H13509

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

DESCRIPTIVE REPORT

Type of Survey:	Navigable Area
Registry Number:	H13509

LOCALITY

State(s):	Maryland
General Locality:	Central Chesapeake Bay
Sub-locality:	Severn River

2021

CHIEF OF PARTY
Brianna Hillstrom, CDR/NOAA

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Date:

U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	REGISTRY NUMBER:
HYDROGRAPHIC TITLE SHEET	**H13509**

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):	**Maryland**
General Locality:	**Central Chesapeake Bay**
Sub-Locality:	**Severn River**
Scale:	**5000**
Dates of Survey:	**05/19/2021 to 09/04/2021**
Instructions Dated:	**05/14/2021**
Project Number:	**OPR-E349-TJ-21**
Field Unit:	**NOAA Ship *Thomas Jefferson***
Chief of Party:	**Brianna Hillstrom, CDR/NOAA**
Soundings by:	**Multibeam Echo Sounder**
Imagery by:	**Multibeam Echo Sounder Backscatter Side Scan Sonar**
Verification by:	**Atlantic Hydrographic Branch**
Soundings Acquired in:	**meters at Mean Lower Low Water**

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 18N, MLLW. 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 H13509

Project: OPR-E349-TJ-21

Locality: Central Chesapeake Bay

Sublocality: Severn River

Scale: 1:5000

May 2021 - September 2021

NOAA Ship *Thomas Jefferson*

Chief of Party: Brianna Hillstrom, CDR/NOAA

A. Area Surveyed

The survey area is referred to as H13509, "Severn River" (sheet 3) in the Project Instructions. The survey area is approximately 9.7 square nautical miles.

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
39° 4' 52" N 76° 36' 8.5" W	38° 55' 11" N 76° 24' 39" W

Table 1: Survey Limits

The northeast portion of the assigned sheet limits were marked as being very shallow in depth, with narrow creeks making surveying with a launch impractical. As such the field unit requested the areas of Whitehall Bay, Whitehall Creek, Mill Creek, and Meredith Creek be reassigned to a platform capable of surveying these areas more efficiently.

After consultation with Hydrographic Survey Division (HSD), new limits were assigned to Navigation Response Branch (NRB) unit Bay Hydro II based off the coverage already acquired by Thomas Jefferson. The original sheet limits and those later created for Bay Hydro II can be seen in the images below. All relevant correspondence with HSD are listed in the project correspondence section submitted with this report.

