

**H13639**

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

**DESCRIPTIVE REPORT**

Type of Survey: Navigable Area

Registry Number: H13639

**LOCALITY**

State(s): Wisconsin

General Locality: Western Lake Michigan

Sub-locality: Offshore Manitowoc

**2022**

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

LIBRARY & ARCHIVES

Date:

**HYDROGRAPHIC TITLE SHEET**

**H13639**

**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 Manitowoc**

Scale: **40000**

Dates of Survey: **07/18/2022 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.*

# Table of Contents

<b>A. Area Surveyed</b> .....	1
A.1 Survey Limits.....	1
A.2 Survey Purpose.....	3
A.3 Survey Quality.....	4
A.4 Survey Coverage.....	4
A.6 Survey Statistics.....	5
<b>B. Data Acquisition and Processing</b> .....	7
B.1 Equipment and Vessels.....	7
B.1.1 Vessels.....	7
B.1.2 Equipment.....	8
B.2 Quality Control.....	8
B.2.1 Crosslines.....	8
B.2.2 Uncertainty.....	9
B.2.3 Junctions.....	11
B.2.4 Sonar QC Checks.....	16
B.2.5 Equipment Effectiveness.....	16
B.2.6 Factors Affecting Soundings.....	17
B.2.7 Sound Speed Methods.....	18
B.2.8 Coverage Equipment and Methods.....	18
B.2.9 Holidays.....	19
B.2.10 Density.....	19
B.2.11 Flier Finder.....	21
B.3 Echo Sounding Corrections.....	21
B.3.1 Corrections to Echo Soundings.....	21
B.3.2 Calibrations.....	22
B.4 Backscatter.....	22
B.5 Data Processing.....	23
B.5.1 Primary Data Processing Software.....	23
B.5.2 Surfaces.....	24
B.5.3 Designated Soundings.....	25
<b>C. Vertical and Horizontal Control</b> .....	26
C.1 Vertical Control.....	26
C.2 Horizontal Control.....	26
<b>D. Results and Recommendations</b> .....	27
D.1 Chart Comparison.....	27
D.1.1 Electronic Navigational Charts.....	29
D.1.2 Shoal and Hazardous Features.....	29
D.1.3 Charted Features.....	29
D.1.4 Uncharted Features.....	29
D.1.5 Channels.....	29
D.2 Additional Results.....	29
D.2.1 Aids to Navigation.....	29
D.2.2 Maritime Boundary Points.....	30

D.2.3 Bottom Samples.....	30
D.2.4 Overhead Features.....	30
D.2.5 Submarine Features.....	30
D.2.6 Platforms.....	30
D.2.7 Ferry Routes and Terminals.....	30
D.2.8 Abnormal Seafloor or Environmental Conditions.....	30
D.2.9 Construction and Dredging.....	30
D.2.10 New Survey Recommendations.....	30
D.2.11 ENC Scale Recommendations.....	31
<b>E. Approval Sheet.....</b>	<b>32</b>
<b>F. Table of Acronyms.....</b>	<b>33</b>

## List of Tables

Table 1: Survey Limits.....	1
Table 2: Survey Coverage.....	4
Table 3: Hydrographic Survey Statistics.....	6
Table 4: Dates of Hydrography.....	7
Table 5: Vessels Used.....	7
Table 6: Major Systems Used.....	8
Table 7: Survey Specific Tide TPU Values.....	9
Table 8: Survey Specific Sound Speed TPU Values.....	10
Table 9: Junctioning Surveys.....	13
Table 10: Primary bathymetric data processing software.....	24
Table 11: Primary imagery data processing software.....	24
Table 12: Submitted Surfaces.....	24
Table 13: ERS method and SEP file.....	26
Table 14: Largest Scale ENCs.....	29

## List of Figures

Figure 1: Overview of project survey limits (H13639 shown in blue), overlaid onto Chart 14901.....	2
Figure 2: H13639 survey limits overlaid onto Chart 14901.....	3
Figure 3: H13639 survey coverage overlaid onto Chart 14901.....	5
Figure 4: H13639 crossline to mainscheme difference statistics.....	9
Figure 5: Finalized 4 m CUBE surface TVU statistics for H13639.....	10
Figure 6: Finalized 8 m CUBE surface TVU statistics for H13639.....	11
Figure 7: Overview of H13639 junction surveys.....	12
Figure 8: Junction analysis between H13639 and H13526.....	14
Figure 9: Junction analysis between H13639 and H13638.....	15
Figure 10: Junction analysis between H13639 and H13642.....	16
Figure 11: H13639 surface artifacts as a result of refraction causing the soundings to trend concave/ convex.....	18
Figure 12: Finalized 4 m CUBE surface density statistics for H13639.....	20



Figure 13: Finalized 8 m CUBE surface density statistics for H13639..... 21  
Figure 14: H13639 backscatter..... 23  
Figure 15: Image representing the finalized CUBE surface resolutions in H13639.....25  
Figure 16: H13639 statistical analysis of surveyed depths to charted depths..... 27  
Figure 17: Areas where the charted soundings differ from the surveyed depth.....28

## Descriptive Report to Accompany Survey H13639

Project: OPR-Y396-KR-22

Locality: Western Lake Michigan

Sublocality: Offshore Manitowoc

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 H13639 located offshore Manitowoc, Wisconsin. Within H13639, 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° 19' 48.37" N 87° 28' 35.06" W	44° 0' 47.39" N 87° 20' 43.27" W

*Table 1: Survey Limits*

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



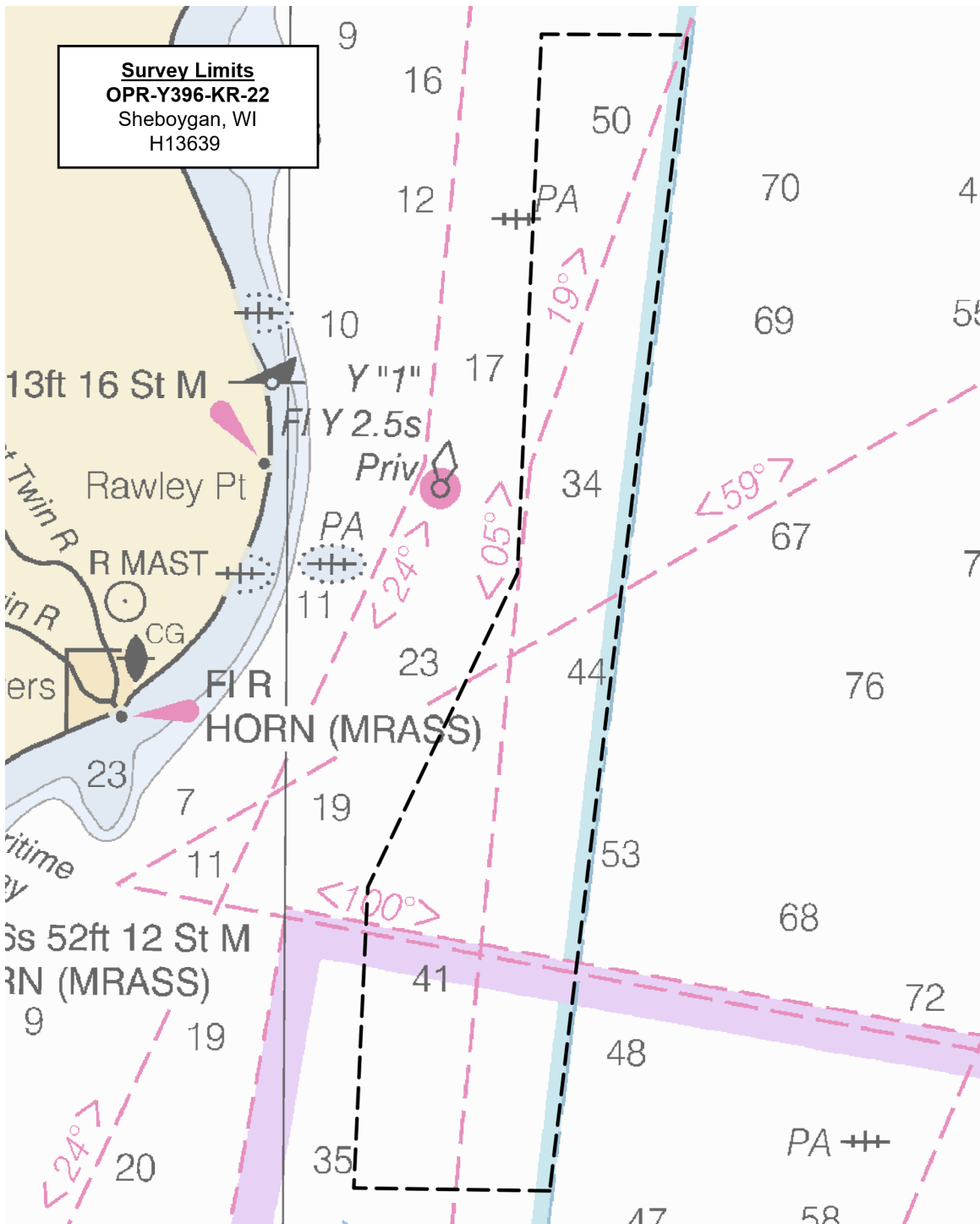


Figure 2: H13639 survey limits overlaid onto Chart 14901

### 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 H13639 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 H13639 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.

