H13642

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Ocean Service

DESCRIPTIVE REPORT

Type of Survey:	Navigable Area
Registry Number:	H13642

LOCALITY

State(s):	Wisconsin
General Locality:	Western Lake Michigan
Sub-locality:	Offshore Sheboygan

2022

CHIEF OF PARTY
David J. Bernstein, CH, PLS, GISP

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Date:

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

REGISTRY NUMBER:

HYDROGRAPHIC TITLE SHEET

H13642

INSTRUCTIONS: The Hydrographic Sheet should be accompanied by this form, filled in as completely as possible, when the sheet is forwarded to the Office.

State(s):	**Wisconsin**
General Locality:	**Western Lake Michigan**
Sub-Locality:	**Offshore Sheboygan**
Scale:	**40000**
Dates of Survey:	**07/06/2022 to 08/22/2022**
Instructions Dated:	**04/06/2022**
Project Number:	**OPR-Y396-KR-22**
Field Unit:	**Geodynamics LLC**
Chief of Party:	**David J. Bernstein, CH, PLS, GISP**
Soundings by:	**Multibeam Echo Sounder**
Imagery by:	**Multibeam Echo Sounder Backscatter**
Verification by:	**Atlantic Hydrographic Branch**
Soundings Acquired in:	**meters at Low Water Datum IGLD-1985**

Remarks:

Any revisions to the Descriptive Report (DR) applied during office processing are shown in red italic text. The DR is maintained as a field unit product, therefore all information and recommendations within this report are considered preliminary unless otherwise noted. The final disposition of survey data is represented in the NOAA nautical chart products. All pertinent records for this survey are archived at the National Centers for Environmental Information (NCEI) and can be retrieved via https://www.ncei.noaa.gov/. Products created during office processing were generated in NAD83 UTM 16N, LWD - IGLD 1985. All references to other horizontal or vertical datums in this report are applicable to the processed hydrographic data provided by the field unit.

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Descriptive Report to Accompany Survey H13642

Project: OPR-Y396-KR-22

Locality: Western Lake Michigan

Sublocality: Offshore Sheboygan

Scale: 1:40000

July 2022 - August 2022

Geodynamics LLC

Chief of Party: David J. Bernstein, CH, PLS, GISP

A. Area Surveyed

Geodynamics LLC conducted a hydrographic survey in the assigned area of H13642 located offshore Sheboygan, Wisconsin. Within H13642, all survey operations were conducted in accordance with the provided Statement of Work (SOW), Hydrographic Survey Project Instructions (PI), and the March 2022 National Ocean Service (NOS) Hydrographic Survey Specifications and Deliverables (HSSD). Any deviations from the aforementioned guidelines have been approved by the National Oceanographic and Atmospheric Administration (NOAA) Hydrographic Survey Division (HSD) Operations (OPS) branch and are documented in the survey correspondences.

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
44° 0' 58.91" N 87° 36' 14.2" W	43° 39' 11.39" N 87° 23' 46.31" W

Table 1: Survey Limits

Data were acquired to the survey limits in accordance with the requirements listed in the PI and the HSSD.

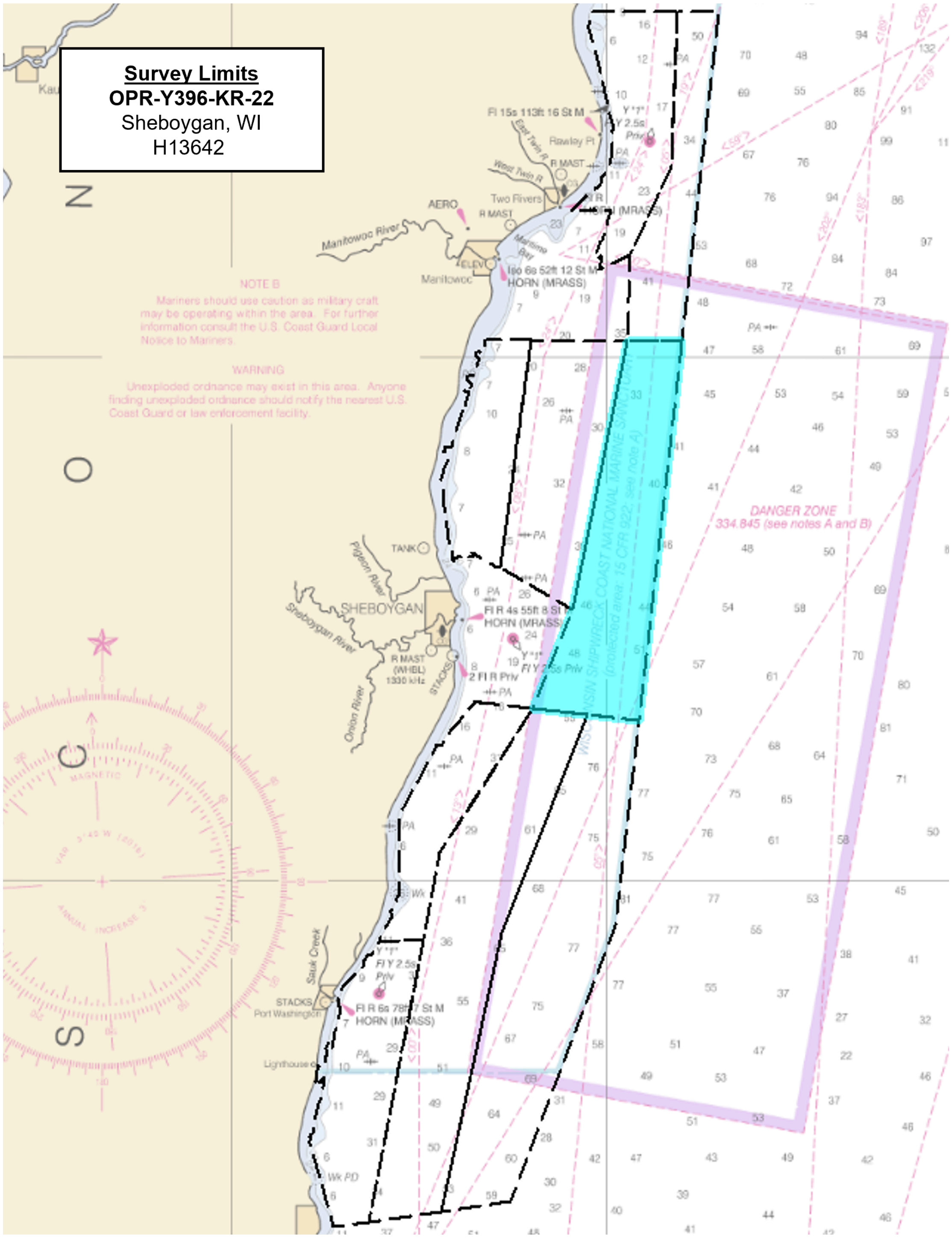


Figure 1: Overview of project survey limits (H13642 shown in blue), overlaid onto Chart 14901

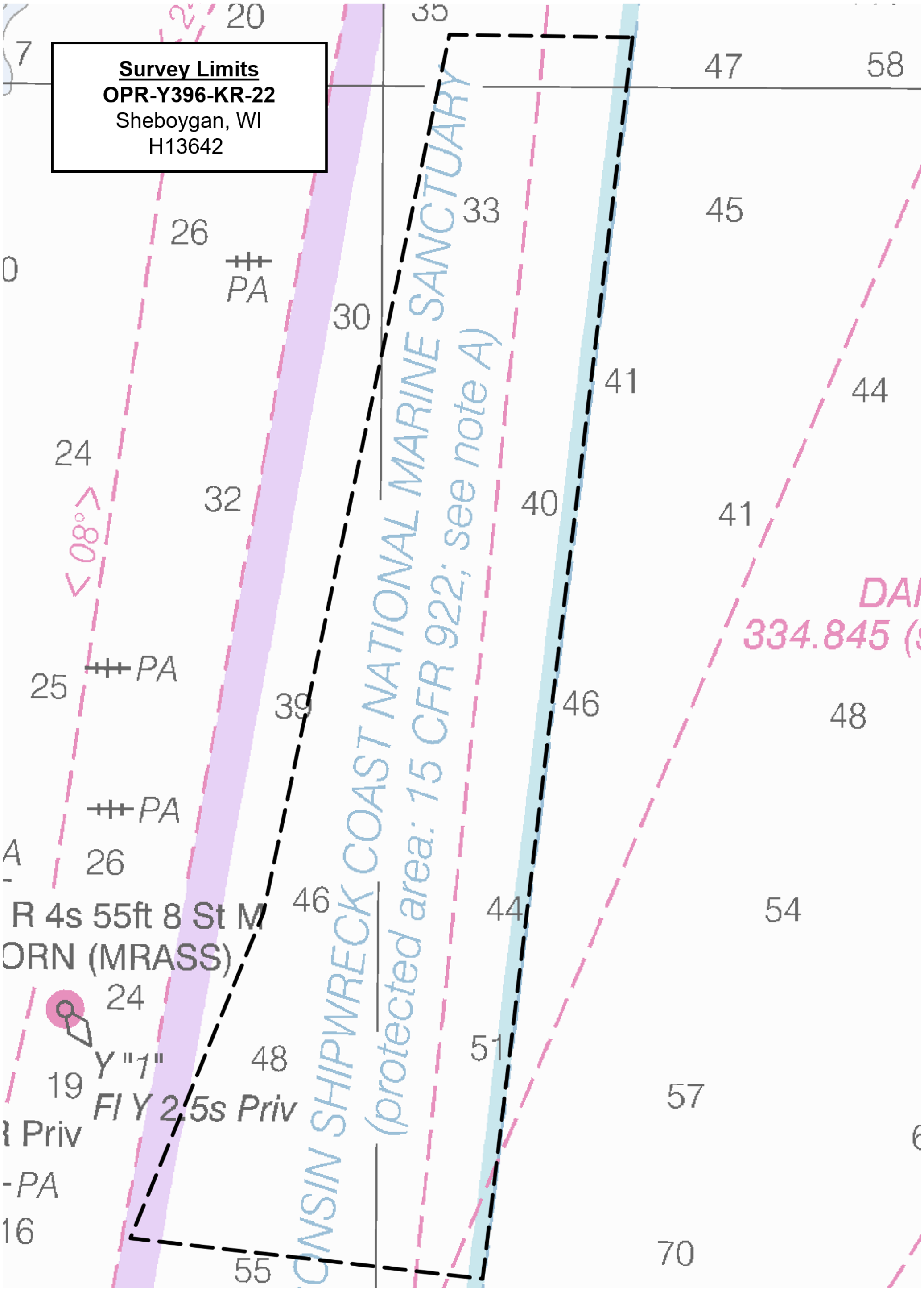


Figure 2: H13642 survey limits overlaid onto Chart 14901

A.2 Survey Purpose

This project is located in Western Lake Michigan, within the Wisconsin Shipwreck Coast National Marine Sanctuary. The sanctuary designation was a culmination of efforts from multiple stakeholders: The October

2015 community-based nomination led to the publication of the 2020 final environmental impact statement and final management plan -- both went through multiple rounds of public input. Co-managed by NOAA and the state of Wisconsin, the sanctuary brings new opportunities for research, resource protection, educational programming, and community engagement.

Previous charting efforts within the proposed 680 SNM project extent were of lead line and singlebeam echo sounders from the mid-twentieth century. The area had never before been surveyed using multibeam echosounder systems (MBES). This project addresses one of the highest priority areas for the Great Lakes by providing modern data to the scientific and benthic mapping communities. Additionally, this project encompasses a nationally significant collection of shipwrecks, including 37 known and as many as 80 shipwrecks yet to be discovered.

Conducting a modern bathymetric survey with concurrent backscatter data in this area will identify hazards and changes to the lakebed, provide critical data for updating National Ocean Service (NOS) nautical charting products, and improve maritime safety. Survey data from this project is intended to supersede all prior survey data in the common area.

A.3 Survey Quality

The entire survey is adequate to supersede previous data.

Survey quality in H13642 meets or exceeds requirements set forth in the HSSD. Survey quality was assessed through visual inspection, the analysis of crosslines, and utilizing QC Tools to assess uncertainty and density. Additionally, junction analyses were conducted between overlapping data collected on this project and existing bathymetric data. For more information on methods and results of the survey data quality assessments for this survey, refer to section B.2 of this report.

A.4 Survey Coverage

The following table lists the coverage requirements for this survey as assigned in the project instructions:

Water Depth	Coverage Required
All waters in survey area	Complete Coverage

Table 2: Survey Coverage

The entirety of H13642 was acquired with complete coverage in accordance with section 5.2.2.3 of the HSSD. See Figure 3 for an overview of the coverage.