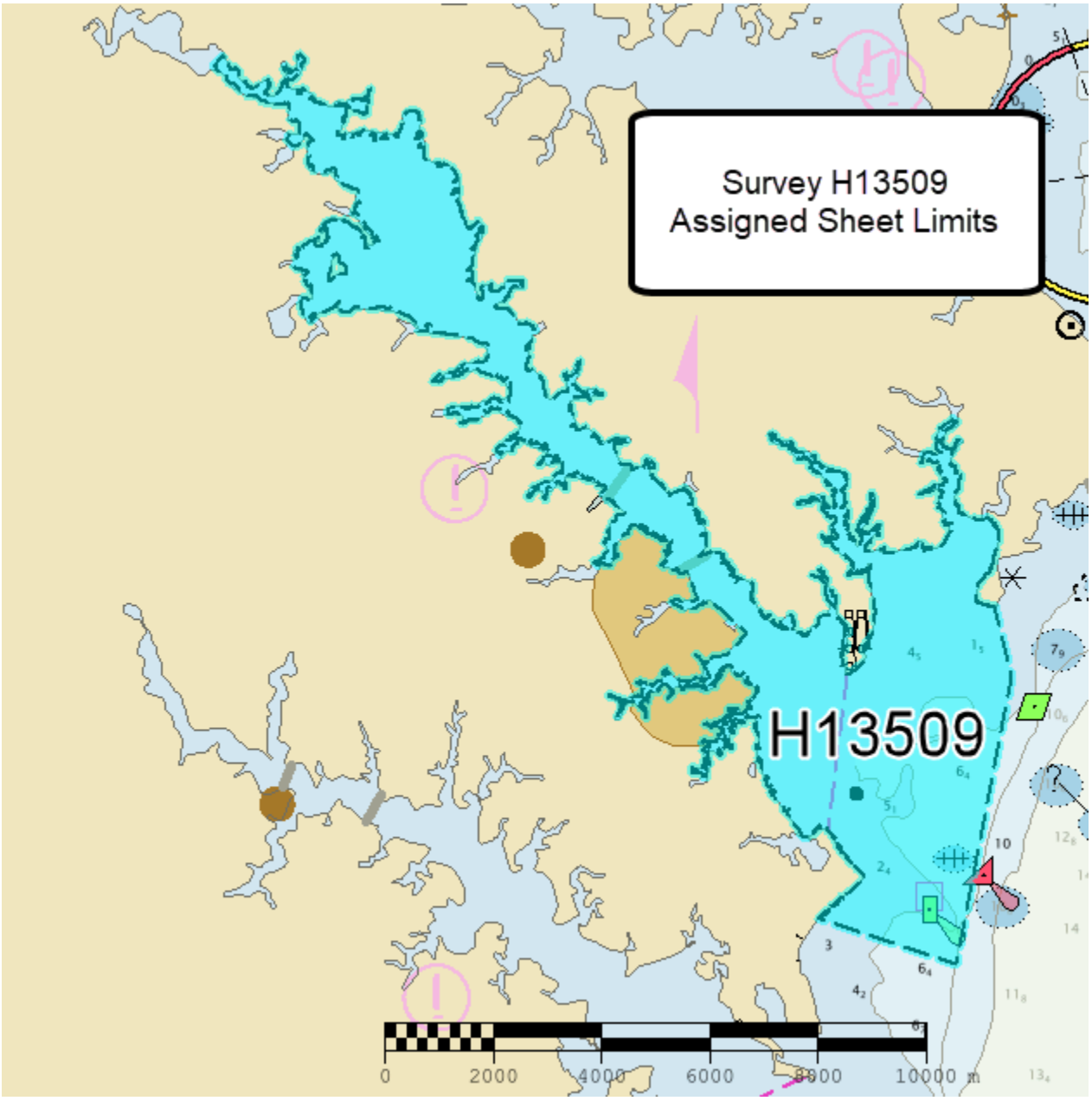


Figure 1: H13509 assigned survey area (Chart US3EC08M)

