates whether a feature is (un)assigned	2001	(E)numeration
cnthgt	Contact height	Contact height	2008	(F)loat
dbkyid	Database key ID	Unique ID for use in relational database	1041	Free text (S)tring
descrp	Description	Field recommended charting action	2000	(E)numeration
images	Images	List of semicolon-delimited file name(s); do not include path(s)	2003	Free text (S)tring
invreq	Investigation Requirements	Specific instructions for investigation requirements	2009	Free text (S)tring
keywrd	Keyword	List of semicolon-delimited user keyword(s)	2006	Free text (S)tring
onotes	Office notes	Office notes	2004	Free text (S)tring
prmsec	Primary / secondary correlation status	Indicates whether a feature is the primary contact or a secondary view	2002	(E)numeration
prkyid	Primary key ID	For Secondary feature(s); the Primary feature dbkyid	2010	Free text (S)tring
recomd	Recommendations	Field Unit charting recommendations	1119	Free text (S)tring
remrks	Remarks	Remarks	1118	Free text (S)tring
sftype	Special feature type	Indicates special features	2005	(E)numeration
hsdrec	HSD recommendations	HSD charting recommendations	2011	(E)numeration

Table of Extended input values for NOAA enumeration attributes

Acronym	IEC/ISO8211 ID	Enumeration ID	Meaning
descrp	2000	1	New
		2	Update
		3	Delete
		4	Retain
		5	Not Addressed
asgnmt	2001	1	Unassigned
		2	Assigned
		3	For Info Only
prmsec	2002	1	Primary
		2	Secondary
		3	Pending
sftype	2005	1	ATON
		2	AWOIS
		3	DTON
		4	MARITIME BOUNDARY
		5	Lidar INVESTIGATION
		6	UNVERIFIED CHARTED FEATURE

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acqsts	2007	1	Investigate
		2	Resolved
hsdrec	2011	1	New
		2	Update
		3	Delete
		4	Retain
		5	Not Addressed

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Glossary

BAG

Bathymetric Attributed Grid.

chart datum

Water level reference for depths on a nautical chart. Typically MLLW, except in the Great Lakes and connecting waterways, which use LWD.

crosslines

A series of supplemental data acquisition lines in support of the regular system of acquisition lines that have good temporal and geographic distribution such that maximal nadir-to-nadir comparisons are achieved.

CUBE

Combined Uncertainty and Bathymetric Estimator, an error-model based, direct DTM generator that estimates the depth plus a confidence interval directly on each node point of a bathymetric grid.

Dangers to Navigation

(DTON) A danger to navigation is considered to be any natural feature (e.g., shoal, boulder, reef, rock outcropping) as well as any anthropogenic feature (e.g., wreck, obstruction, pile) which, during the course of survey operations was found by the hydrographer to pose an imminent danger to the mariner or to be inadequately charted as described below. Potential dangers must be evaluated in the context of the largest scale nautical chart of the area and with detailed knowledge of vessel traffic in the area including usual and seasonal routes. All features with depths of 20 meters or less in navigable waters may be considered potential dangers to navigation and subject to reporting. All charted and uncharted pipelines that are elevated at least 1 m off the bottom between depths of 0 and 20 m and 10% off the bottom in depths deeper than 20 m may pose a hazard to surface navigation and may be considered a DTON.

data breach

loss or theft of, or other unauthorized access to, other than an unauthorized access incidental to the scope of employment, data containing sensitive information, in electronic or printed form, that results in the potential compromise of the confidentiality or integrity of the data.

depth

A fully processed seabed elevation value relative to an established vertical datum, portrayed in a gridded data set or product surface of a hydrographic survey. A surveyed depth may be computed based on statistical analysis and uncertainty estimates from a sample set of soundings.

depth value

A generic vertical seabed elevation value, inclusive of soundings and depths.

DRGARE

Dredged area.

DRVAL1

Depth range value 1. The minimum (most shoal) value of a depth range.

ESD

External Source Data, defined as hydrographic data voluntarily submitted to the Office of Coast Survey, but which was not collected under Hydrographic Survey Project Instructions issued by the Office of Coast Survey.

External Source Data providers

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Any Field Unit voluntarily providing data to the Office of Coast Survey in the interest of contributing to our national and global mapping objectives, but not tasked under Hydrographic Survey Project Instructions issued by the Office of Coast Survey.

feature

A feature can be any anthropogenic or natural object that may merit individual cartographic representation (e.g., rocks, wrecks, obstructions, bottom types).