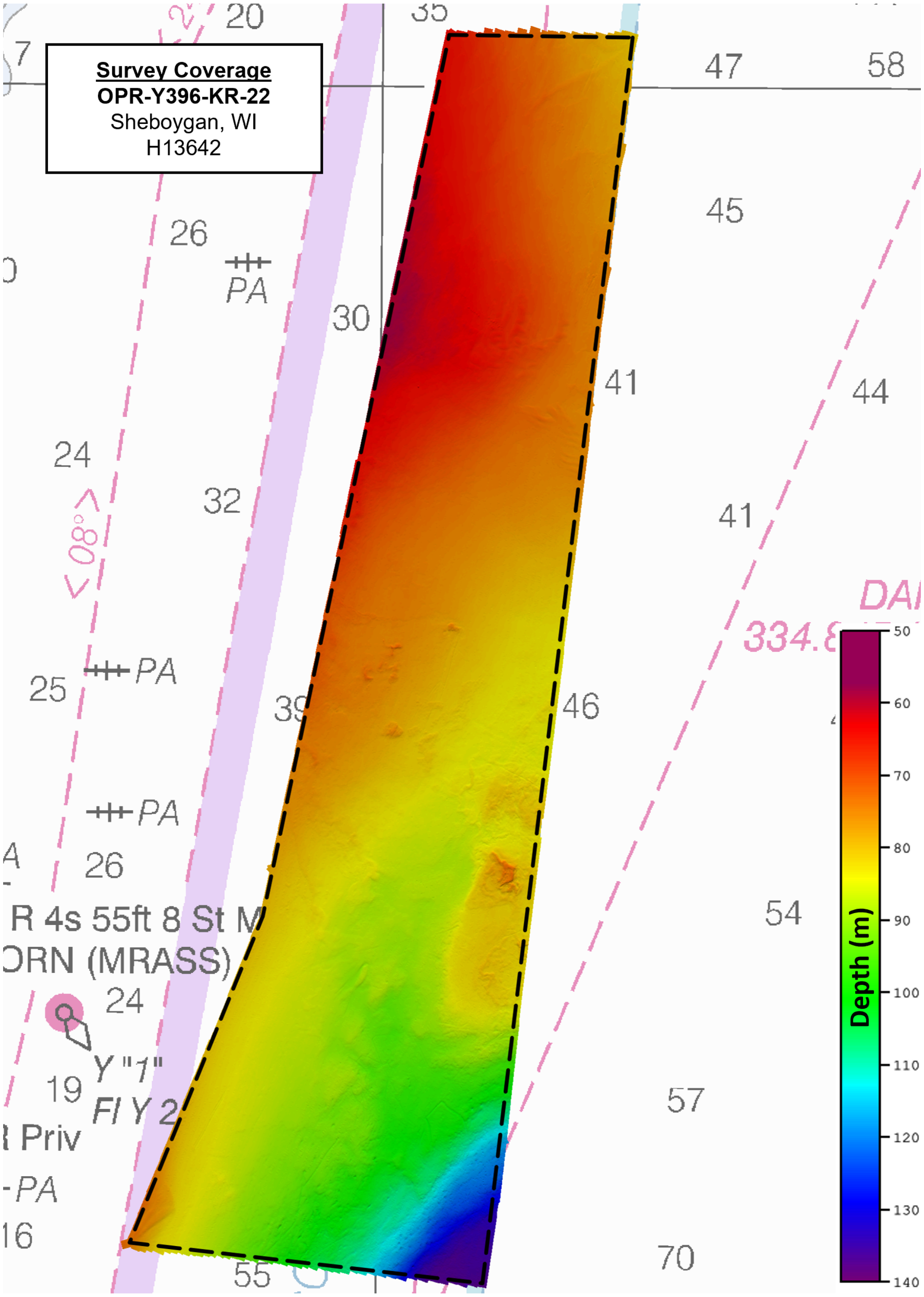


Figure 3: H13642 survey coverage overlaid onto Chart 14901

A.6 Survey Statistics

The following table lists the mainscheme and crossline acquisition mileage for this survey:

	HULL ID	*R/V Substantial*	*Total*
LNM	**SBES Mainscheme**	0.0	0.0
	MBES Mainscheme	923.97	923.97
	Lidar Mainscheme	0.0	0.0
	SSS Mainscheme	0.0	0.0
	SBES/SSS Mainscheme	0.0	0.0
	MBES/SSS Mainscheme	0.0	0.0
	SBES/MBES Crosslines	40.89	40.89
	Lidar Crosslines	0.0	0.0
Number of Bottom Samples			0
Number Maritime Boundary Points Investigated			0
Number of DPs			0
Number of Items Investigated by Dive Ops			0
Total SNM			96.04

Table 3: Hydrographic Survey Statistics

The following table lists the specific dates of data acquisition for this survey:

Survey Dates	Day of the Year
07/06/2022	187

Survey Dates	Day of the Year
07/12/2022	193
07/13/2022	194
07/14/2022	195
07/15/2022	196
07/16/2022	197
07/17/2022	198
07/18/2022	199
08/02/2022	214
08/03/2022	215
08/06/2022	218
08/09/2022	221
08/22/2022	234

Table 4: Dates of Hydrography

B. Data Acquisition and Processing

B.1 Equipment and Vessels

Refer to the OPR-Y396-KR-22 Data Acquisition and Processing Report (DAPR) for a complete description of survey equipment and configurations, data acquisition procedures, data processing methods, quality control measures, and survey reporting methods. Additional information to supplement survey data and any deviations from the DAPR are discussed in the following sections.

B.1.1 Vessels

The following vessels were used for data acquisition during this survey:

Hull ID	***R/V Substantial***
LOA	18.0 meters
Draft	2.22 meters

Table 5: Vessels Used

B.1.2 Equipment

The following major systems were used for data acquisition during this survey:

Manufacturer	Model	Type
Kongsberg Maritime	EM 2040C	MBES
Applanix	POS MV 320 v5	Positioning and Attitude System
AML Oceanographic	MicroX SV	Sound Speed System
AML Oceanographic	MVP30-350	Sound Speed System

Table 6: Major Systems Used

R/V Substantial utilized a dual-head Kongsberg EM 2040C multibeam system, a POS M/V 320 v5 positioning and attitude system, an AML MicroX surface sound speed system, and an AML MVP30-350 sound speed profiling system.

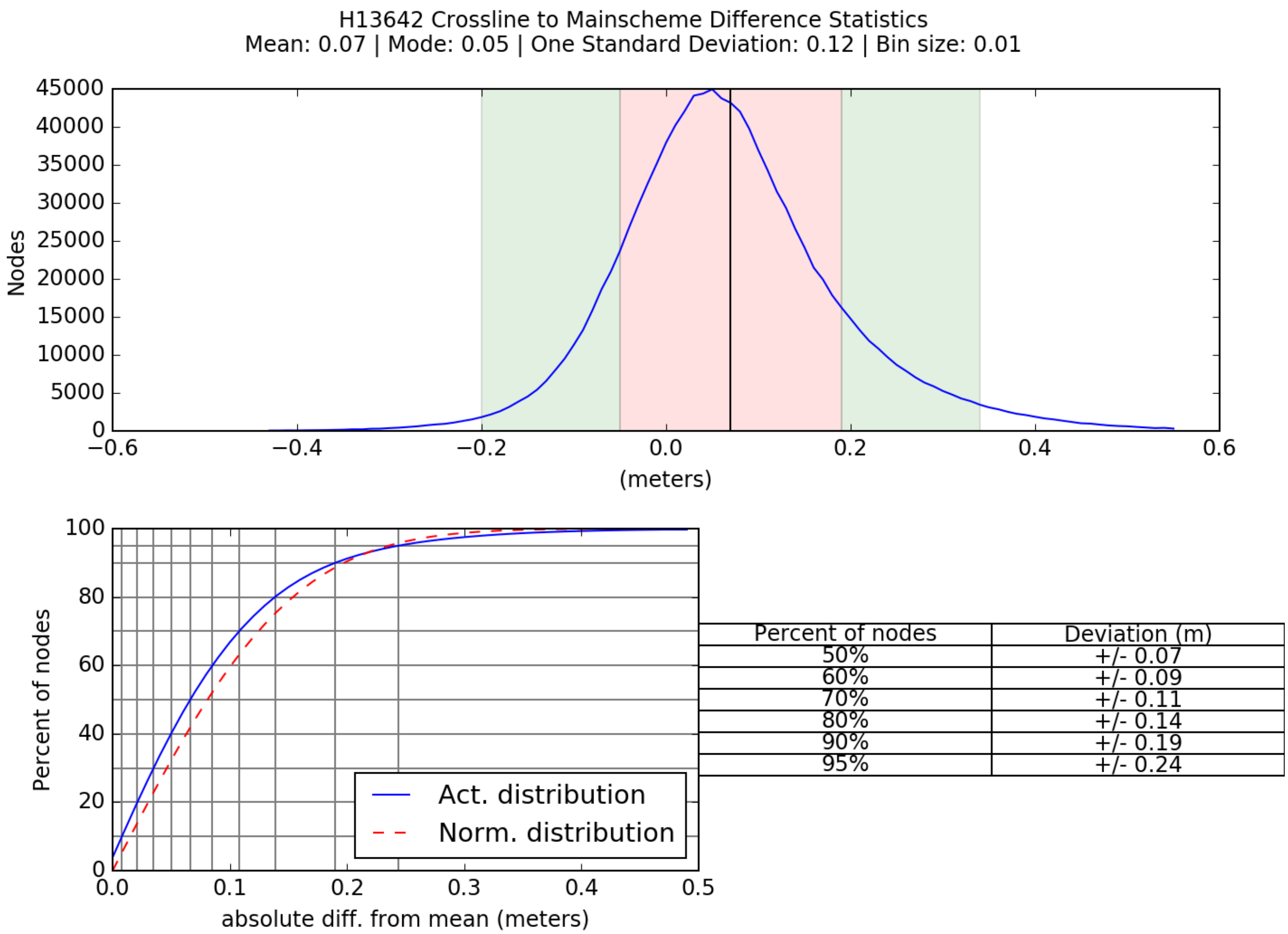
B.2 Quality Control

B.2.1 Crosslines

Multibeam crosslines acquired for H13642 totaled 4.43% of mainscheme acquisition.

H13642 crosslines were collected and analyzed in accordance with section 5.2.4.2 of the HSSD. Crosslines were evaluated in CARIS HIPS with a detailed visual inspection followed by a thorough statistical analysis. To conduct the statistical analysis, a 4 m CUBE surface was generated with strictly mainscheme data and another, separate 4 m CUBE surface was generated with only crossline data. The mainscheme and crossline surfaces were analyzed using the Compare Grids tool in Pydro Explorer, which generated a difference surface and associated statistics. In addition to the direct statistics from the surface differencing, the tool assessed the difference surface statistics and computed the proportion of NOS total allowable vertical uncertainty (TVU) consumed by the mainscheme to crossline differences per surface node.

The statistical results of the difference comparison show 95% of nodes falling within +/- 0.24 m, with a mean difference of 0.07 m (Figure 4). Additionally, at least 95% of the difference surface nodes met or exceed TVU specification, as described in section 5.1.3 of the HSSD.



Percent of nodes	Deviation (m)
50%	+/- 0.07
60%	+/- 0.09
70%	+/- 0.11
80%	+/- 0.14
90%	+/- 0.19
95%	+/- 0.24

Figure 4: H13642 crossline to mainscheme difference statistics

B.2.2 Uncertainty

The following survey specific parameters were used for this survey:

Method	Measured	Zoning
ERS via VDATUM	0.0 meters	0.045 meters

Table 7: Survey Specific Tide TPU Values.

Hull ID	Measured - CTD	Measured - MVP	Measured - XBT	Surface
R/V Substantial	N/A	2.00 meters/second	N/A	0.05 meters/second

Table 8: Survey Specific Sound Speed TPU Values.

The finalized CUBE surfaces were analyzed using the HydrOffice QC Tools Grid QA tool to assure 95% of the surface nodes meet TVU specifications. The results of the Grid QA tool determined that the finalized CUBE surfaces met or exceeded the TVU specifications, as shown in Figures 5 and 6.