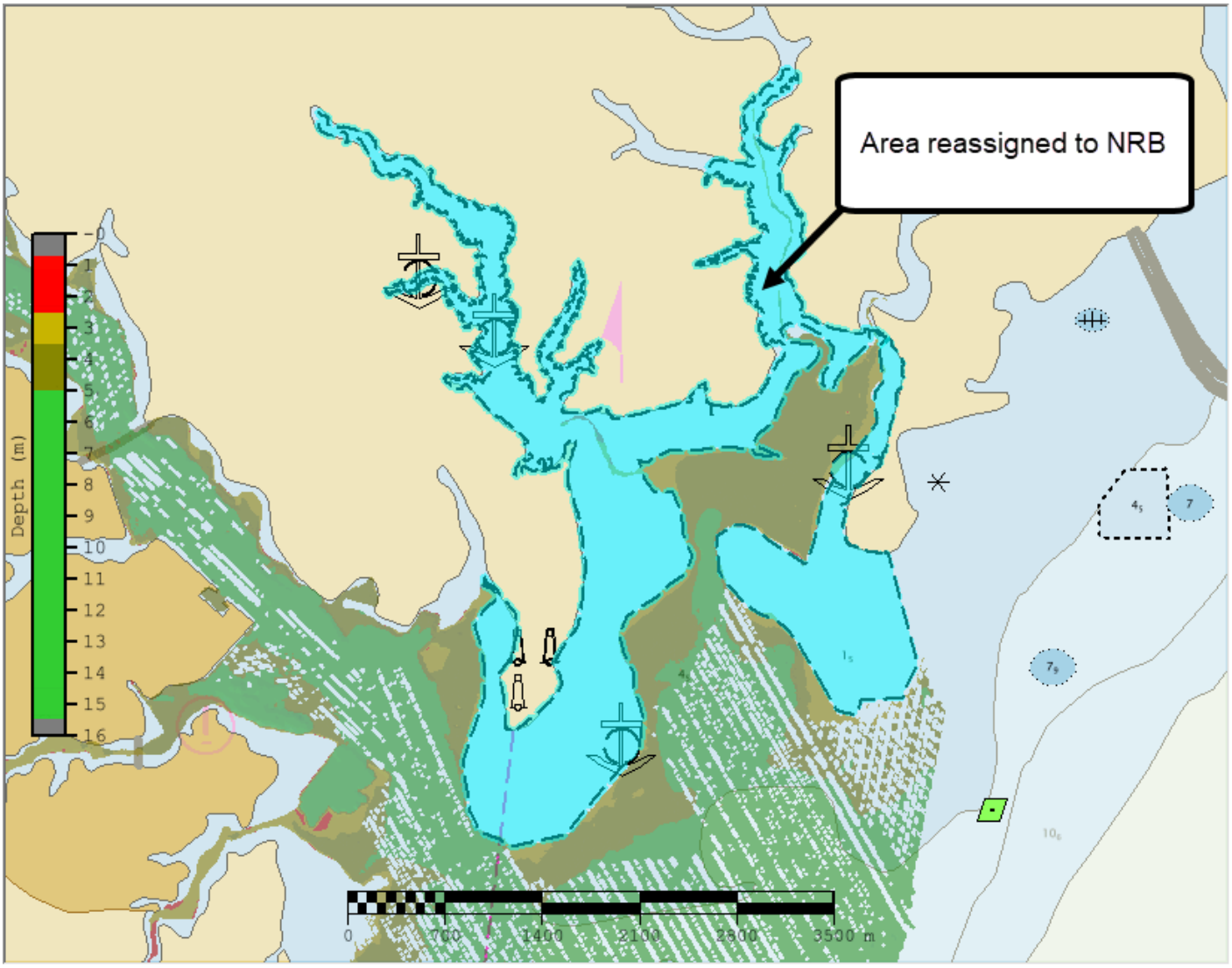


Figure 2: Area later reassigned to Bay Hydro II.

A.2 Survey Purpose

The Chesapeake Bay is the largest estuary in North America and heavily trafficked by commercial vessels in route to the Port of Baltimore. The city of Annapolis and its major waterway, the Severn River, are centers of tourism, fishing, and marine commerce. Annapolis is colloquially referred to as "the sailing capital of the world" is home to one of the nations largest recreational boating communities. Additionally, the numerous harbors and marinas of the Severn River offer excellent protection from northern gales. The majority of the prior data in the project area spans from the 1880s to 1940s. The bathymetric data vintage coupled with numerous storms and hurricanes having potentially changed the seabed over the last century raises a need to survey the area. This survey will provide contemporary data to update National Ocean Service Nautical (NOS) charting products. Additionally, survey data from this project will support the Seabed 2030 global mapping initiative.

A.3 Survey Quality

The entire survey is adequate to supersede previous data.

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.	Object Detection Coverage (Refer to HSSD Section 5.2.2.2)

Table 2: Survey Coverage

Survey coverage was acquired in accordance with the 2021 Hydrographic Survey Specifications and Deliverables (HSSD). Object Detection coverage requirements were met with either 200% side scan sonar (SSS) with concurrent multibeam (MBES) or full MBES coverage. See image below for more detail on the extents of survey coverage.

Coverage met the inshore limit of hydrography, the Navigable Area Limit Line (NALL). The NALL is defined as the most seaward of the following: the surveyed 3.5- meter depth contour, the line defined by the distance seaward from the observed mean high water (MHW) line which is equivalent to 0.8 millimeters at chart scale, or the inshore limit of safe navigation. Areas where H13509 survey coverage reached neither 3.5 meters water depth, nor the assigned sheet limits, was due to the presence of hazards such as a thick weeds, recreational boaters, swimmers or private docks and moorings.See image below for an example of NALL determination for this survey.