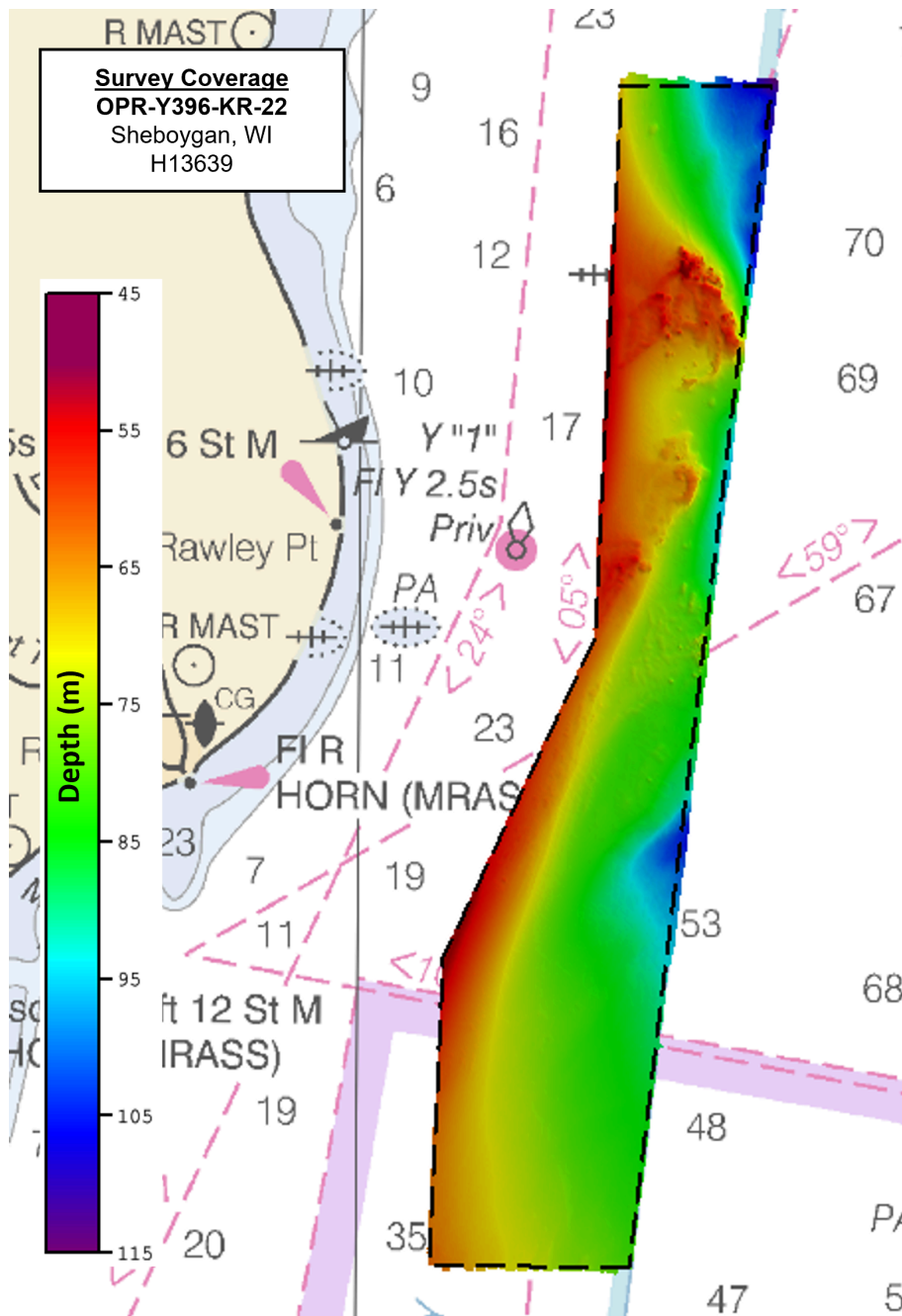


Figure 3: H13639 survey coverage overlaid onto Chart 14901

### A.6 Survey Statistics

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

	<b>HULL ID</b>	<i>R/V Substantial</i>	<i>Total</i>
<b>LNM</b>	<b>SBES Mainscheme</b>	0.0	0.0
	<b>MBES Mainscheme</b>	547.04	547.04
	<b>Lidar Mainscheme</b>	0.0	0.0
	<b>SSS Mainscheme</b>	0.0	0.0
	<b>SBES/SSS Mainscheme</b>	0.0	0.0
	<b>MBES/SSS Mainscheme</b>	0.0	0.0
	<b>SBES/MBES Crosslines</b>	26.56	26.56
	<b>Lidar Crosslines</b>	0.0	0.0
<b>Number of Bottom Samples</b>			0
<b>Number Maritime Boundary Points Investigated</b>			0
<b>Number of DPs</b>			0
<b>Number of Items Investigated by Dive Ops</b>			0
<b>Total SNM</b>			50.8

*Table 3: Hydrographic Survey Statistics*

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

<b>Survey Dates</b>	<b>Day of the Year</b>
07/18/2022	199

<b>Survey Dates</b>	<b>Day of the Year</b>
07/19/2022	200
07/21/2022	202
07/22/2022	203
07/23/2022	204
07/29/2022	210
08/08/2022	220
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:

<b>Hull ID</b>	<i><b>R/V Substantial</b></i>
<b>LOA</b>	18.0 meters
<b>Draft</b>	2.22 meters

*Table 5: Vessels Used*



## B.1.2 Equipment

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

<b>Manufacturer</b>	<b>Model</b>	<b>Type</b>
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 H13639 totaled 4.86% of mainscheme acquisition.

H13639 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 +/- 0.18 m, with a mean difference of -0.03 m (Figure 4). Additionally, at least 95% of the difference surface nodes met or exceeded TVU specifications, as described in section 5.1.3 of the HSSD.