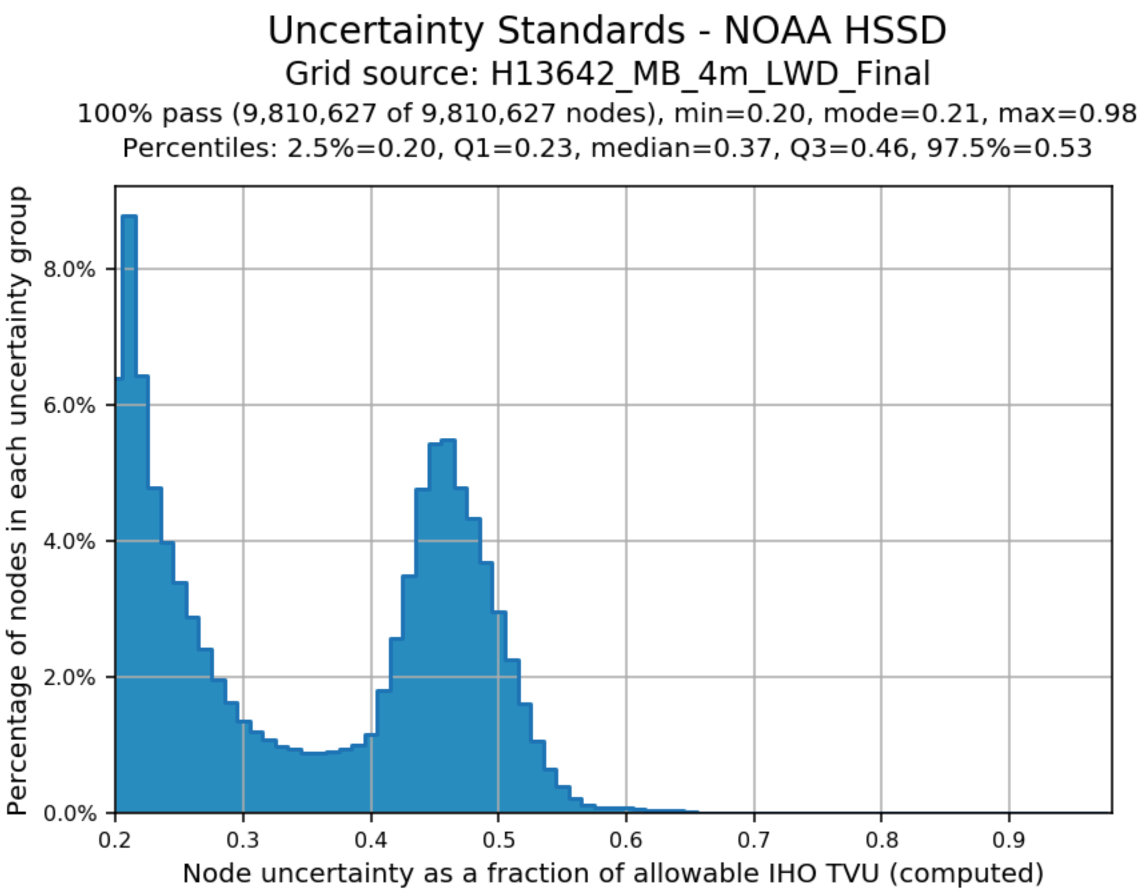


Figure 5: Finalized 4 m CUBE surface TVU statistics for H13642

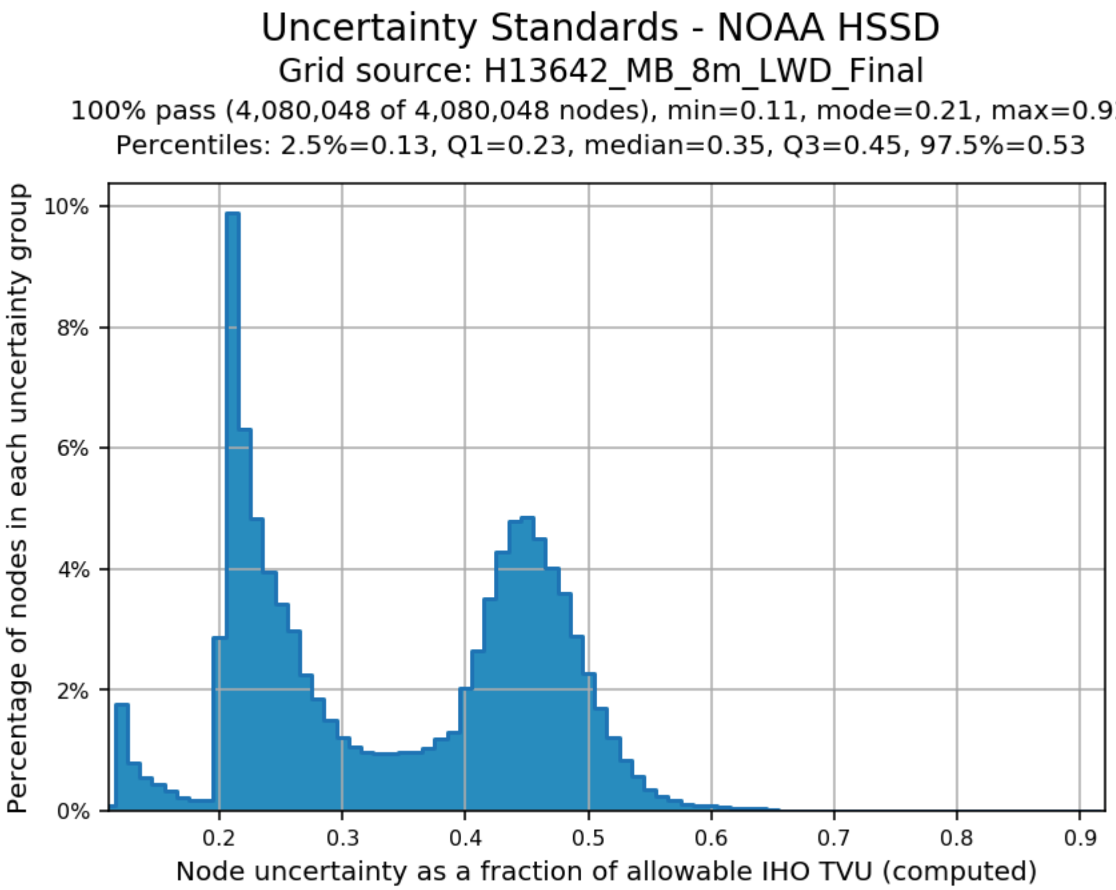


Figure 6: Finalized 8 m CUBE surface TVU statistics for H13642

B.2.3 Junctions

H13642 junctions with H13639, H13640, H13641, H13643 and the 2021 NRT-New London MBES data, registry numbers H13526 and H13527. Data overlap between H13642 and the adjacent surveys were attained. To conduct the junction analyses, similar to section B.2.1 of this report, the Pydro Compare Grids tool was utilized. The inputs for this tool were the surfaces for each individual survey at matching resolutions.

In addition to the statistical results of the junction analyses, the resultant difference surfaces were visually inspected and CARIS HIPS Subset Editor was used to examine overlapping data for consistency, agreement between surveys, and confirming data met TVU specifications.

Refer to the Project Correspondence for further information regarding junctions with existing surveys.

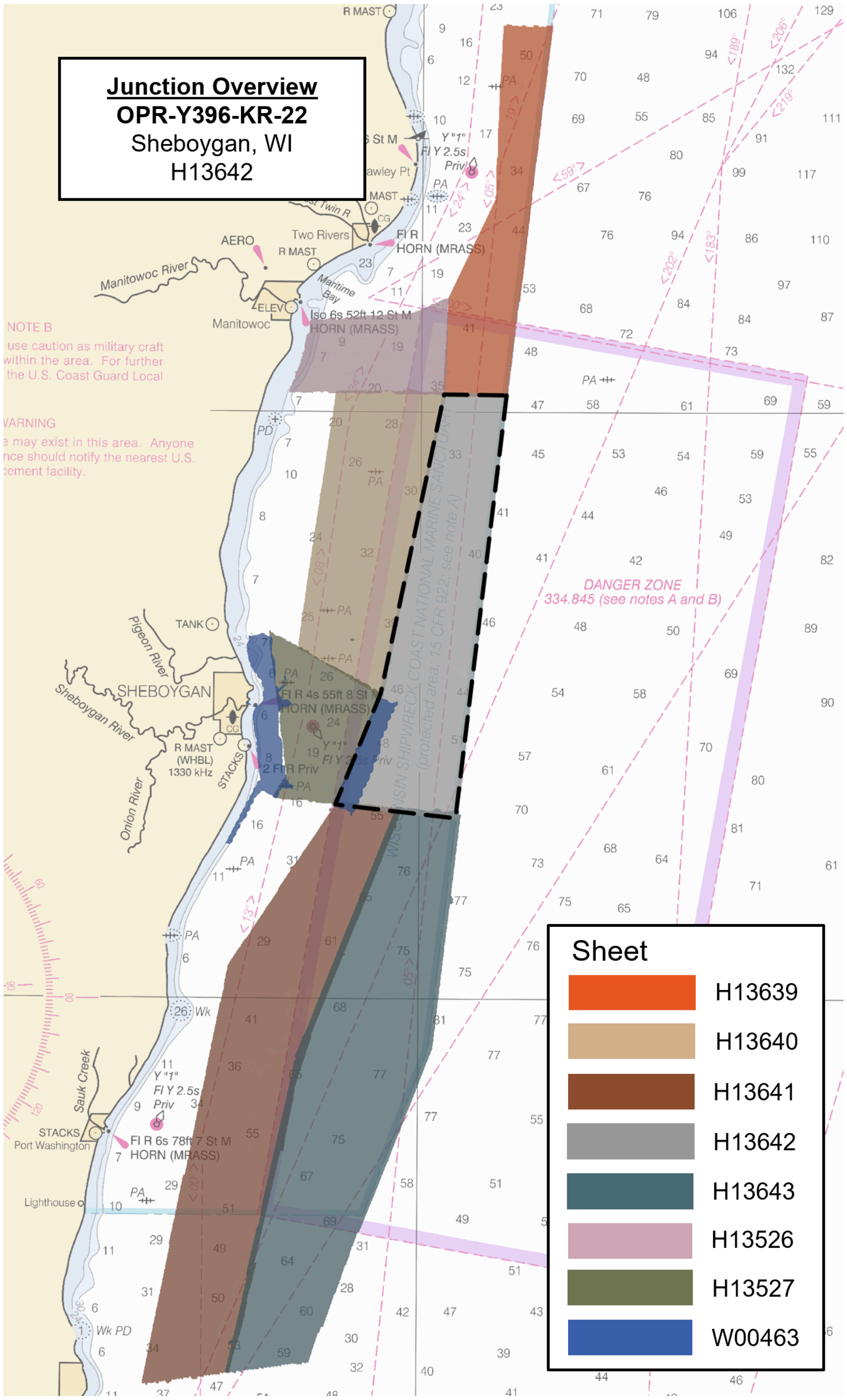


Figure 7: Overview of H13642 junction surveys

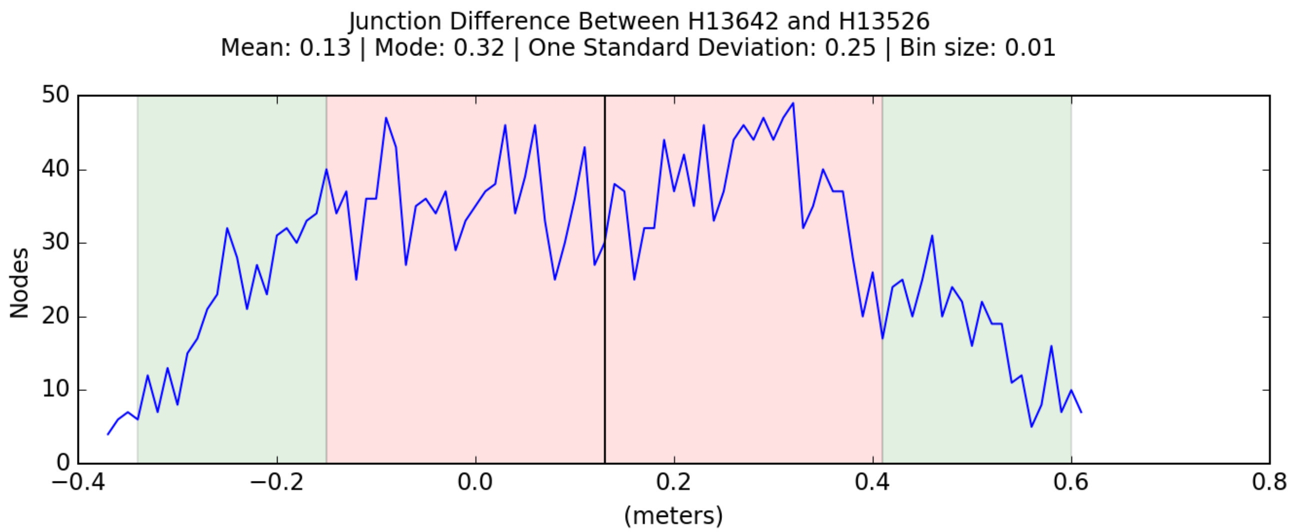
The following junctions were made with this survey:

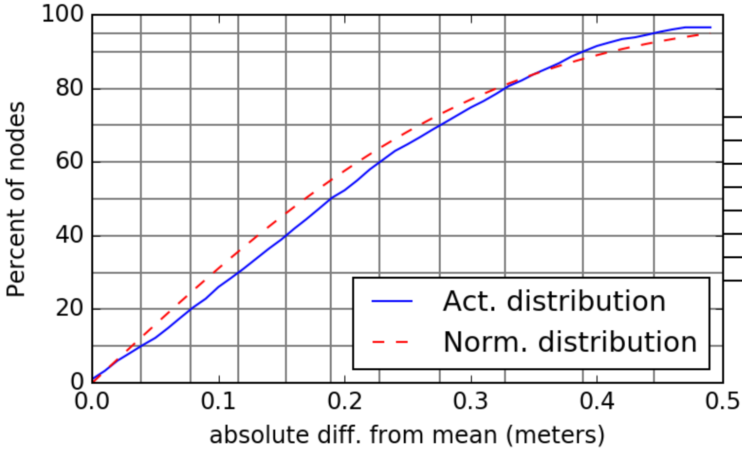
Registry Number	Scale	Year	Field Unit	Relative Location
H13526	1:10000	2021	NRT-New London	NW
H13527	1:10000	2021	NRT-New London	SW
W00463	1:40000	2018	NCCOS R/V Storm	SW
H13640	1:40000	2022	Geodynamics	W
H13639	1:40000	2022	Geodynamics	N
H13641	1:40000	2022	Geodynamics	S
H13643	1:40000	2022	Geodynamics	S

Table 9: Junctioning Surveys

H13526

The statistical results of the difference comparison show 95% of nodes falling within +/- 0.45 m, with a mean difference of 0.13 m (Figure 8). Additionally, at least 95% of the difference surface nodes met or exceeded TVU specifications, as described in section 5.1.3 of the HSSD.



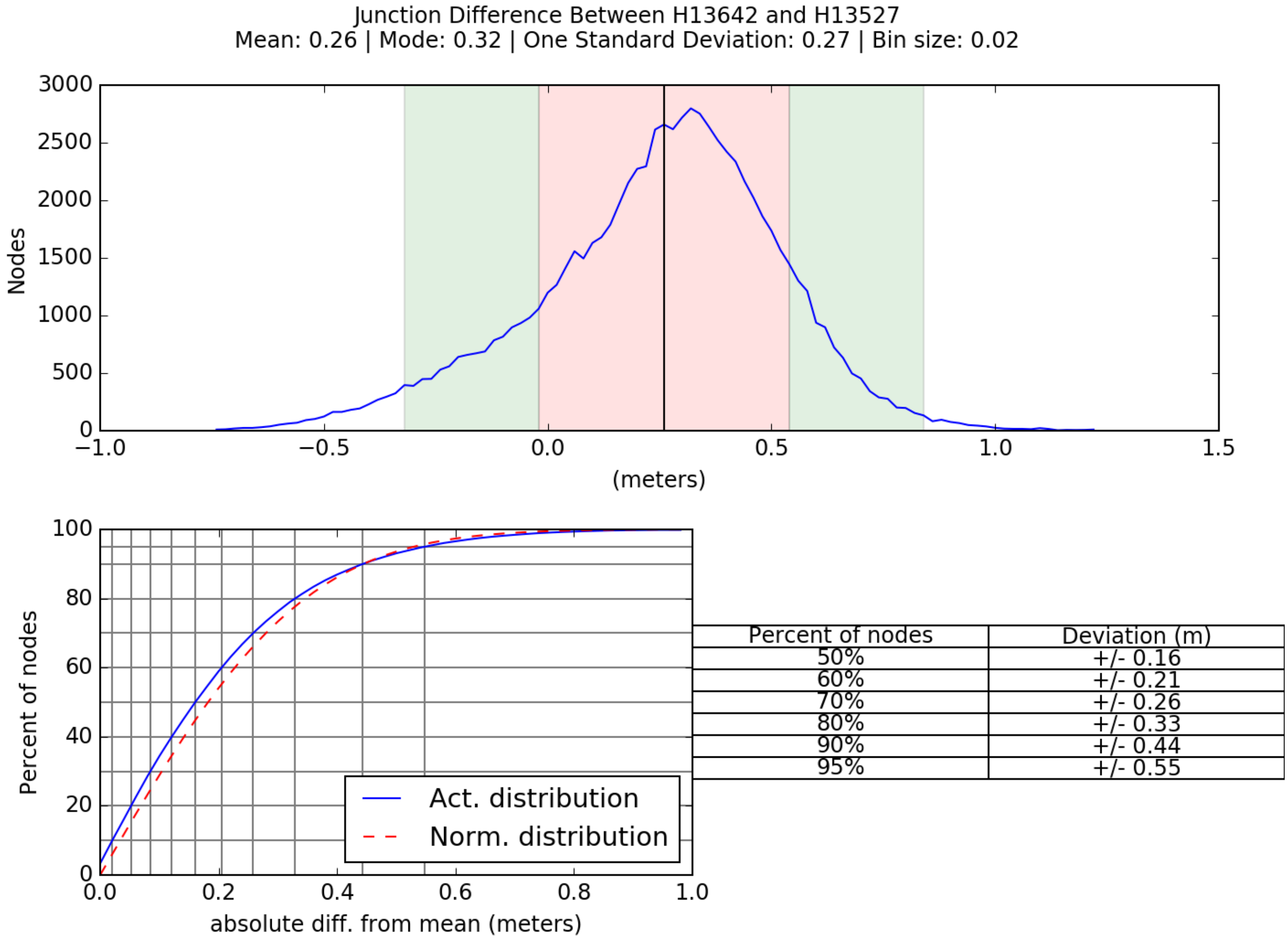


Percent of nodes	Deviation (m)
50%	+/- 0.19
60%	+/- 0.23
70%	+/- 0.28
80%	+/- 0.33
90%	+/- 0.39
95%	+/- 0.45

Figure 8: Junction analysis between H13642 and H13526

<u>H13527</u>

The statistical results of the difference comparison show 95% of nodes falling within +/- 0.55 m, with a mean difference of 0.26 m (Figure 9). Additionally, at least 95% of the difference surface nodes met or exceeded TVU specifications, as described in section 5.1.3 of the HSSD.

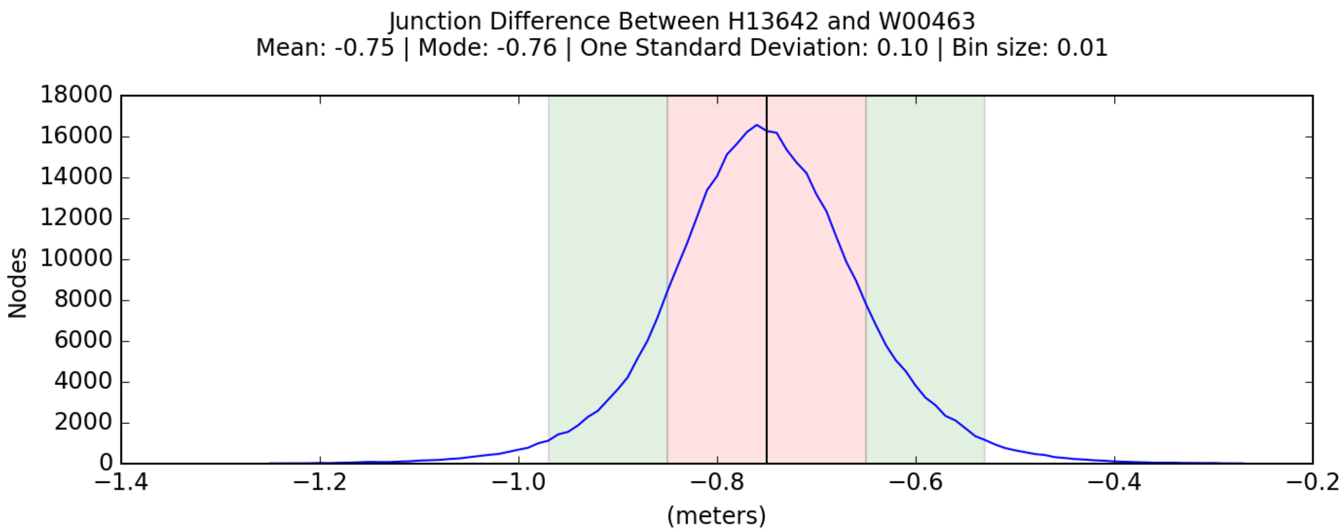


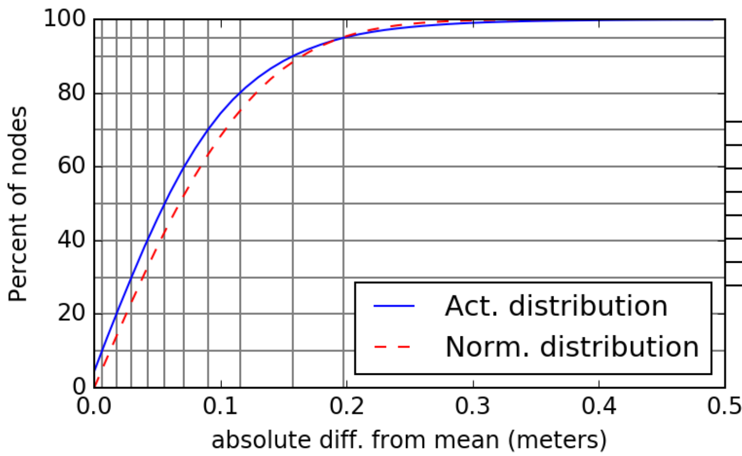
Percent of nodes	Deviation (m)
50%	+/- 0.16
60%	+/- 0.21
70%	+/- 0.26
80%	+/- 0.33
90%	+/- 0.44
95%	+/- 0.55

Figure 9: Junction analysis between H13642 and H13527

<u>W00463</u>

The statistical results of the difference comparison show 95% of nodes falling within +/- 0.20 m, with a mean difference of -0.75 m (Figure 10). Additionally, at least 95% of the difference surface nodes met or exceeded TVU specifications, as described in section 5.1.3 of the HSSD.



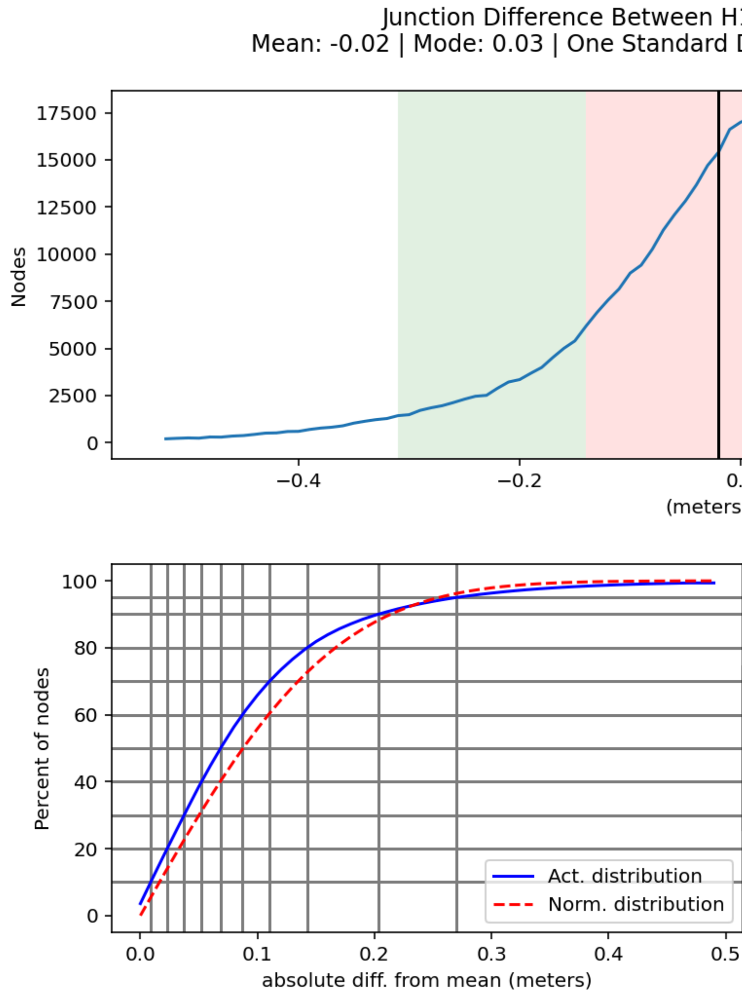


Percent of nodes	Deviation (m)
50%	+/- 0.06
60%	+/- 0.07
70%	+/- 0.09
80%	+/- 0.12
90%	+/- 0.16
95%	+/- 0.20

Figure 10: Junction analysis between H13642 and W00463

<u>H13640</u>

The statistical results of the difference comparison show 95% of nodes falling within +/- 0.27 m, with a mean difference of -0.02 m (Figure 11). Additionally, at least 95% of the difference surface nodes met or exceeded TVU specifications, as described in section 5.1.3 of the HSSD.