The use of 200% SSS with concurrent multibeam for this survey was undoubtedly more efficient, however it did lead to some additional post-processing time and effort in regards to data gaps (holiday) detection. With a single MBES surface, the Pydro Explorer QC Tool Holiday Finder would be used to detect holidays, however this tool is unable to find gaps between multiple coverage types. As such, we used the Pydro Explorer Extract Survey Outlines Tool to determine coverage of sidescan data and multibeam data. When using the mixed coverage processing mode with the “Full Coverage” checkbox selected, 2 different sidescan sources must overlap an area to be considered covered. A single bathymetry source is also considered “Full Coverage” and does not need an overlapping sidescan or bathymetry file. See image below for an example of holiday determination.

With this methodology, approximately 616 certain holidays were found in the surfaces sent for submission. Close inspection of shoaling trends was made while reviewing these holidays and surrounding node depths generally appear to honor least depth soundings. In the field, multiple days were spent on holiday collection, however it was eventually decided that data collection on other sheets was a higher survey priority. See image below for an example of holiday determination for this survey.

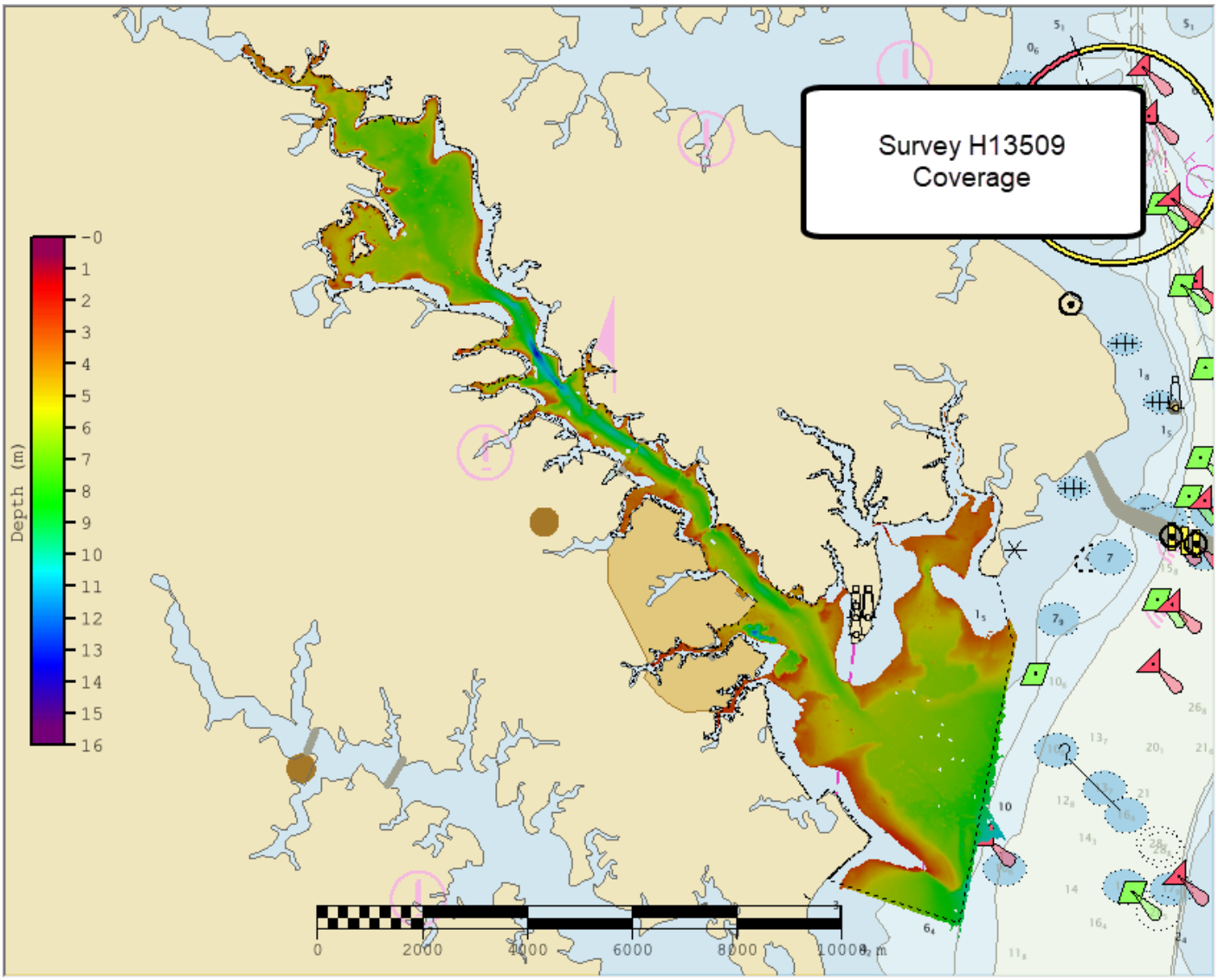


Figure 3: H13509 MBES coverage and assigned survey limits.