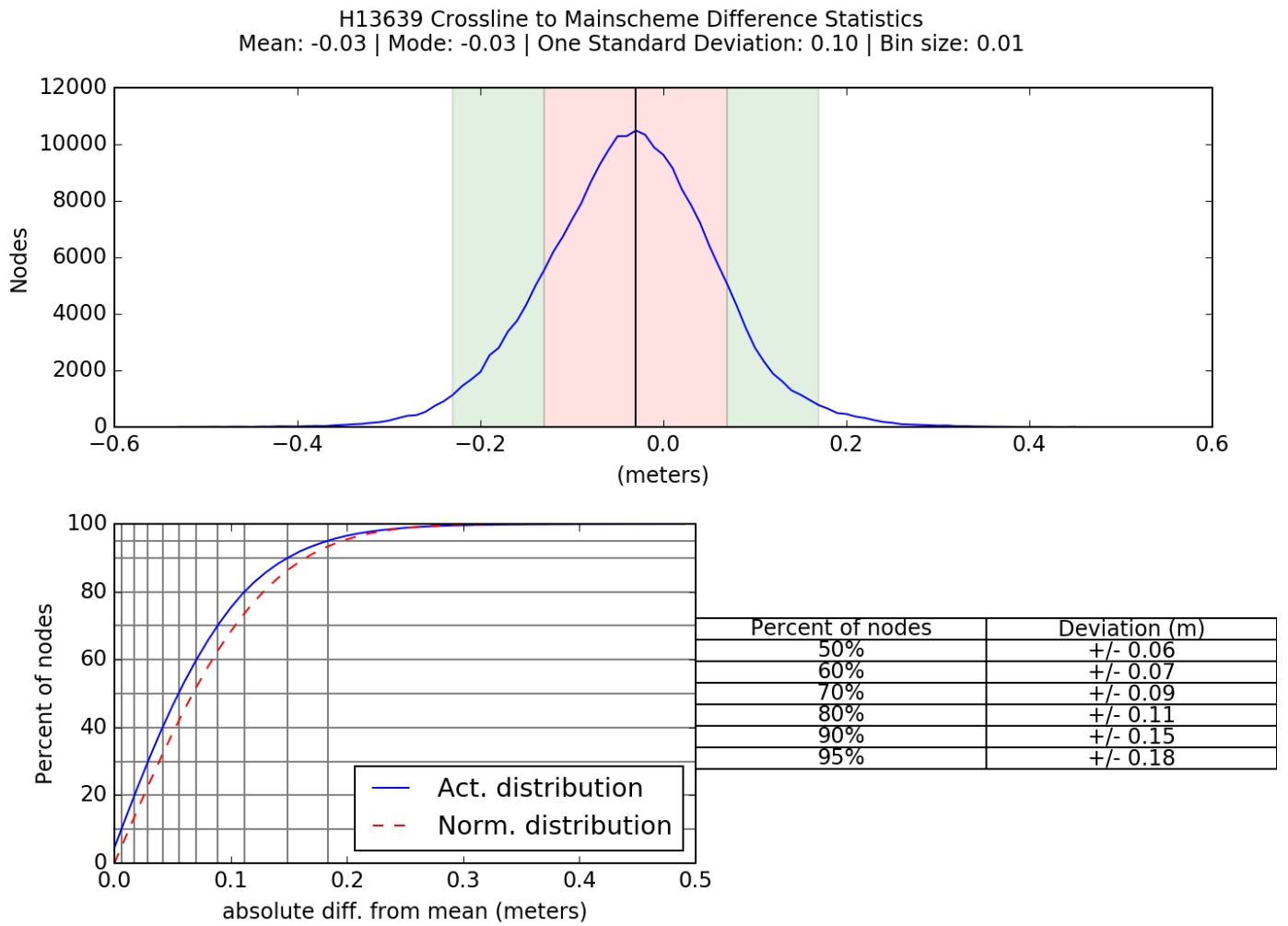


Figure 4: H13639 crossline to mainscheme difference statistics

### 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.

All 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.

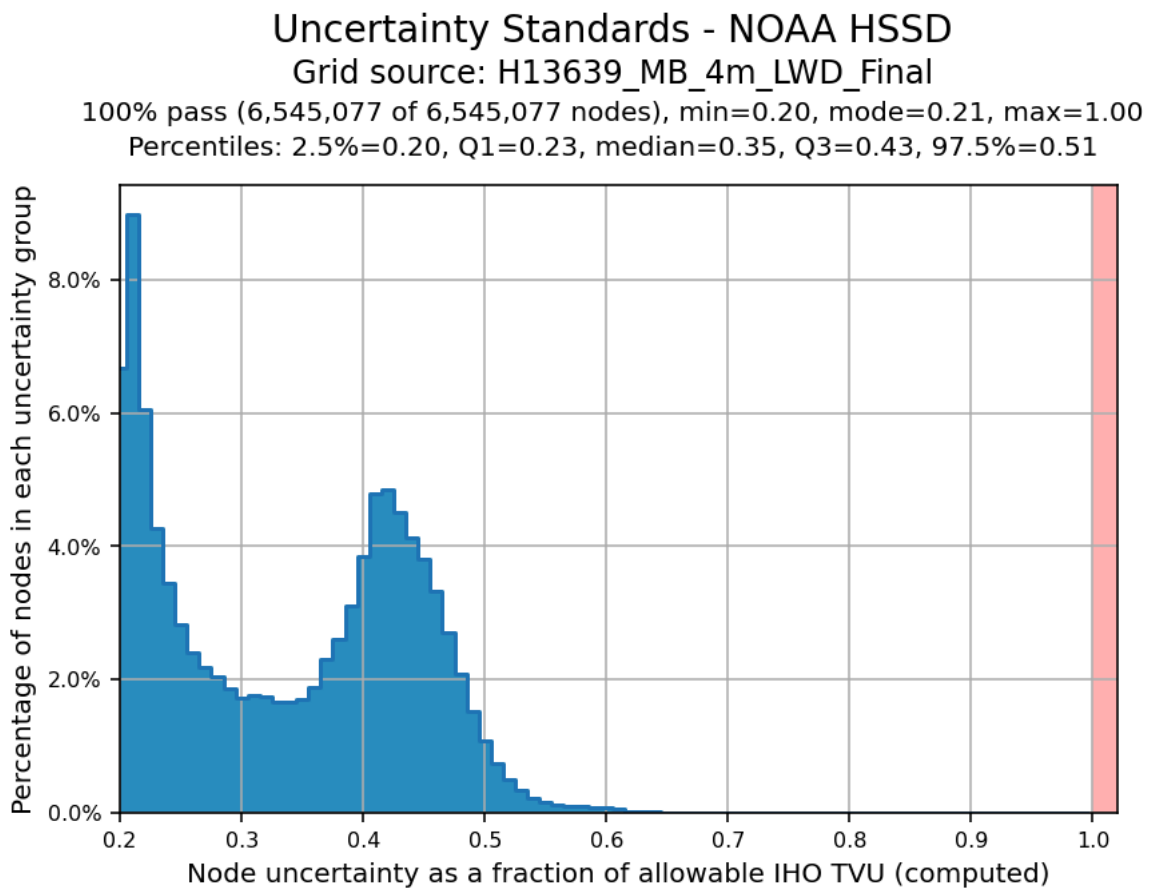
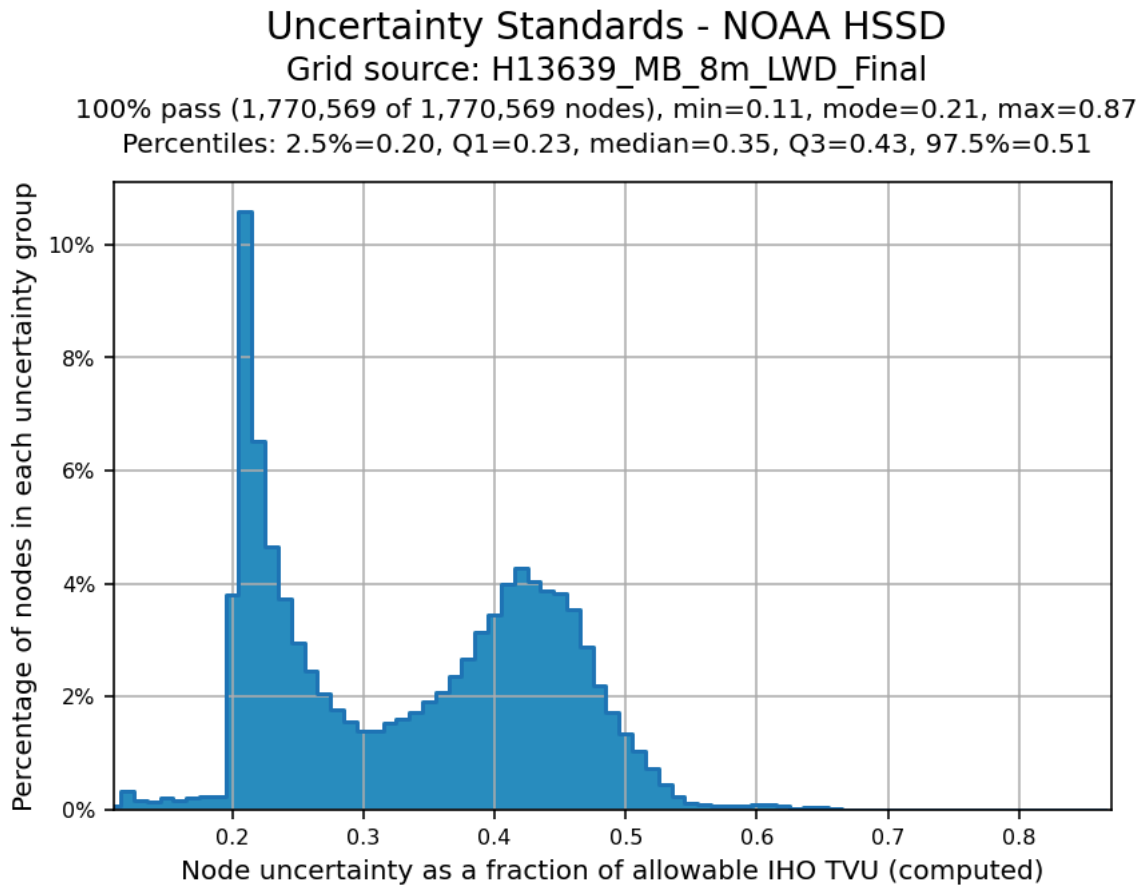


Figure 5: Finalized 4 m CUBE surface TVU statistics for H13639



*Figure 6: Finalized 8 m CUBE surface TVU statistics for H13639*

### B.2.3 Junctions

H13639 junctions with H13638, H13642, and the 2021 NRT-New London MBES data, registry number H13526 (Figure 7). Data overlap between H13639 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.