Foul Area

IHO definition: An area of numerous potential dangers to navigation. The area serves as a warning to the mariner that all dangers are not identified individually and that navigation through the area may be hazardous. NOAA definition: Dangerous area that the hydrographer has identified the extents of, but does not have bathymetric coverage over.

Foul Ground

IHO definition: Area over which it is safe to navigate but which should be avoided for anchoring, taking the ground or ground fishing. NOAA definition: Area with full bathymetric coverage where several obstructions are located. Least depths of individual obstructions within must be represented in the grid, but need not be included in the feature file as individual point features.

height

When referencing features, the vertical distance of an area or point above the shoreline plane of reference, typically defined as Mean High Water (MHW).

holiday

A gap in gridded data large enough to contain a significant feature.

integrity

Completeness, consistency, and accuracy of the data and products.

ISD

Internal Source Data, defined as hydrographic survey data collected by NOAA Field Units (or Contractors) who are tasked via Hydrographic Survey Project Instructions issued by the Office of Coast Survey.

junction

Areas where two surveys overlap; at a minimum must consist of approximately one bathymetric swath width at the nominal depth of the junction area; this requirement may be superseded by project instructions.

lidar

Light Detection and Ranging.

LWD

Low Water Datum, the chart datum in the Great Lakes and connecting waterways.

MBES

Multibeam Echo Sounder.

MHW

Mean High Water, the average of all the high water heights observed over the National Tidal Datum Epoch.

Minimum Metadata

Minimum Metadata is metadata that is mandatory to include in data submissions to the Office of Coast Survey. Not including the Minimum Metadata will preclude the Office of Coast Survey from accepting the submission. The Minimum Metadata is defined as: Data License, Responsible Party, Contact Information,

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Survey Start Date, Survey End Date, Horizontal Coordinate Reference System and Units, Vertical Coordinate Reference System and Units, and Technique of Vertical Measurement.

MLLW

Mean Lower Low Water, the average of the lower low water height of each tidal day observed over the National Tidal Datum Epoch.

NALL

The Navigable Area Limit Line is the inshore limit of hydrography and feature verification.

NOAA

National Oceanic and Atmospheric Administration.

NOS

National Ocean Service.

OCS

Office of Coast Survey.

OGC

The Open Geospatial Consortium (OGC) is an international organization responsible for generating royalty free, publicly available open geospatial standards.

ONSWG

Open Navigation Surface Working Group.

Pydro

Pydro (Python + Hydro), a suite of software developed by NOAA and the University of New Hampshire's Center for Coastal and Ocean Mapping (CCOM). Built primarily from open source components and public domain custom-developed software.

significant features

Features which exceed the minimum required detected feature size.

sounding

A measurement from the sea surface to the seafloor, regardless of method (echo sounder, lidar, lead line, diver’s least depth gauge, etc.). A sounding may be corrected for factors such as sound speed, vessel draft, and water levels, but remains the product of a single measurement sample.

SPOR

Shoreline plane of reference, the vertical datum accepted as the reference plane for shoreline.

SSS

Side Scan Sonar.

structure from motion

Structure from motion (SfM) refers to a photogrammetric technique that estimates the x,y,z position of three dimensional structures from two dimension image sequences.

SVP

Sound Velocity Profile.

take

For the purposes of these specifications (in the context of environmental compliance): to harass, hunt, capture, kill, harm, pursue, shoot, wound, trap, or collect, or attempt to engage in any such conduct any ESA-listed species or marine mammal.

Total Horizontal Uncertainty

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Component of total propagated uncertainty (TPU) calculated in the horizontal dimension. THU is a two-dimensional quantity with all contributing horizontal measurement uncertainties included.

Total Vertical Uncertainty

Component of total propagated uncertainty (TPU) calculated in the vertical dimension. TVU is a one dimensional quantity with all contributing vertical measurement uncertainties included.

UCF

Unverified Charted Feature.

uncertainty

Estimate characterizing the range of values within which the true value of a measurement is expected to lie as defined within a particular confidence level. It is expressed as a positive value.

underkeel clearance

Distance between the lowest point of the ship's hull and the seabed, riverbed, etc.

USACE

United States Army Corps of Engineers.

USCG

United States Coast Guard.

UxS

Uncrewed system.

VBES

Vertical Beam Echo Sounder.

Maritime Boundary Point

Maritime Boundary Point (MBP) are feature investigations to assist defining the maritime zones in accordance with the United Nations Convention on the Law of the Sea (UNCLOS). The maritime zones are 1) Three Nautical Mile Line. Territorial Sea at 12 nautical miles; 2) Contiguous Zone at 24 nautical miles; and 3) Exclusive Economic Zone (EEZ) at 200 nautical miles.

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