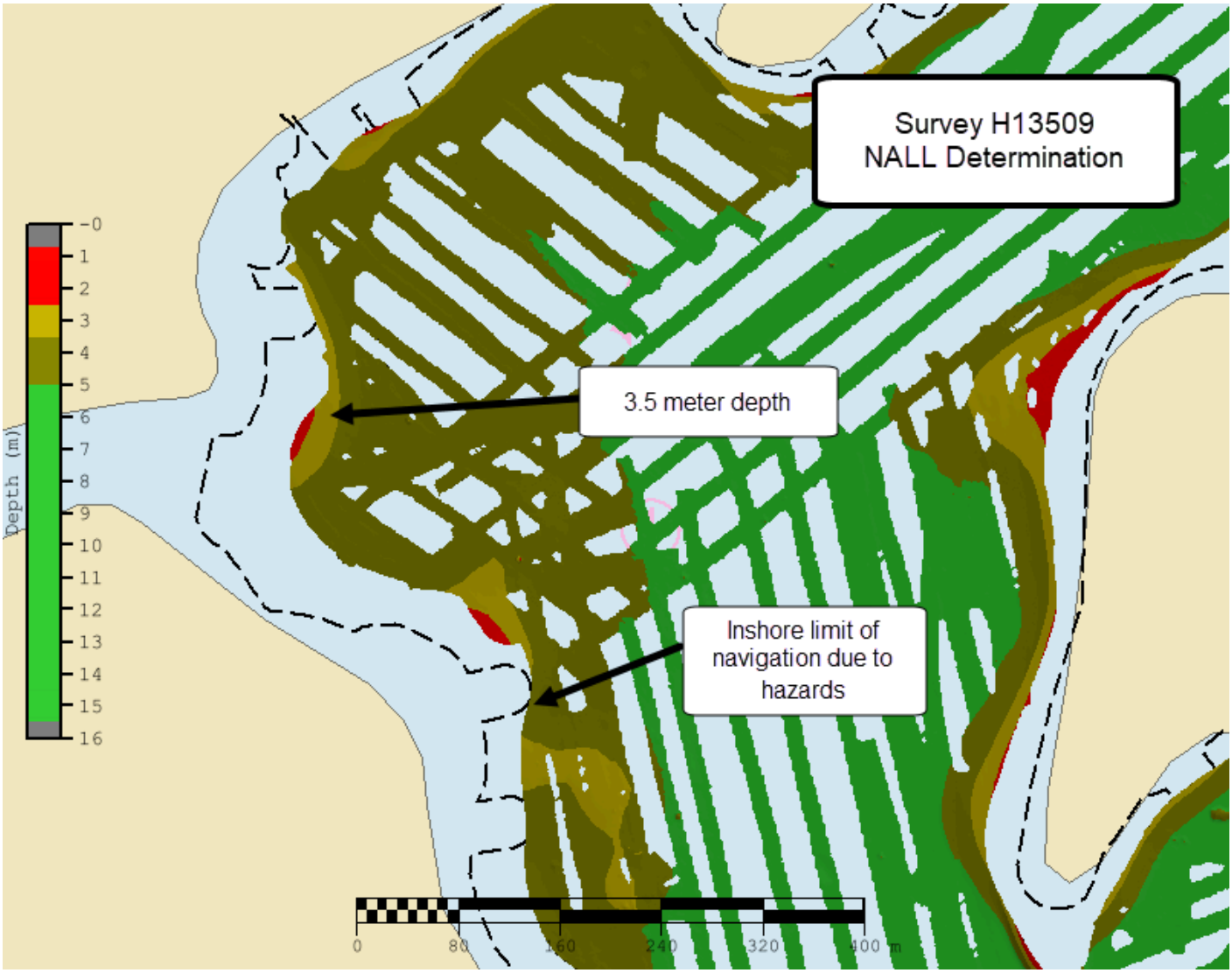


Figure 4: Examples of H13509 NALL determination; the black dashed line indicates assigned sheet limits and the yellow indicates where the 3.5-meter contour was reached.