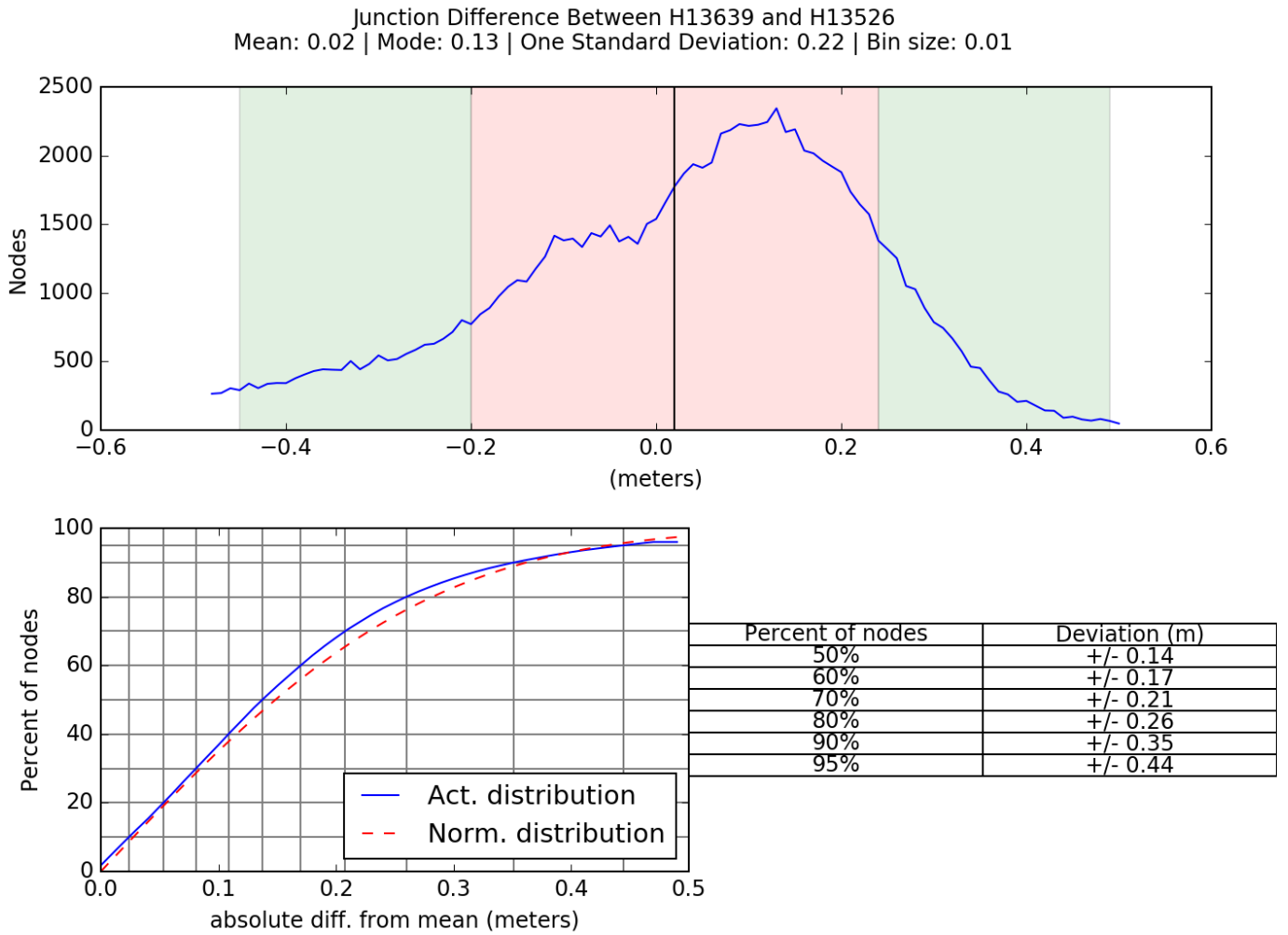


Registry Number	Scale	Year	Field Unit	Relative Location
H13526	1:10000	2021	NRT-New London	SW
H13638	1:40000	2022	Geodynamics	W
H13642	1:40000	2022	Geodynamics	S

*Table 9: Junctioning Surveys*

### H13526

The statistical results of the difference comparison show 95% of nodes falling within +/- 0.44 m, with a mean difference of 0.02 m (Figure 8). Additionally, at least 95% of the difference surface nodes met or exceed TVU specifications, as described in section 5.1.3 of the HSSD.



*Figure 8: Junction analysis between H13639 and H13526*

H13638

The statistical results of the difference comparison show 95% of nodes falling within +/- 0.31 m, with a mean difference of -0.06 m (Figure 9). Additionally, at least 95% of the difference surface nodes met or exceed TVU specifications, as described in section 5.1.3 of the HSSD.