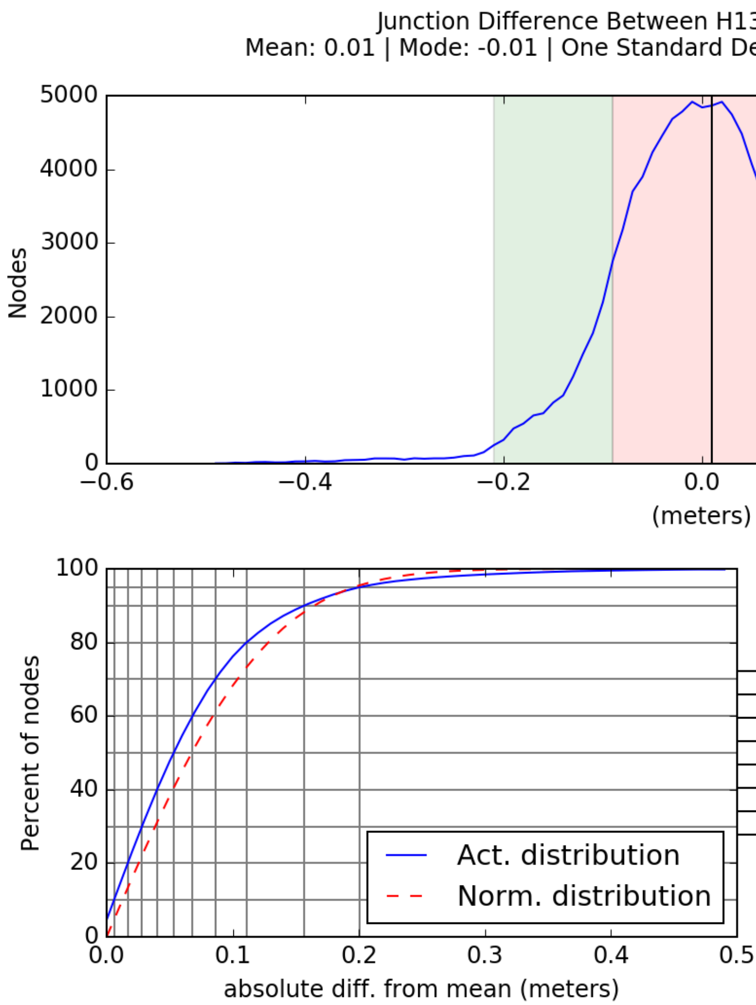


Percent of nodes	Deviation (m)
50%	+/- 0.07
60%	+/- 0.09
70%	+/- 0.11
80%	+/- 0.14
90%	+/- 0.20
95%	+/- 0.27

Figure 11: Junction analysis between H13642 and H13640

<u>H13639</u>

The statistical results of the difference comparison show 95% of nodes falling within +/- 0.20 m, with a mean difference of 0.01 m (Figure 12). Additionally, at least 95% of the difference surface nodes met or exceeded TVU specifications, as described in section 5.1.3 of the HSSD.

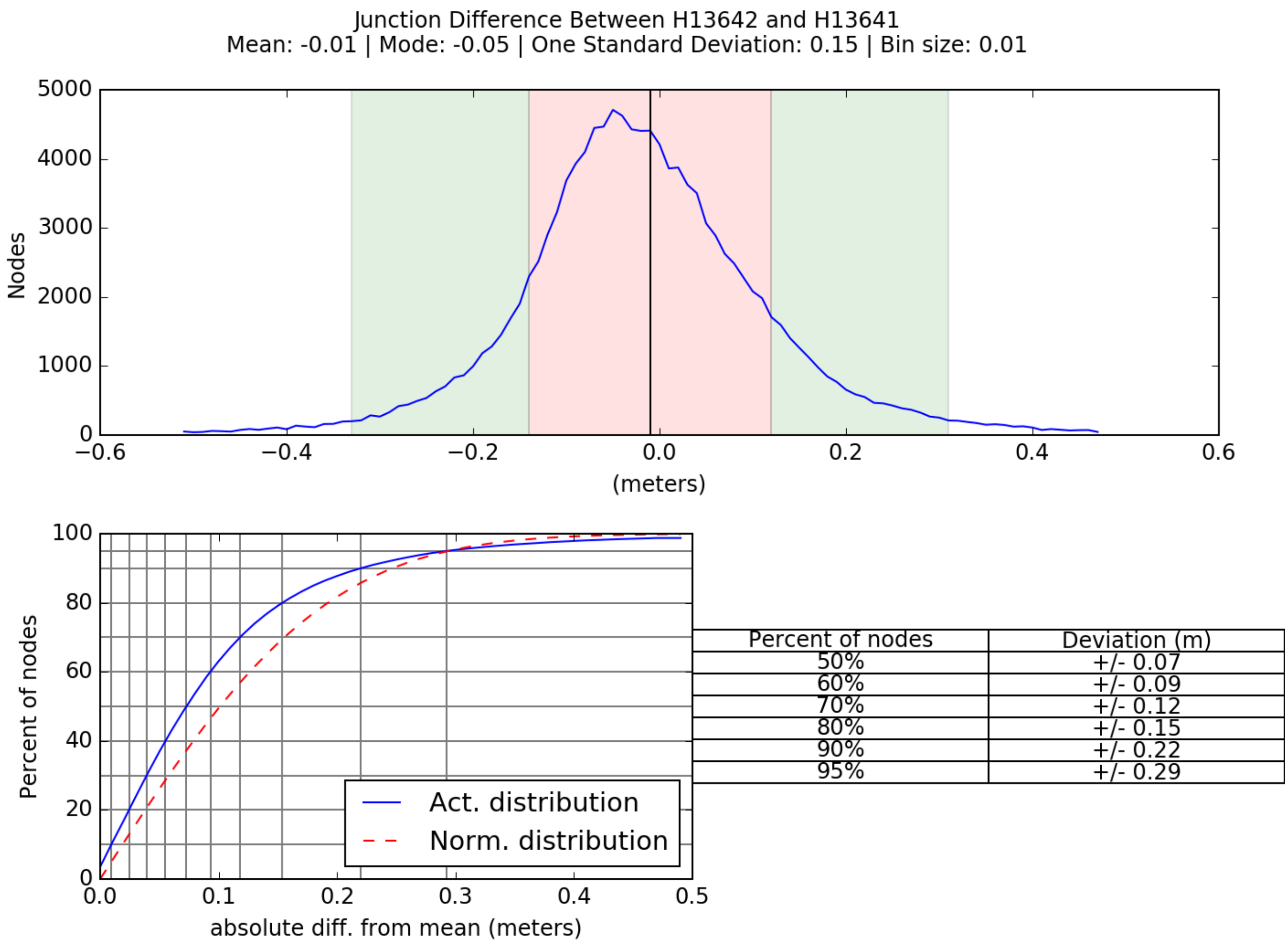


Percent of nodes	Deviation (m)
50%	+/- 0.05
60%	+/- 0.07
70%	+/- 0.09
80%	+/- 0.11
90%	+/- 0.16
95%	+/- 0.20

Figure 12: Junction analysis between H13642 and H13639

<u>H13641</u>

The statistical results of the difference comparison show 95% of nodes falling within +/- 0.29 m, with a mean difference of -0.01 m (Figure 13). Additionally, at least 95% of the difference surface nodes met or exceeded TVU specifications, as described in section 5.1.3 of the HSSD.

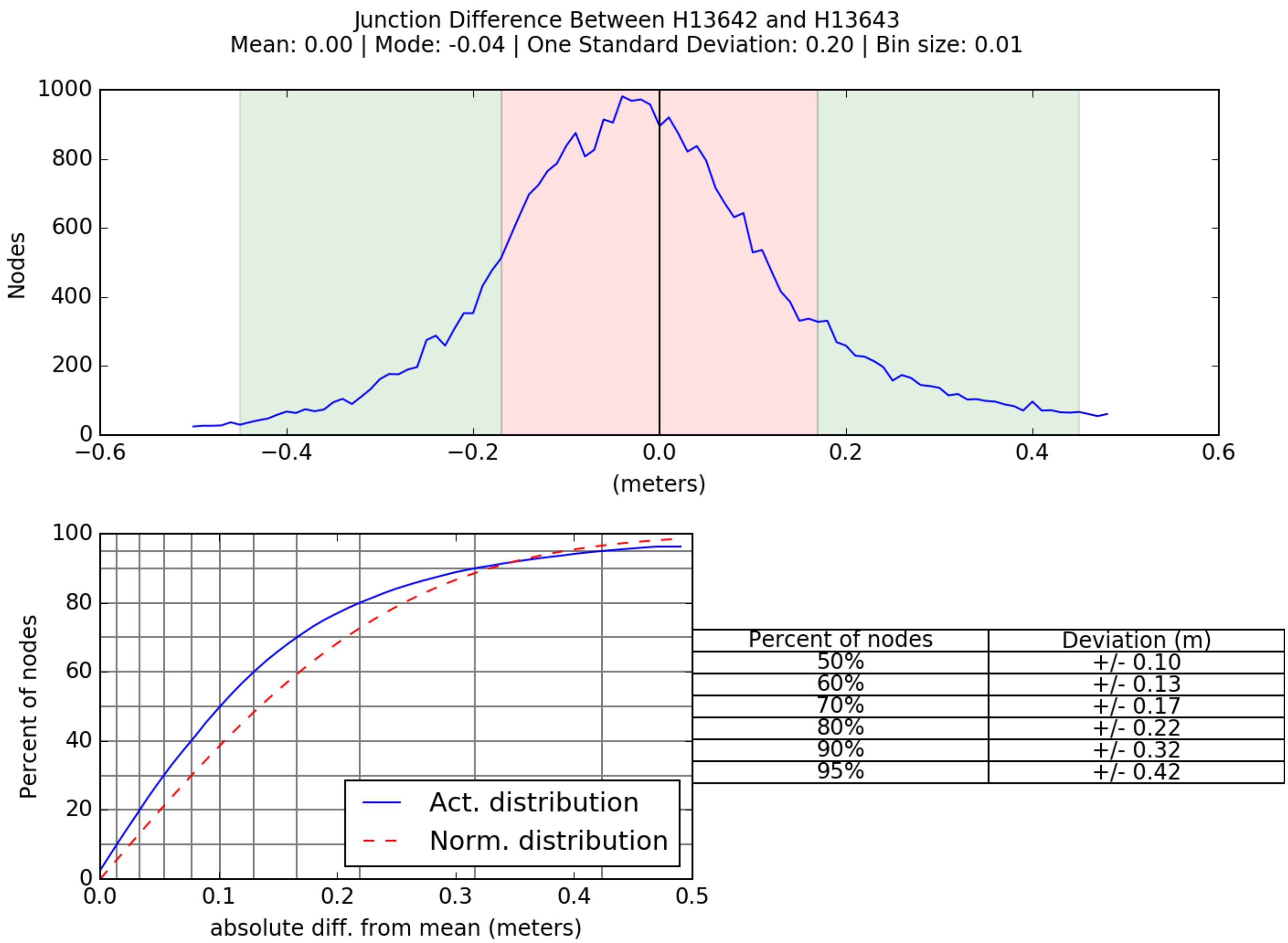


Percent of nodes	Deviation (m)
50%	+/- 0.07
60%	+/- 0.09
70%	+/- 0.12
80%	+/- 0.15
90%	+/- 0.22
95%	+/- 0.29

Figure 13: Junction analysis between H13642 and H13641

<u>H13643</u>

The statistical results of the difference comparison show 95% of nodes falling within +/- 0.42 m, with a mean difference of 0.00 m (Figure 14). Additionally, at least 95% of the difference surface nodes met or exceeded TVU specifications, as described in section 5.1.3 of the HSSD.