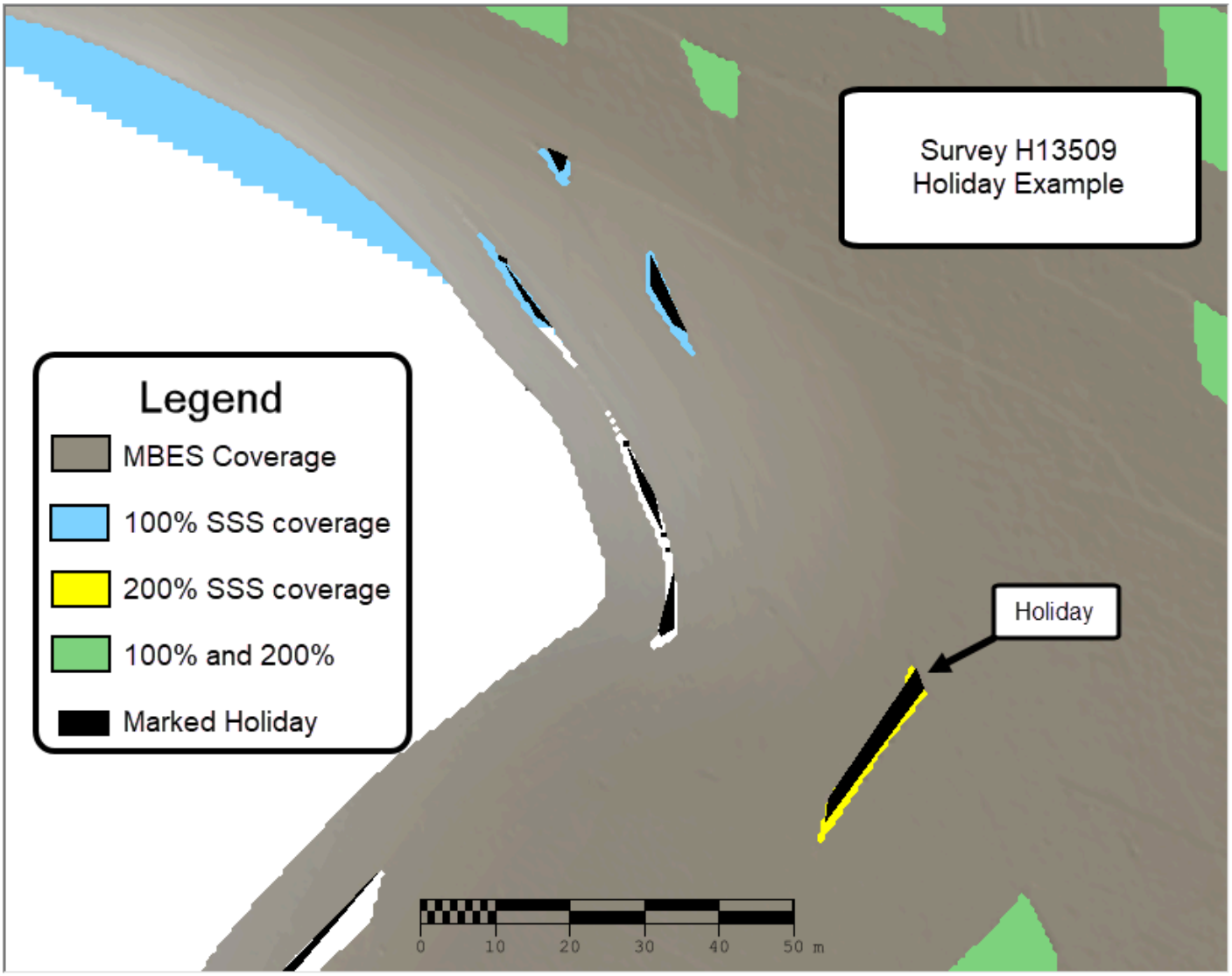


Figure 5: Example of Holidays between coverage types.

A.6 Survey Statistics

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

	HULL ID	*2903*	*2904*	*Total*
LNM	**SBES Mainscheme**	0.0	0.0	0.0
	MBES Mainscheme	605.3	391.28	996.59
	Lidar Mainscheme	0.0	0.0	0.0
	SSS Mainscheme	177.06	316.09	493.16
	SBES/SSS Mainscheme	0.0	0.0	0.0
	MBES/SSS Mainscheme	0.0	0.0	0.0
	SBES/MBES Crosslines	52.97	1.56	54.53
	Lidar Crosslines	0.0	0.0	0.0
Number of Bottom Samples				7
Number Maritime Boundary Points Investigated				0
Number of DPs				0
Number of Items Investigated by Dive Ops				0
Total SNM				9.7

Table 3: Hydrographic Survey Statistics

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

Survey Dates	Day of the Year
05/19/2021	139
05/20/2021	140

Survey Dates	Day of the Year
06/22/2021	173
07/11/2021	192
07/12/2021	193
07/13/2021	194
07/14/2021	195
07/20/2021	201
07/21/2021	202
07/22/2021	203
07/24/2021	205
07/25/2021	206
07/26/2021	207
07/27/2021	208
08/19/2021	231
08/20/2021	232
08/21/2021	233
08/22/2021	234
08/23/2021	235
08/24/2021	236
08/25/2021	237
08/26/2021	238
08/27/2021	239
08/30/2021	242
08/31/2021	243
09/04/2021	247

Table 4: Dates of Hydrography

B. Data Acquisition and Processing

B.1 Equipment and Vessels