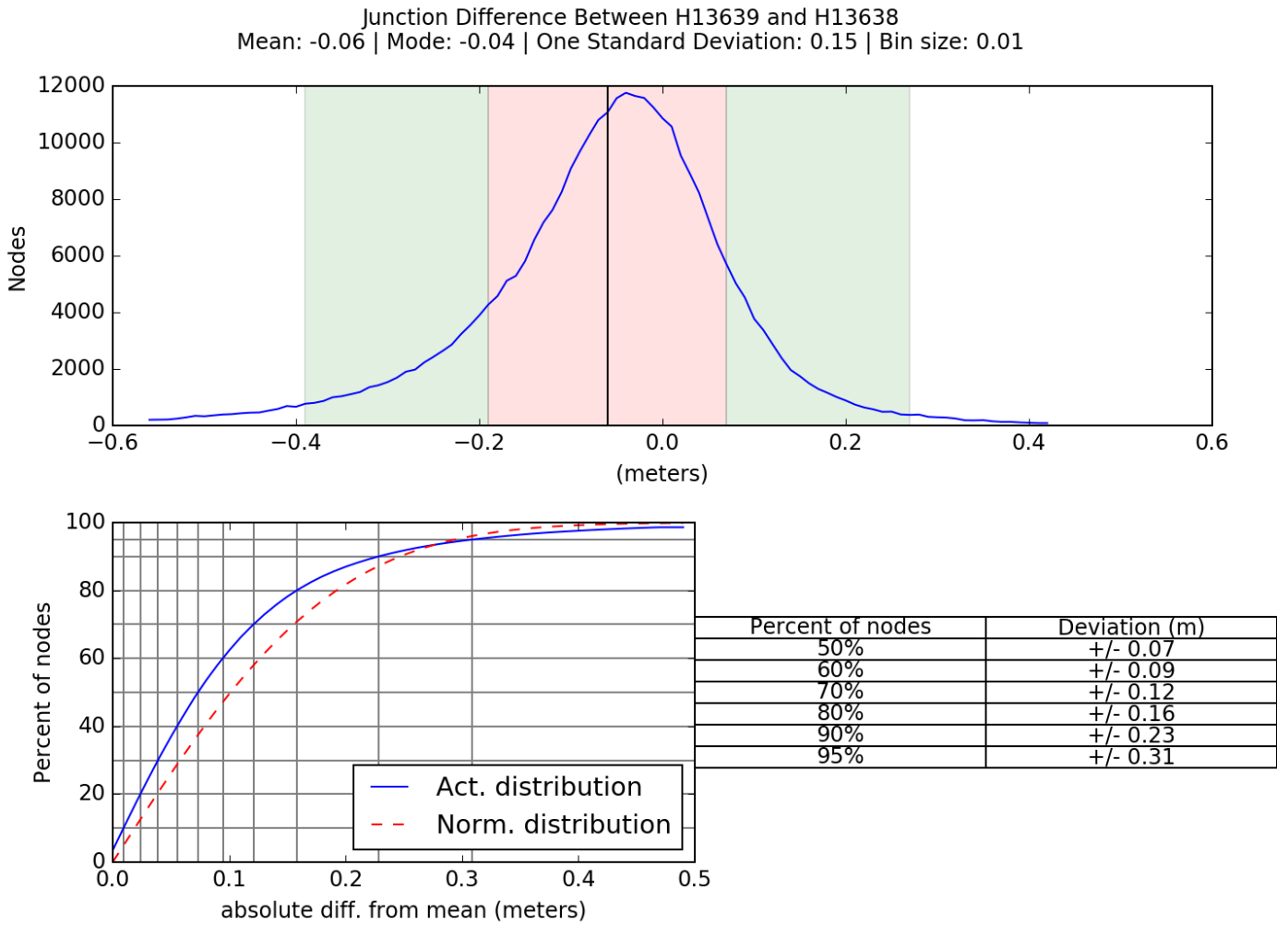


Figure 9: Junction analysis between H13639 and H13638

H13642

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 10). Additionally, at least 95% of the difference surface nodes met or exceed TVU specifications, as described in section 5.1.3 of the HSSD.



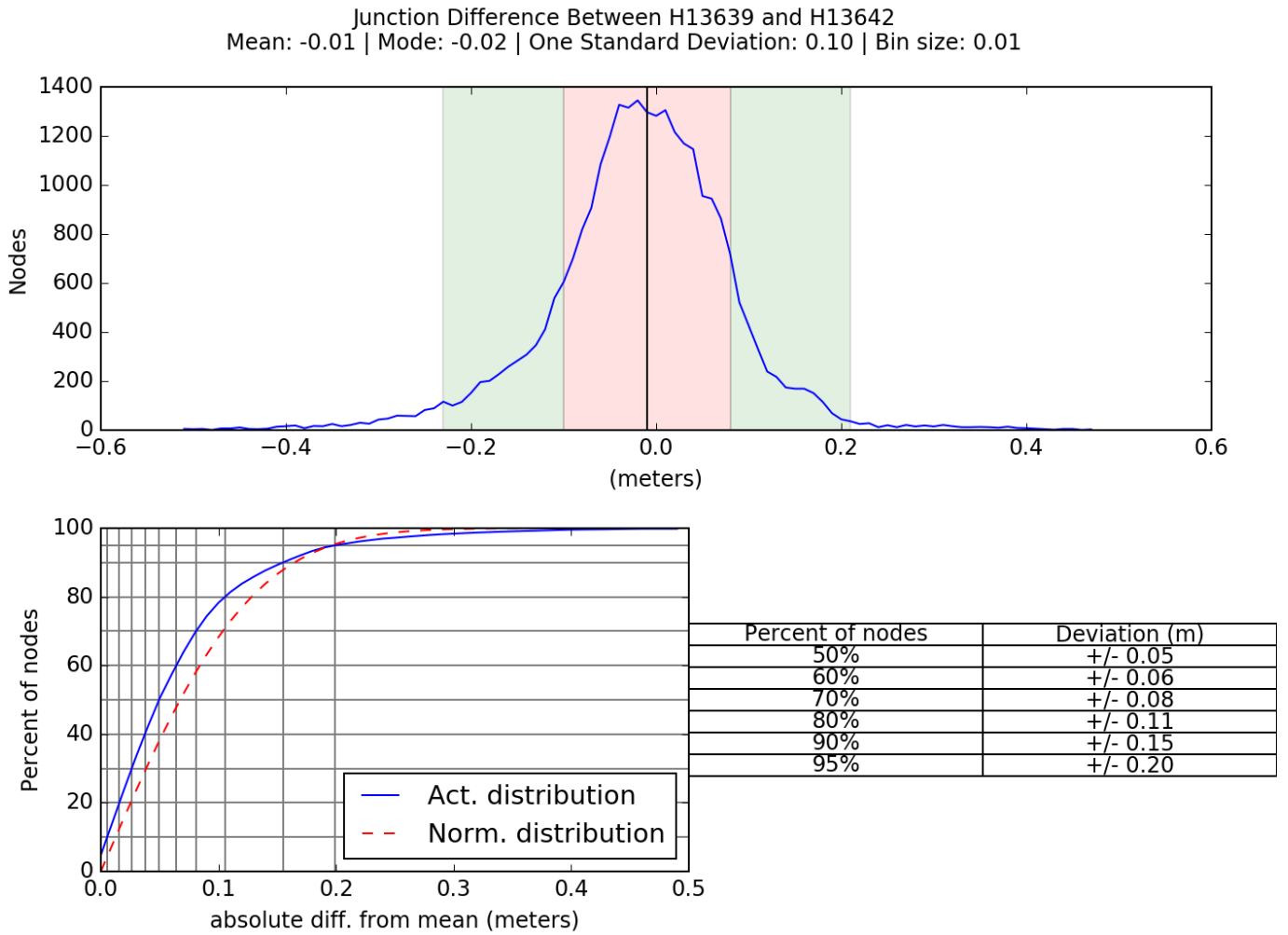


Figure 10: Junction analysis between H13639 and H13642

**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 Figure 11.

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.

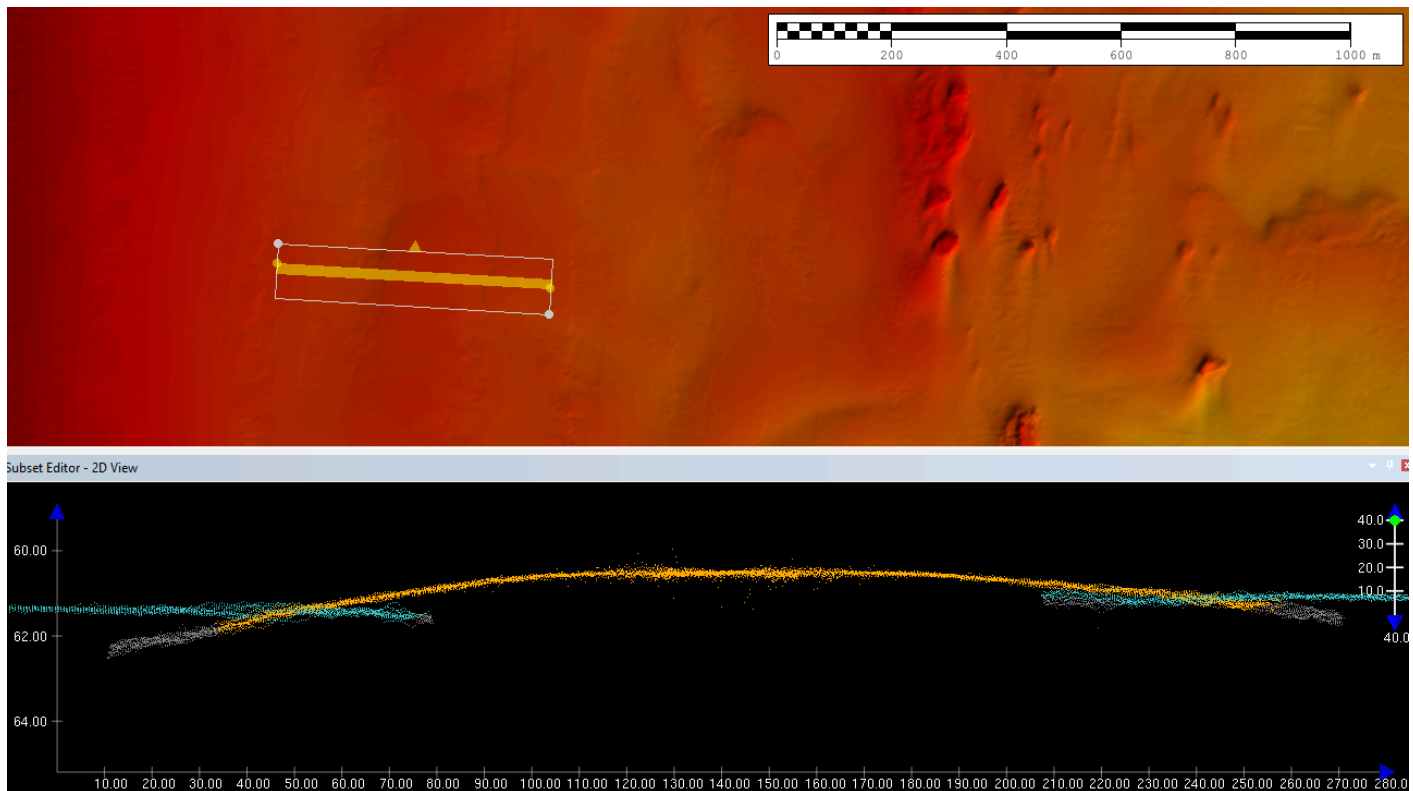


Figure 11: H13639 surface artifacts as a result of refraction causing the soundings to trend concave/convex