Percent of nodes	Deviation (m)
50%	+/- 0.10
60%	+/- 0.13
70%	+/- 0.17
80%	+/- 0.22
90%	+/- 0.32
95%	+/- 0.42

Figure 14: Junction analysis between H13642 and H13643

B.2.4 Sonar QC Checks

Sonar system quality control checks were conducted as detailed in the quality control section of the DAPR.

B.2.5 Equipment Effectiveness

There were no conditions or deficiencies that affected equipment operational effectiveness.

B.2.6 Factors Affecting Soundings

Sound Speed

The spatio-temporal variability in temperature of the water column created complex sound speed conditions throughout the survey. These complexities often created challenges for the field team and resulted in occasional refraction artifacts in the survey data and resultant surfaces, as shown in Figures 15 and 16.

The hydrographer made considerable efforts to reduce the impact of sound speed issues during acquisition. These efforts included increasing the frequency of casts, closely monitoring real-time swath "smiling" or "frowning", utilizing alerts for surface-to-profile sound speed deviation, observing the real-time standard deviation map display, and utilizing Sound Speed Manager to track spatial changes in surface sound speed along with profile location. Additional efforts in post-processing to minimize refraction artifacts included outer beam filtering, manual outer beam editing, and strategic application of sound speed profiles.

In addition to the outer beam noise associated with refraction, the convex or concave trend in the across-track sonar data is most prevalent in the outer beams and is noticeable in the surface as a striped line to line artifact.

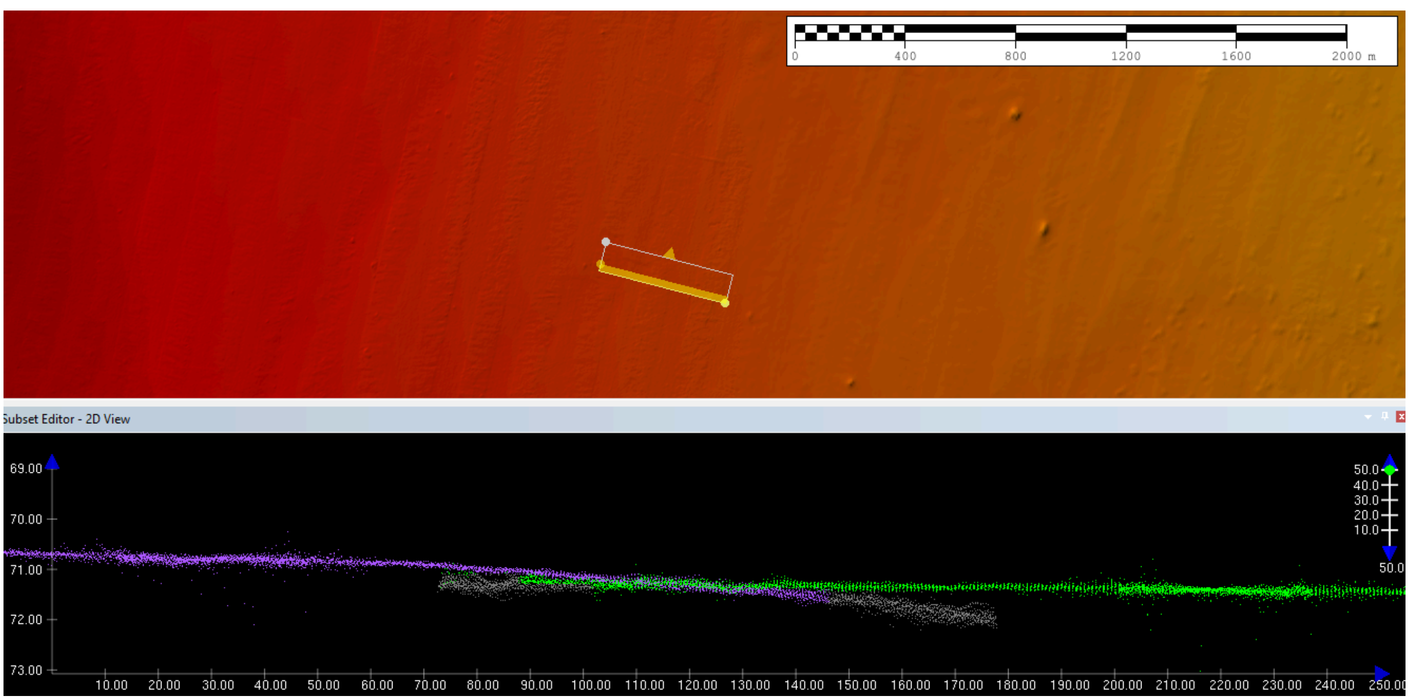


Figure 15: H13642 surface artifacts as a result of refraction causing the soundings to trend concave/convex

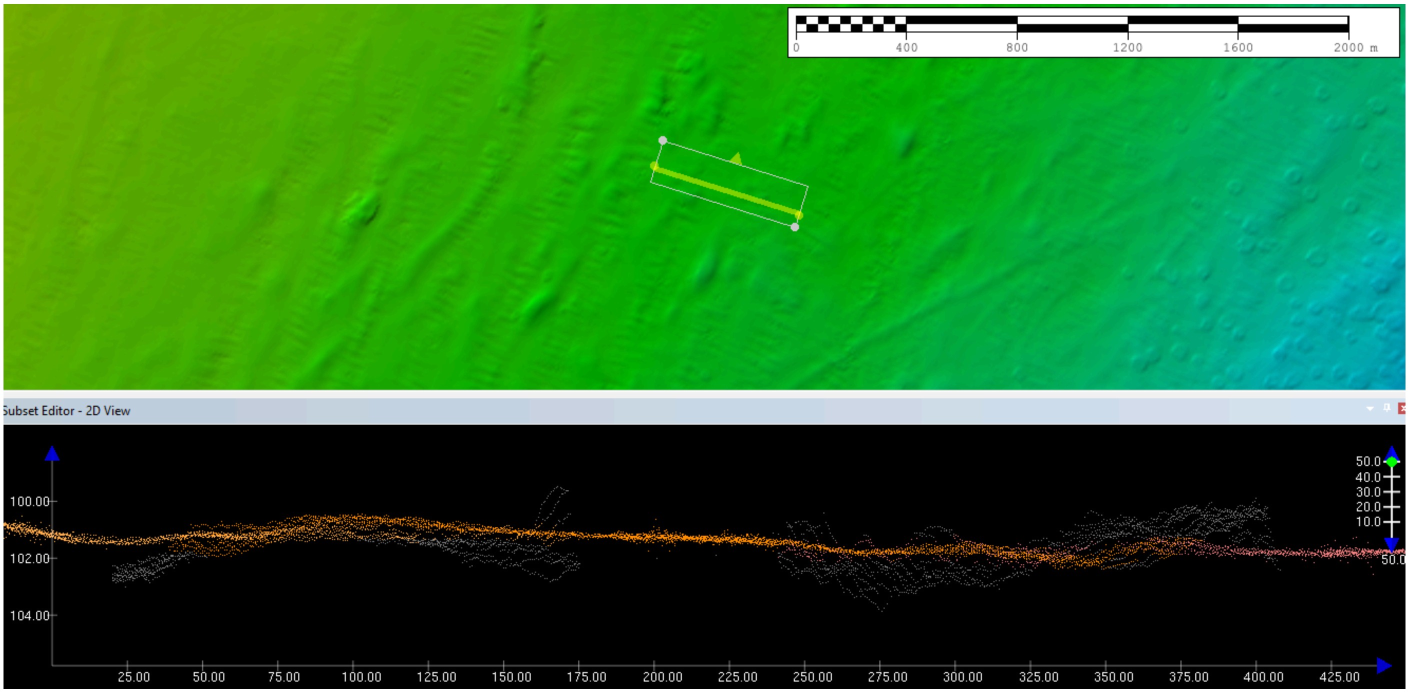


Figure 16: H13642 surface artifacts as a result of refraction causing outer beam noise

B.2.7 Sound Speed Methods

Sound Speed Cast Frequency: The R/V Substantial utilized an MVP onboard which allowed for a higher frequency of casts.

Surface sound speed was compared in real-time to the sound speed profile. When the comparison differed by more than 2 m/s, a new sound speed profile was acquired. Additionally, QPS Qinsy and Kongsberg SIS provided a real-time visual assessment of data quality (standard deviation grids, bathymetric grids, swath views) aiding the hydrographer in determining when a new cast was required.

For more detailed information on sound speed methods, refer to the DAPR.

B.2.8 Coverage Equipment and Methods

All equipment and survey methods were used as detailed in the DAPR.

B.2.9 Holidays

All CUBE surfaces were analyzed using HydrOffice QC Tools Holiday Finder to determine if the surfaces contained holidays, as described in section 5.2.2.3 of the HSSD. The tool scanned the CUBE surfaces, identifying any holidays, and generated an S-57 file to illustrate the locations of holidays. The tool determined no holidays were present within the CUBE surfaces.

Another method of holiday evaluation was to visually pan the CUBE surfaces to identify holidays. The hydrographer would often alter the surface display (color ranges, symbology, shading) to help aid the hydrographer in identifying coverage gaps. The results reflected the same outcome as the tool, no holidays exist within the survey extents.

B.2.10 Density

The finalized 4 m and 8 m CUBE surfaces were analyzed using HydrOffice QC Tools Grid QA tool to assure data met the required density specifications. Density requirements were achieved for the finalized surfaces in H13642 with 99.5% of the 4 m and 8 m surface nodes (Figure 17 & 18) containing at least five or more soundings, exceeding the specifications required by section 5.2.2.3 of the HSSD.