### B.2.7 Sound Speed Methods

Sound Speed Cast Frequency: Sound speed casts were acquired at least once every four hours. Casts were often conducted more frequently than this time interval because of the dynamic water properties in the survey area. Additionally, 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 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 H13639 with 99.5% of the surface nodes (Figures 12 and 13) containing at least five or more soundings, exceeding the specifications required by section 5.2.2.3 of the HSSD.

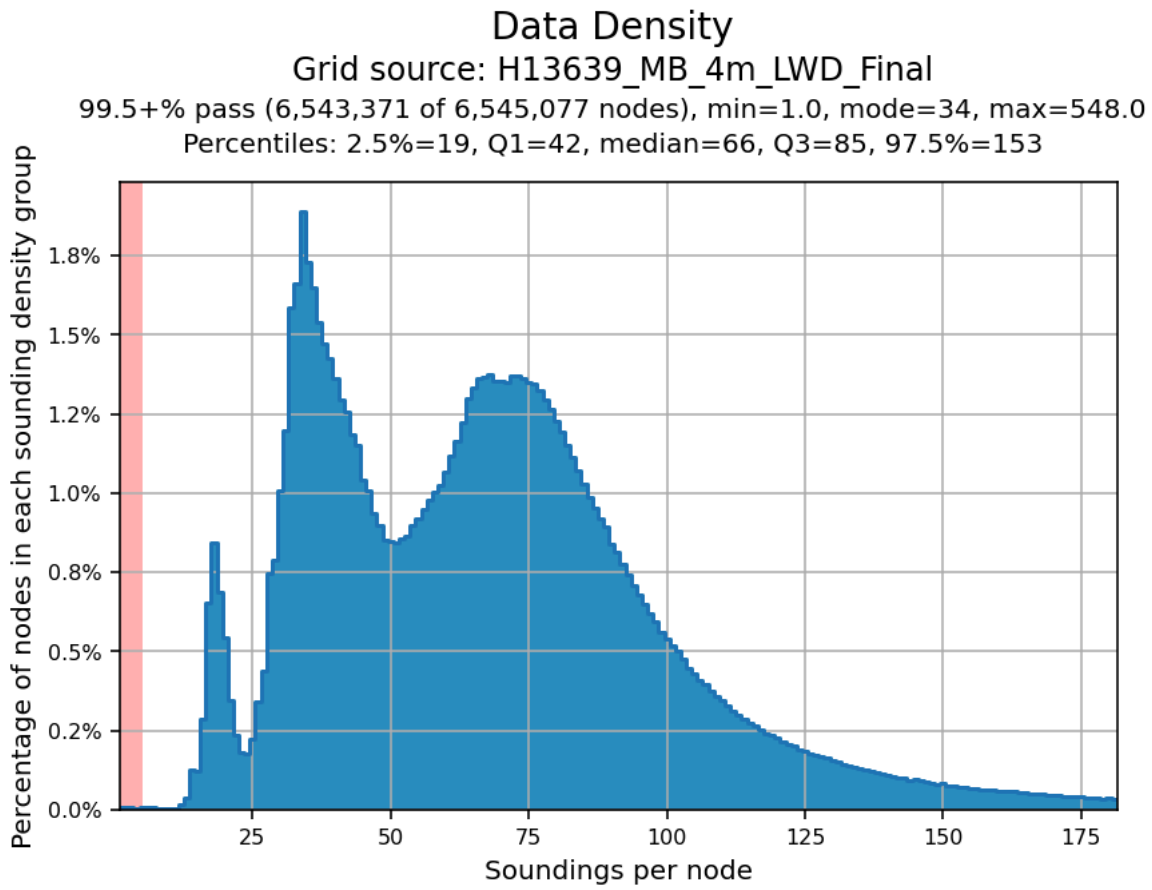
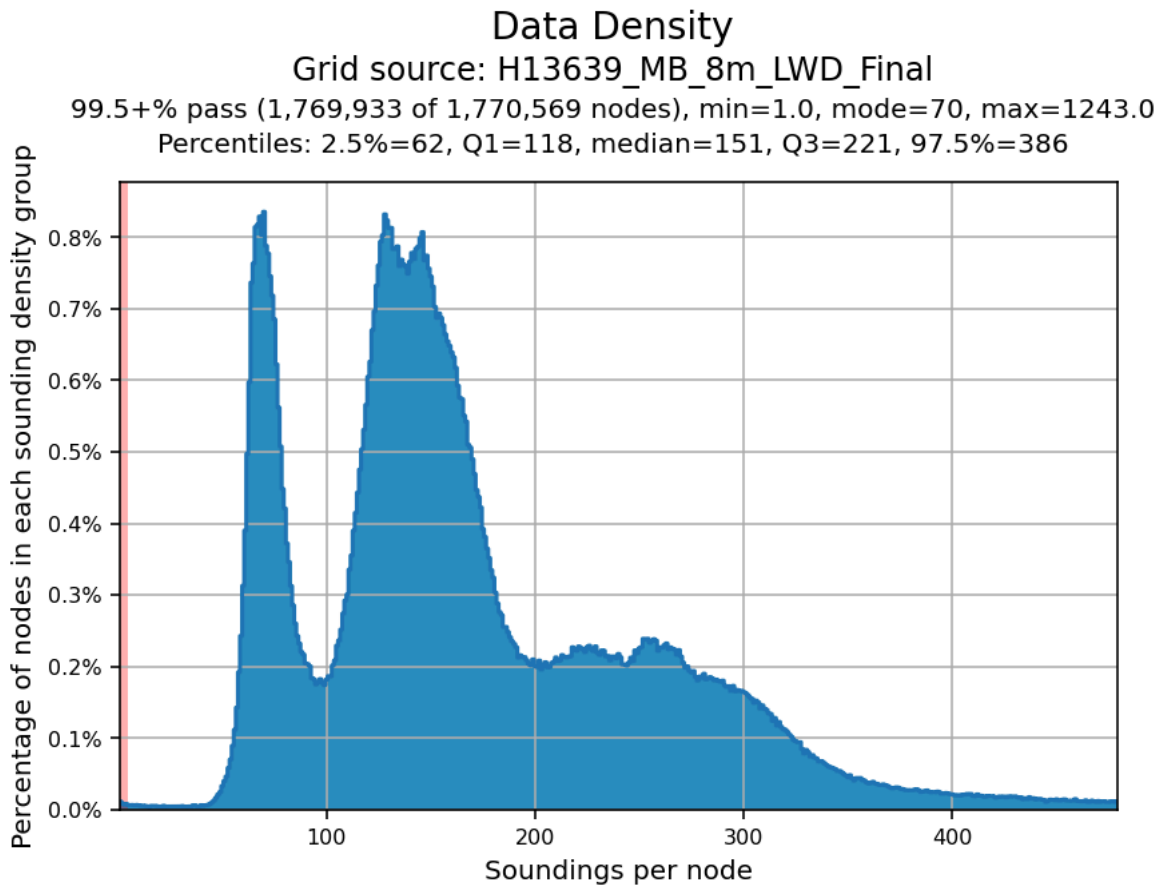


Figure 12: Finalized 4 m CUBE surface density statistics for H13639



*Figure 13: Finalized 8 m CUBE surface density statistics for H13639*

### 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 realtime 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.

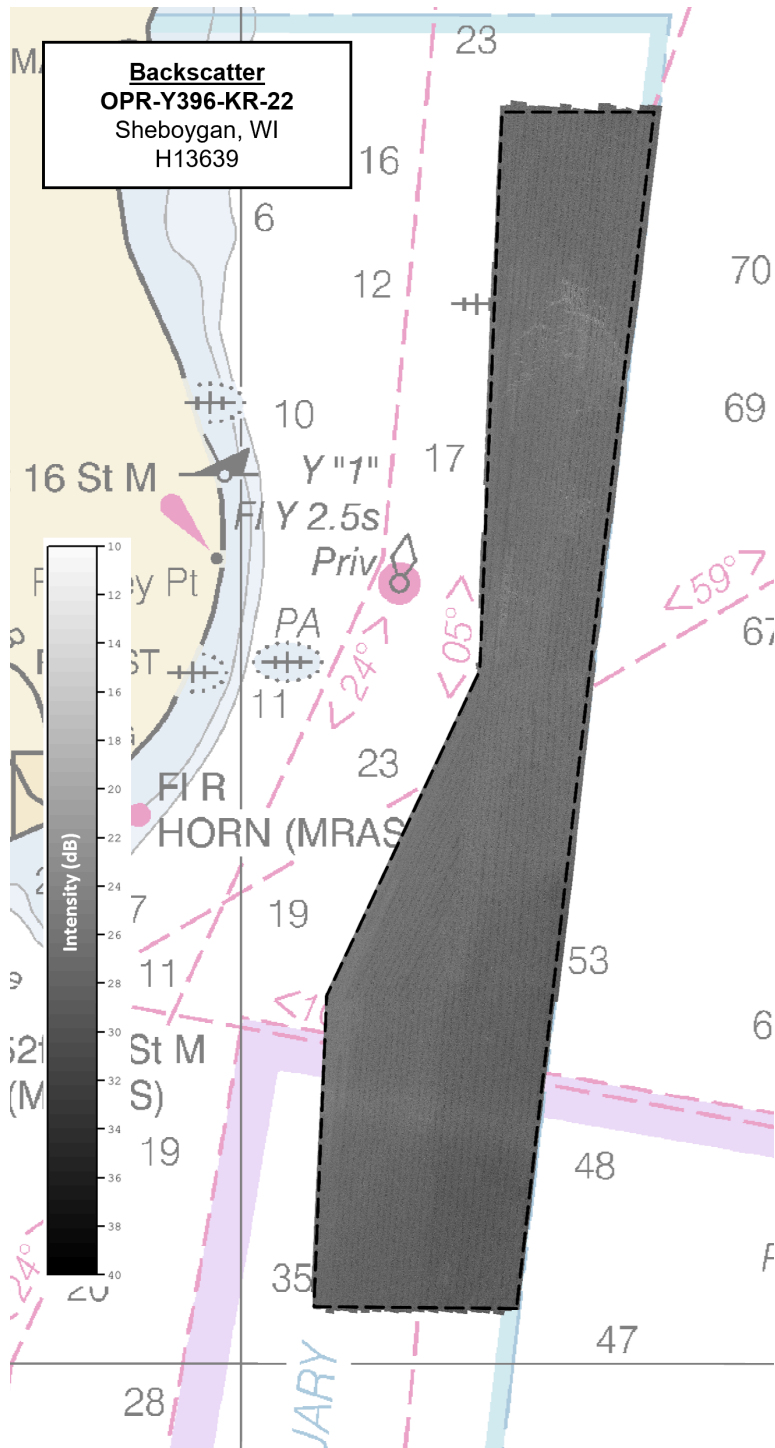


Figure 14: H13639 backscatter

## B.5 Data Processing

### B.5.1 Primary Data Processing Software



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

<b>Manufacturer</b>	<b>Name</b>	<b>Version</b>
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:

<b>Manufacturer</b>	<b>Name</b>	<b>Version</b>
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:

<b>Surface Name</b>	<b>Surface Type</b>	<b>Resolution</b>	<b>Depth Range</b>	<b>Surface Parameter</b>	<b>Purpose</b>
H13639_MB_4m_LWD_Final	CARIS Raster Surface (CUBE)	4 meters	51.49 meters - 80.0 meters	NOAA_4m	Complete MBES
H13639_MB_8m_LWD_Final	CARIS Raster Surface (CUBE)	8 meters	72.0 meters - 114.44 meters	NOAA_8m	Complete MBES
H13639_MB_4m_LWD	CARIS Raster Surface (CUBE)	4 meters	51.49 meters - 114.55 meters	NOAA_4m	Complete MBES
H13639_MB_8m_LWD	CARIS Raster Surface (CUBE)	8 meters	51.72 meters - 114.44 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 15 below for an overview of the submitted finalized surface resolutions.

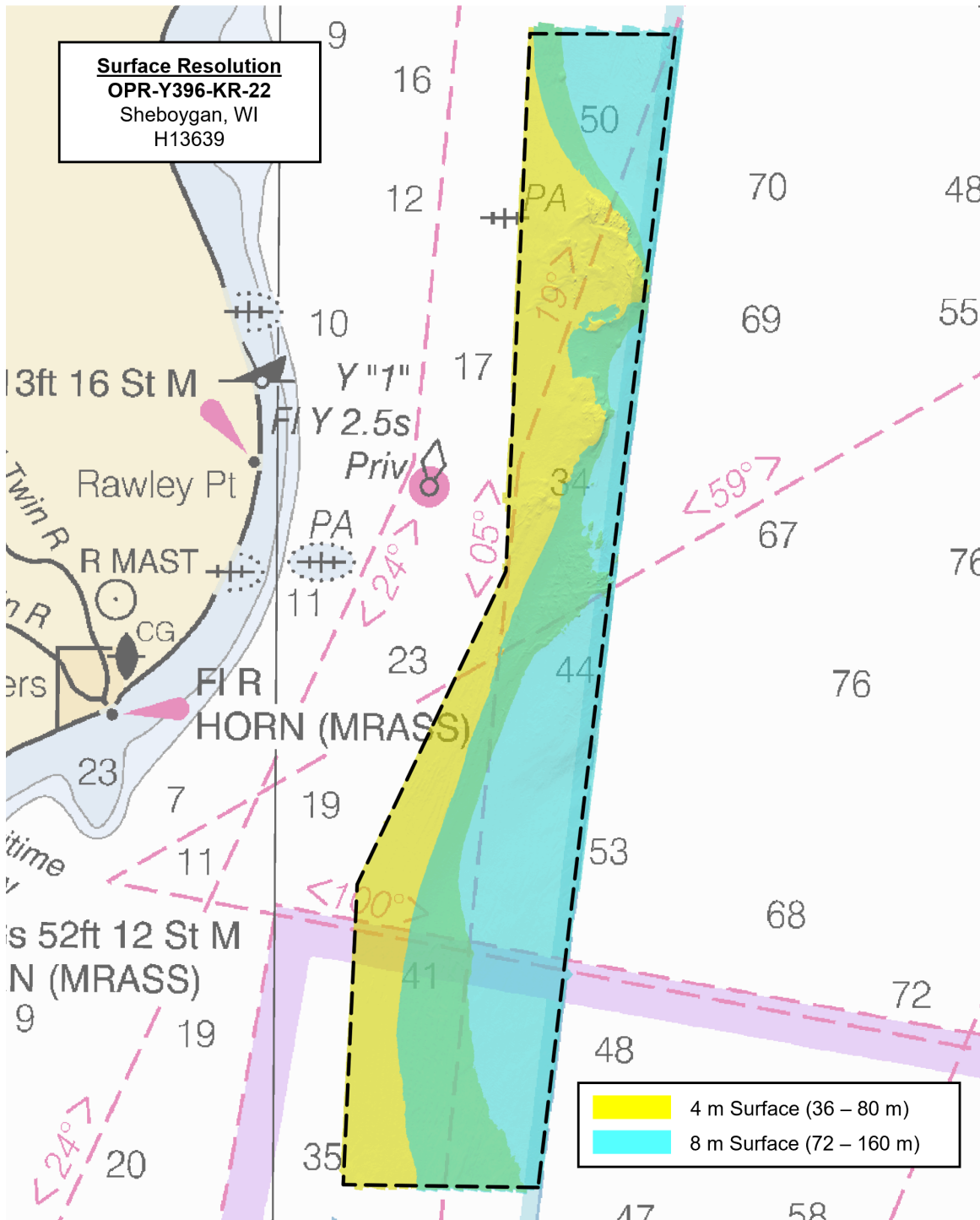


Figure 15: Image representing the finalized CUBE surface resolutions in H13639

**B.5.3 Designated Soundings**

No soundings were designated in H13639.