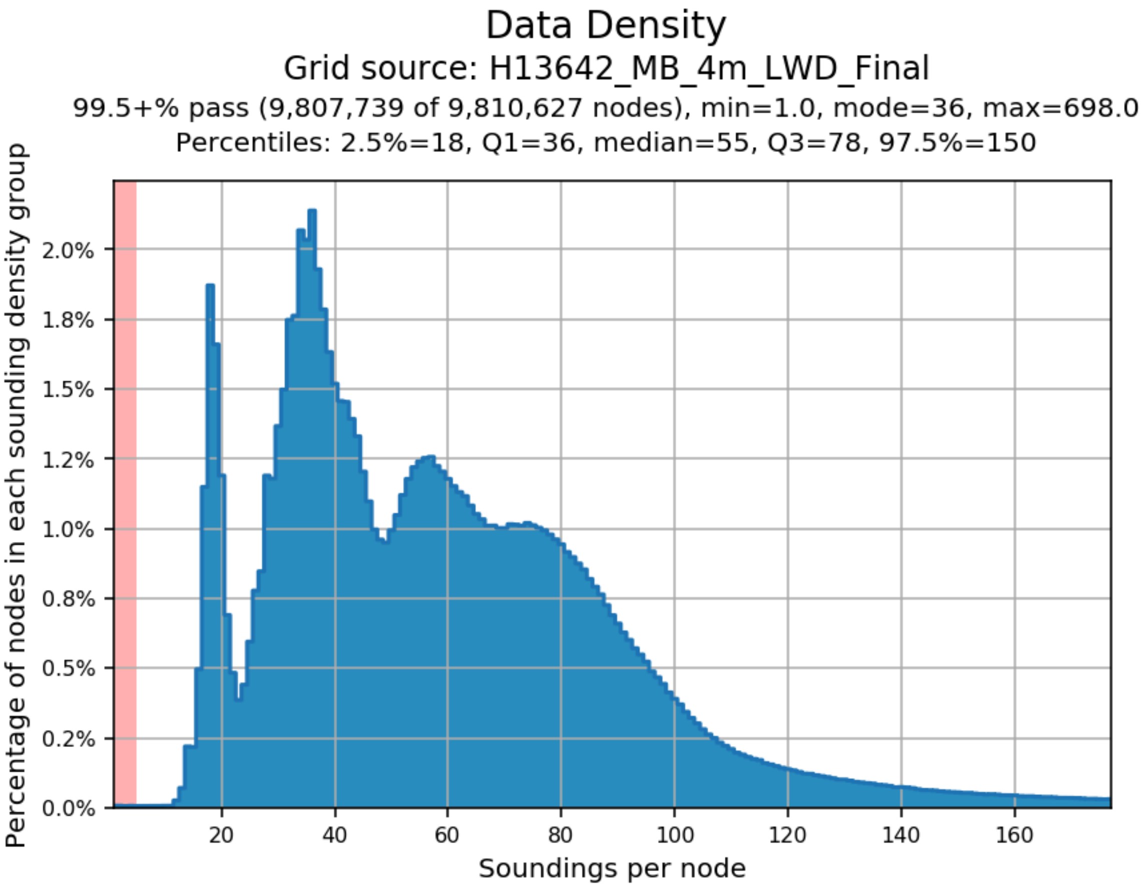


Figure 17: Finalized 4 m CUBE surface density statistics for H13642

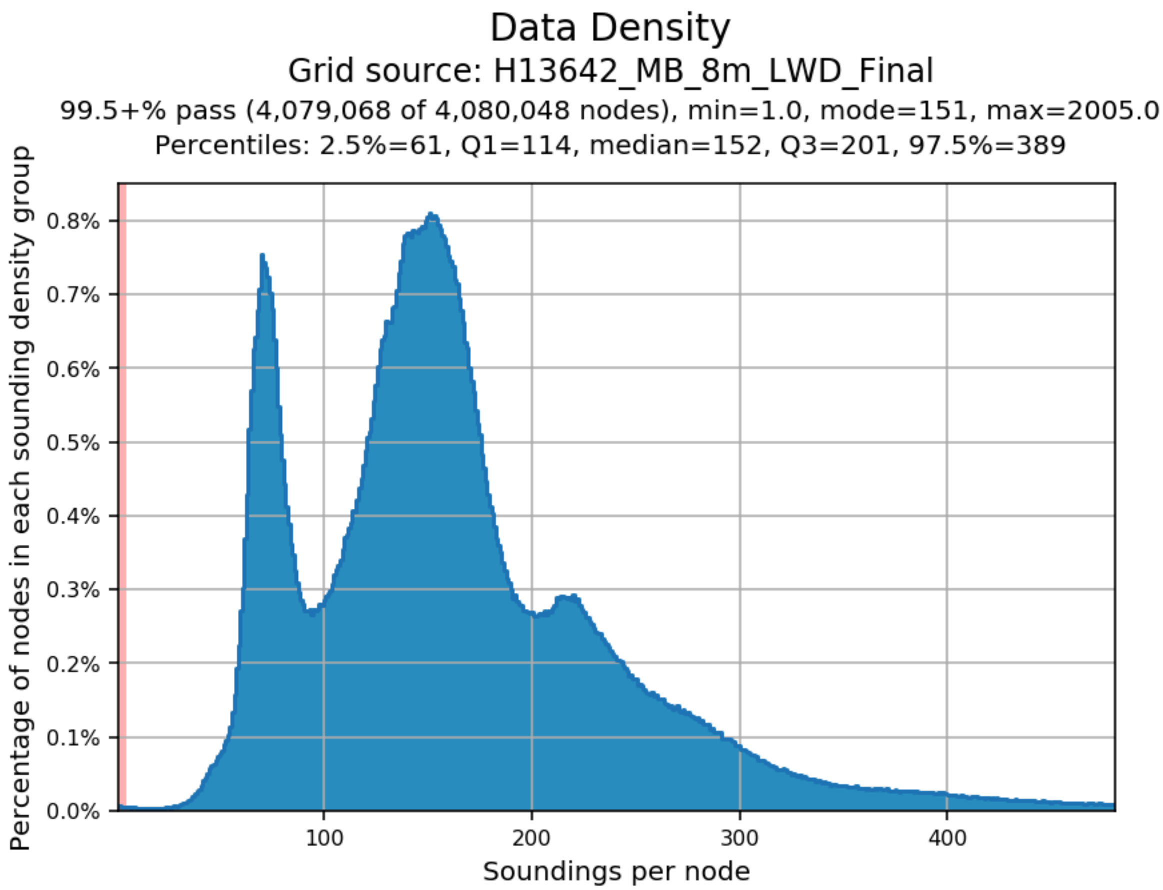


Figure 18: Finalized 8 m CUBE surface density statistics for H13642

B.2.11 Flier Finder

In addition to a visual inspection, all CUBE surfaces were analyzed using HydrOffice QC Tools Flier Finder tool to assure data does not contain fliers (anomalous data as defined by QC Tools flier finding algorithms #2-5). While the Flier Finder tool flags surface fliers meeting a set criteria, it will also flag real surface features that meet the same criteria. Spurious soundings flagged by Flier Finder were cleaned until either no fliers remained or the remaining flagged fliers were deemed valid aspects of the surface.

B.3 Echo Sounding Corrections

B.3.1 Corrections to Echo Soundings

All data reduction procedures conform to those detailed in the DAPR.

B.3.2 Calibrations

All sounding systems were calibrated as detailed in the DAPR.

B.4 Backscatter

Raw backscatter data were collected and stored within the .ALL files. Backscatter data were processed and reviewed for quality assurance in QPS FMGT. In accordance with the PI Appendix 2, GSFs and backscatter mosaics were exported from FMGT. Hydrographers in the field monitored backscatter intensities in real-time and made efforts to collect quality backscatter without hindering bathymetric data quality. Refer to the DAPR for more information on backscatter data acquisition and processing procedures.

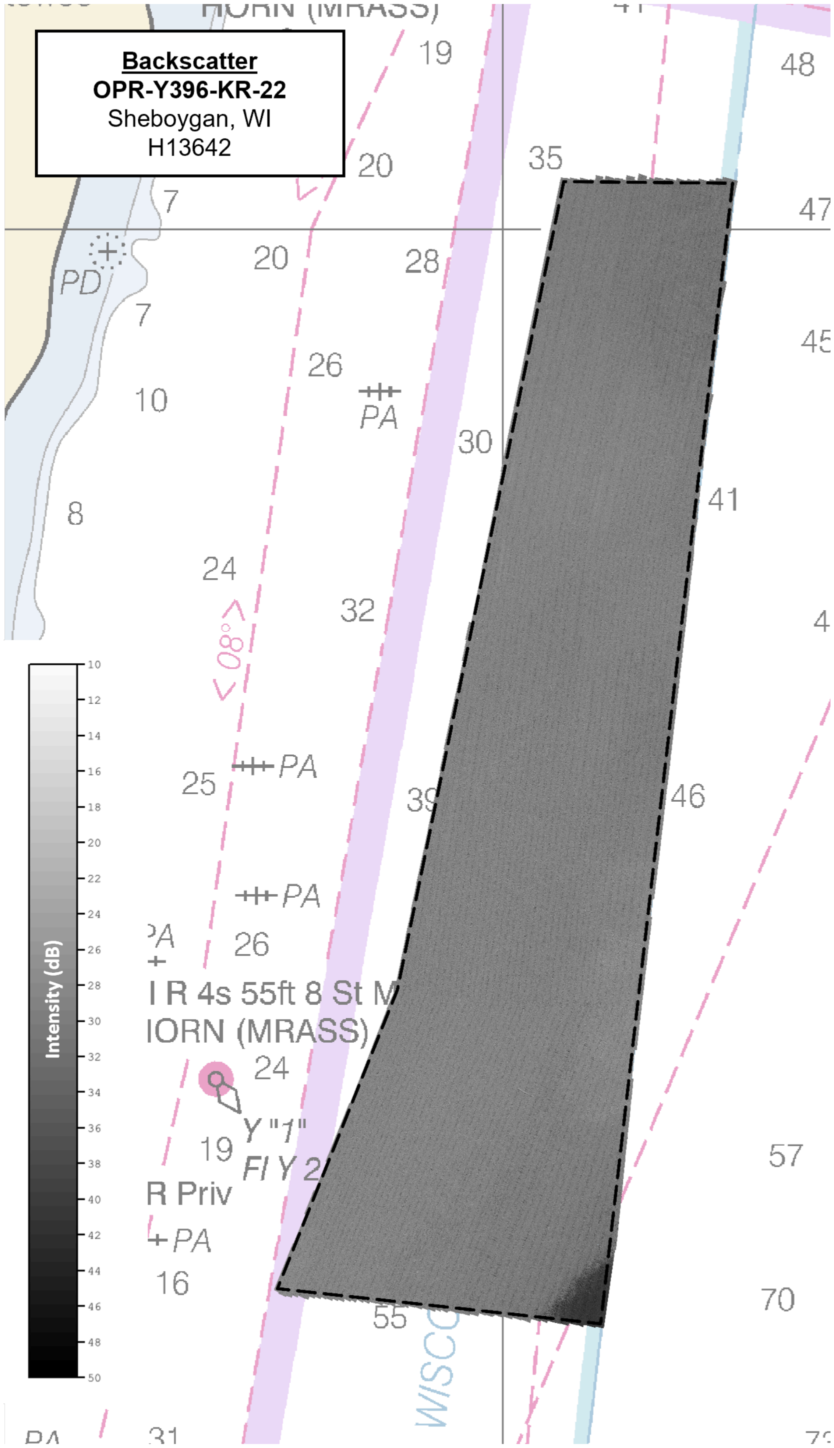


Figure 19: H13642 backscatter

B.5 Data Processing

B.5.1 Primary Data Processing Software

The following software program was the primary program used for bathymetric data processing:

Manufacturer	Name	Version
CARIS	HIPS and SIPS	11.4.4

Table 10: Primary bathymetric data processing software

The following software program was the primary program used for imagery data processing:

Manufacturer	Name	Version
QPS	FMGT	7.10.1

Table 11: Primary imagery data processing software

The following Feature Object Catalog was used: NOAA Profile Version 2022.

B.5.2 Surfaces

The following surfaces and/or BAGs were submitted to the Processing Branch:

Surface Name	Surface Type	Resolution	Depth Range	Surface Parameter	Purpose
H13642_MB_4m_LWD_Final	CARIS Raster Surface (CUBE)	4 meters	57.99 meters - 80.0 meters	NOAA_4m	Complete MBES
H13642_MB_8m_LWD_Final	CARIS Raster Surface (CUBE)	8 meters	72.0 meters - 138.91 meters	NOAA_8m	Complete MBES
H13642_MB_4m_LWD	CARIS Raster Surface (CUBE)	4 meters	57.99 meters - 139.08 meters	NOAA_4m	Complete MBES
H13642_MB_8m_LWD	CARIS Raster Surface (CUBE)	8 meters	58.07 meters - 138.91 meters	NOAA_8m	Complete MBES

Table 12: Submitted Surfaces

All surfaces submitted are in compliance with the complete coverage MBES requirements per section 5.2.2.3 of the HSSD. See Figure 20 below for an overview of the submitted finalized surface resolutions.

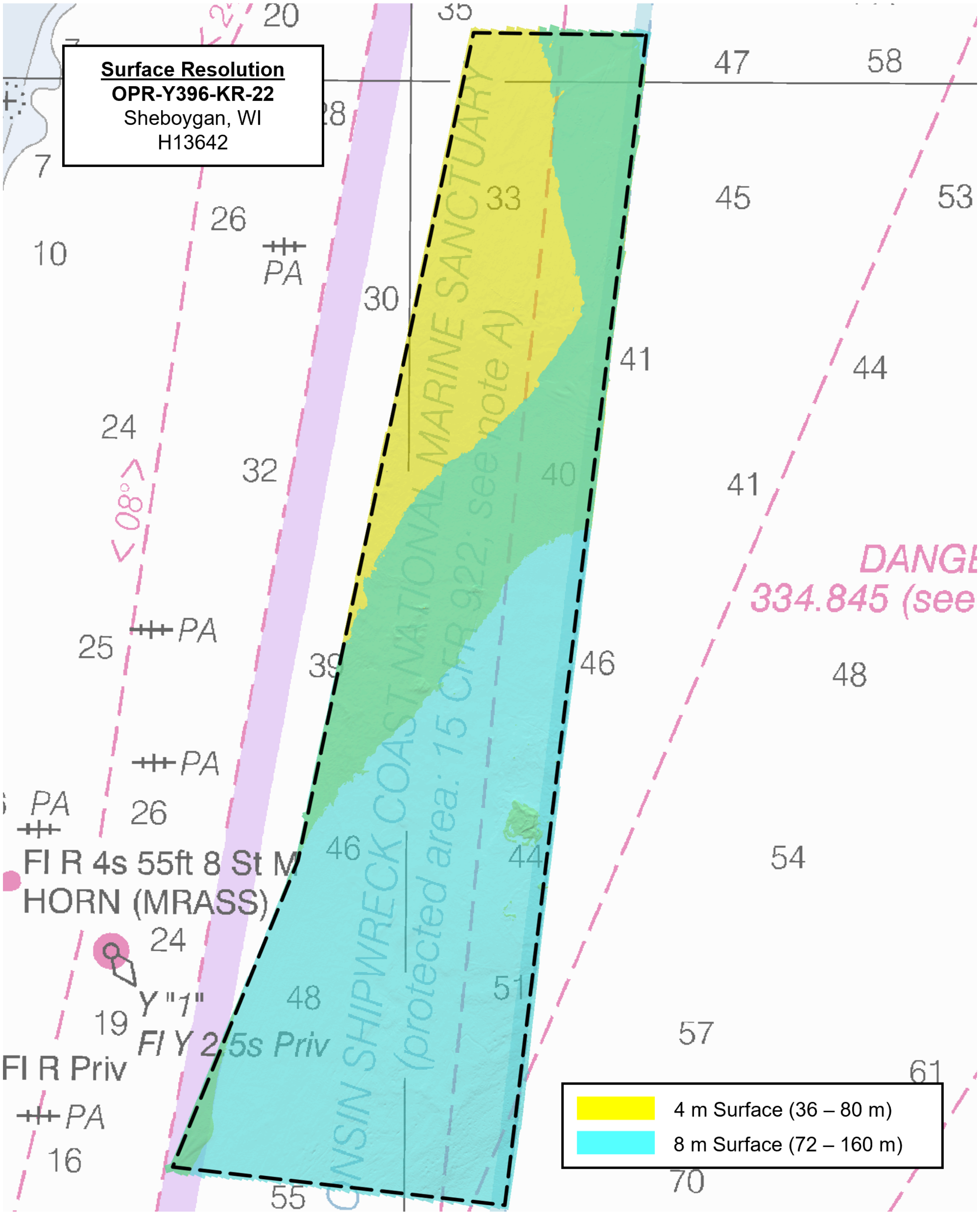


Figure 20: Image representing the finalized CUBE surface resolutions in H13642

B.5.3 Designated Soundings

H13642 contains one (1) designated sounding in accordance with sections 5.2.1.2.3 and 7.4 of the HSSD. Designated soundings are created to facilitate feature management and best represent the least depths of features in the Final Feature File (FFF). In the finalized CUBE surfaces, the CARIS HIPS Apply Designated Soundings function ensured designated sounding depths are retained in the finalized surfaces.

C. Vertical and Horizontal Control

Additional information discussing the vertical or horizontal control for this survey can be found in the accompanying HVCR.

C.1 Vertical Control

The vertical datum for this project is Low Water Datum IGLD-1985.

ERS Datum Transformation

The following ellipsoid-to-chart vertical datum transformation was used:

Method	Ellipsoid to Chart Datum Separation File
ERS via VDATUM	TO3_SEP_extents_new_100m_NAD83_2011-LWD_IGLD85_geoid18.csar

Table 13: ERS method and SEP file

Real-time positional data were corrected with G2+ Global Navigation Satellite System (GNSS) satellite corrections provided by the Fugro Marinestar Satellite-Based Augmentation System (SBAS). To improve the accuracy of the real-time data, real-time position data were post-processed using Applanix POSPac Mobile Mapping Solution (MMS) software. Trimble CenterPoint RTX correction methods were used to create Smoothed Best Estimate of Trajectory (SBET) files, which were applied to the survey data in CARIS HIPS. The provided separation model was then utilized to bring the data from ellipsoid heights to chart datum.

C.2 Horizontal Control

The horizontal datum for this project is North American Datum 1983 (2011).

The projection used for this project is Universal Transverse Mercator (UTM) Zone 16.

RTK

Real-time positional data were corrected with G2+ GNSS satellite corrections provided by the Fugro Marinestar SBAS.

D. Results and Recommendations

D.1 Chart Comparison

A comparison was performed in CARIS HIPS between H13642 and the ENCs listed in Table 14 of section D.1.1. Sounding layers were generated from the CUBE surface and overlaid onto the ENCs to visually assess differences between the surveyed and charted depths.

In addition to a detailed visual inspection in CARIS HIPS, all soundings from the chart were downloaded as a shapefile from NOAA's ENC Direct to GIS application and differenced with the nearest surveyed depth from the 8 m surface in ESRI ArcPro. A statistical analysis of the difference comparison is shown in Figure 21. The surveyed depths from H13642 generally agree with the charted soundings from the largest scale ENCs within the survey area, with a mean difference of 0.13 m.

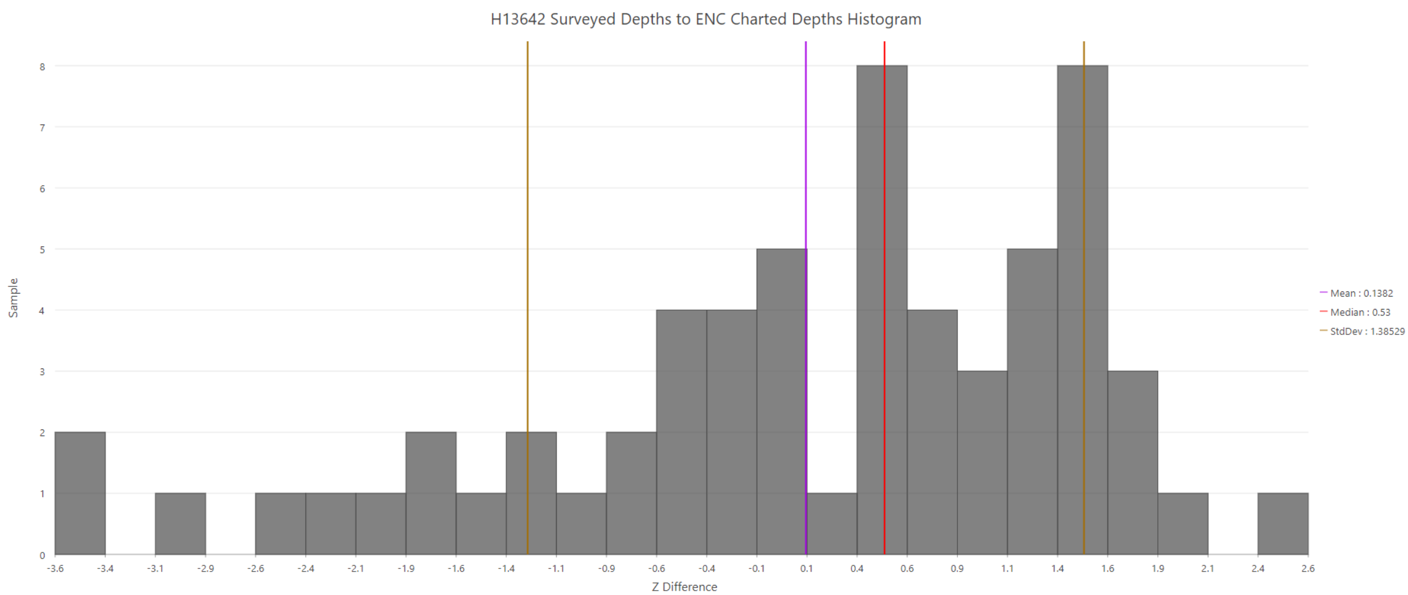


Figure 21: H13642 statistical analysis of surveyed depths to charted depths

D.1.1 Electronic Navigational Charts

The following are the largest scale ENCs, which cover the survey area:

ENC	Scale	Edition	Update Application Date	Issue Date
US4WI34M	1:120000	14	09/15/2021	05/18/2022

Table 14: Largest Scale ENCs

D.1.2 Shoal and Hazardous Features

No shoals or potentially hazardous features exist for this survey.

D.1.3 Charted Features

No charted features exist for this survey.

D.1.4 Uncharted Features

All new features found within H13642 are detailed in the FFF in accordance with section 7.3 of the HSSD.

D.1.5 Channels

No channels exist for this survey. There are no designated anchorages, precautionary areas, safety fairways, traffic separation schemes, pilot boarding areas, or channel and range lines within the survey limits.

D.2 Additional Results

D.2.1 Aids to Navigation

No Aids to navigation (ATONs) exist for this survey.

D.2.2 Maritime Boundary Points

No Maritime Boundary Points were assigned for this survey.

D.2.3 Bottom Samples

No bottom samples were required for this survey.

D.2.4 Overhead Features

No overhead features exist for this survey.

D.2.5 Submarine Features

No submarine features exist for this survey.

D.2.6 Platforms

No platforms exist for this survey.

D.2.7 Ferry Routes and Terminals

No ferry routes or terminals exist for this survey.

D.2.8 Abnormal Seafloor or Environmental Conditions

No abnormal seafloor or environmental conditions exist for this survey.

D.2.9 Construction and Dredging

No present or planned construction or dredging exist within the survey limits.

D.2.10 New Survey Recommendations

No new surveys or further investigations are recommended for this area.

D.2.11 ENC Scale Recommendations

No new ENC scales are recommended for this area.

E. Approval Sheet

As Chief of Party, field operations for this hydrographic survey were conducted under my direct supervision, with frequent personal checks of progress and adequacy. I have reviewed the attached survey data and reports.

All field sheets, this Descriptive Report, and all accompanying records and data are approved. All records are forwarded for final review and processing to the Processing Branch.

The survey data meets or exceeds requirements as set forth in the NOS Hydrographic Surveys Specifications and Deliverables, Field Procedures Manual, Letter Instructions, and all HSD Technical Directives. These data are adequate to supersede charted data in their common areas. This survey is complete and no additional work is required with the exception of deficiencies noted in the Descriptive Report.

Report Name	Report Date Sent
Data Acquisition and Processing Report	2022-12-18
Horizontal and Vertical Control Report	2022-12-18
Coast Pilot Report	2022-11-21

Approver Name	Approver Title	Approval Date	Signature
David J. Bernstein	Chief of Party	12/21/2022	David J. Bernstein Digitally signed by David J. Bernstein Date: 2022.12.21 13:39:12 -05'00'

F. Table of Acronyms

Acronym	Definition
AHB	Atlantic Hydrographic Branch
AST	Assistant Survey Technician
ATON	Aid to Navigation
AWOIS	Automated Wreck and Obstruction Information System
BAG	Bathymetric Attributed Grid
BASE	Bathymetry Associated with Statistical Error
CO	Commanding Officer
CO-OPS	Center for Operational Products and Services
CORS	Continuously Operating Reference Station
CTD	Conductivity Temperature Depth
CEF	Chart Evaluation File
CSF	Composite Source File
CST	Chief Survey Technician
CUBE	Combined Uncertainty and Bathymetry Estimator
DAPR	Data Acquisition and Processing Report
DGPS	Differential Global Positioning System
DP	Detached Position
DR	Descriptive Report
DTON	Danger to Navigation
ENC	Electronic Navigational Chart
ERS	Ellipsoidal Referenced Survey
ERTDM	Ellipsoidally Referenced Tidal Datum Model
ERZT	Ellipsoidally Referenced Zoned Tides
FFF	Final Feature File
FOO	Field Operations Officer
FPM	Field Procedures Manual
GAMS	GPS Azimuth Measurement Subsystem
GC	Geographic Cell
GPS	Global Positioning System
HIPS	Hydrographic Information Processing System
HSD	Hydrographic Surveys Division

Acronym	Definition
HSSD	Hydrographic Survey Specifications and Deliverables
HSTB	Hydrographic Systems Technology Branch
HSX	Hypack Hysweep File Format
HTD	Hydrographic Surveys Technical Directive
HVCR	Horizontal and Vertical Control Report
HVF	HIPS Vessel File
IHO	International Hydrographic Organization
IMU	Inertial Motion Unit
ITRF	International Terrestrial Reference Frame
LNM	Linear Nautical Miles
MBAB	Multibeam Echosounder Acoustic Backscatter
MCD	Marine Chart Division
MHW	Mean High Water
MLLW	Mean Lower Low Water
NAD 83	North American Datum of 1983
NALL	Navigable Area Limit Line
NTM	Notice to Mariners
NMEA	National Marine Electronics Association
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NRT	Navigation Response Team
NSD	Navigation Services Division
OCS	Office of Coast Survey
OMAO	Office of Marine and Aviation Operations (NOAA)
OPS	Operations Branch
MBES	Multibeam Echosounder
NWLON	National Water Level Observation Network
PDBS	Phase Differencing Bathymetric Sonar
PHB	Pacific Hydrographic Branch
POS/MV	Position and Orientation System for Marine Vessels
PPK	Post Processed Kinematic
PPP	Precise Point Positioning
PPS	Pulse per second

Acronym	Definition
PRF	Project Reference File
PS	Physical Scientist
RNC	Raster Navigational Chart
RTK	Real Time Kinematic
RTX	Real Time Extended
SBES	Singlebeam Echosounder
SBET	Smooth Best Estimate and Trajectory
SNM	Square Nautical Miles
SSS	Side Scan Sonar
SSSAB	Side Scan Sonar Acoustic Backscatter
ST	Survey Technician
SVP	Sound Velocity Profiler
TCARI	Tidal Constituent And Residual Interpolation
TPU	Total Propagated Uncertainty
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
UTM	Universal Transverse Mercator
XO	Executive Officer
ZDF	Zone Definition File