## 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 H13639 and the ENC's listed in Table 14 of section D.1.1. Sounding layers were generated from the CUBE surface and overlaid onto the ENC's 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 16. The surveyed depths from H13639 generally agree with the charted soundings from the largest scale ENC's within the survey area, with a mean difference of -1.34 m. In some areas, the surveyed depths were shallower than the charted soundings by 20 m or more. Figure 17 highlights these areas within the survey.

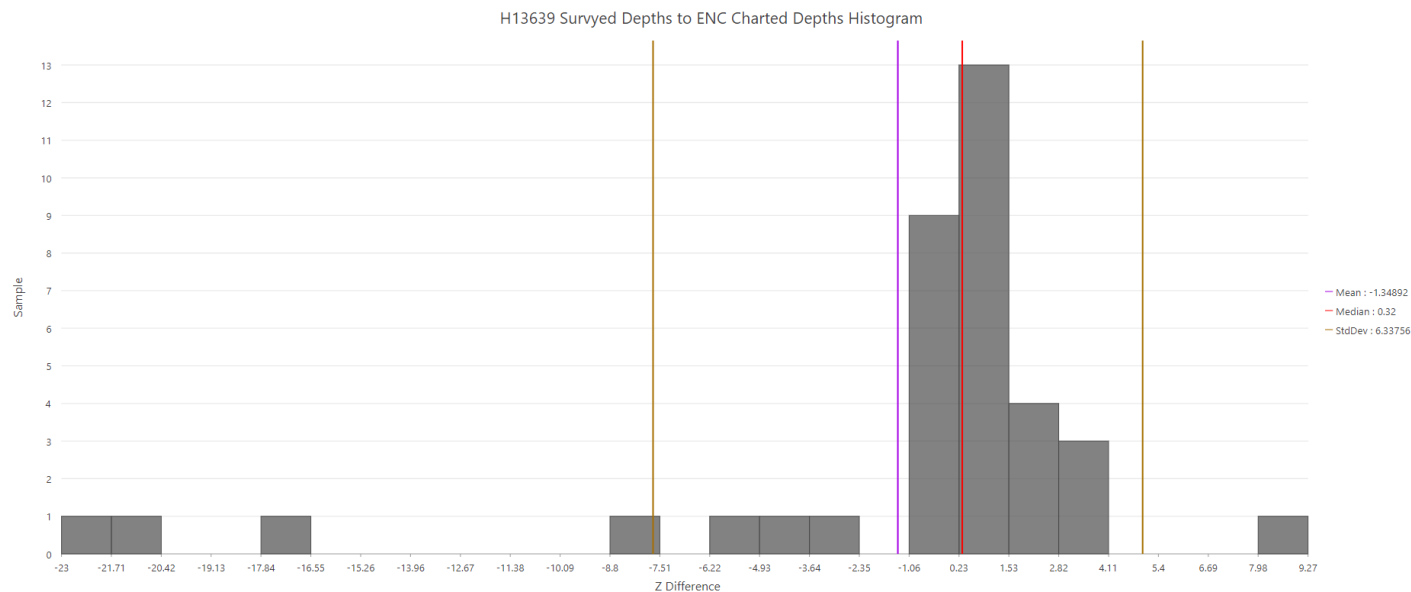


Figure 16: H13639 statistical analysis of surveyed depths to charted depths

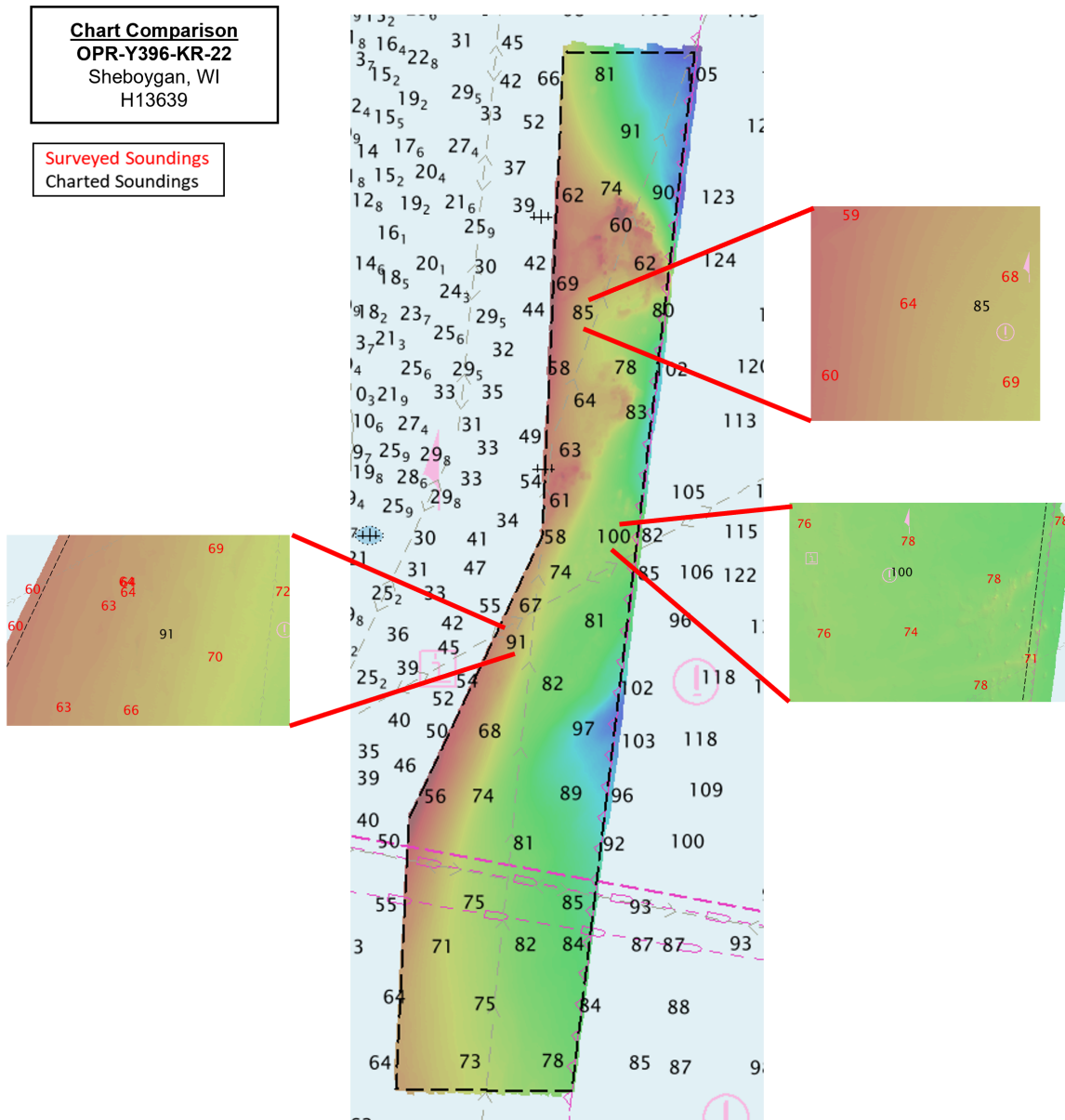


Figure 17: Areas where the charted soundings differ from the surveyed depth

### D.1.1 Electronic Navigational Charts

The following are the largest scale ENC's, 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 ENC's*

### D.1.2 Shoal and Hazardous Features

No shoals or potentially hazardous features exist for this survey.

### D.1.3 Charted Features

The assigned charted features in H13639 were addressed in accordance with the investigation requirements and therefore not included in the FFF.

### D.1.4 Uncharted Features

No new uncharted features were found in H13639.

### 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**

Ferry routes exist for this survey but were not investigated.

**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	 Digitally signed by David J. Bernstein Date: 2022.12.21 10:49:48 -05'00'

## F. Table of Acronyms

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

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

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