Refer to the Data Acquisition and Processing Report (DAPR) for a complete description of data acquisition and processing systems, survey vessels, quality control procedures and data processing methods. Additional

information to supplement sounding and 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	***2903***	***2904***
LOA	8.5 meters	8.5 meters
Draft	1.2 meters	1.2 meters

Table 5: Vessels Used

Figure 6: Thomas Jefferson launch 2903 operating in the Central Chesapeake Bay.

B.1.2 Equipment

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

Manufacturer	Model	Type
Applanix	POS MV 320 v5	Positioning and Attitude System
EdgeTech	4200	SSS
Kongsberg Maritime	EM 2040	MBES
Sea-Bird Scientific	SBE 19plus V2	Conductivity, Temperature, and Depth Sensor
Teledyne RESON	SVP 71	Sound Speed System

Table 6: Major Systems Used

B.2 Quality Control

B.2.1 Crosslines

Thomas Jefferson launches 2903 and 2904 acquired 54.53 nautical miles of multibeam crosslines or 5.4 % of mainscheme lines across most depth ranges and multiple boat days. H13509 crossline data is adequate for verifying and evaluating the internal consistency of survey data. The Compare Grids function in Pydro Explorer analyzed finalized VR surfaces of H13509 crossline-only data and mainscheme-only data. In the difference surface, 99.5% of nodes met IHO allowable Total Vertical Uncertainty (TVU) standards. See figures below for specific details on crossline analysis.

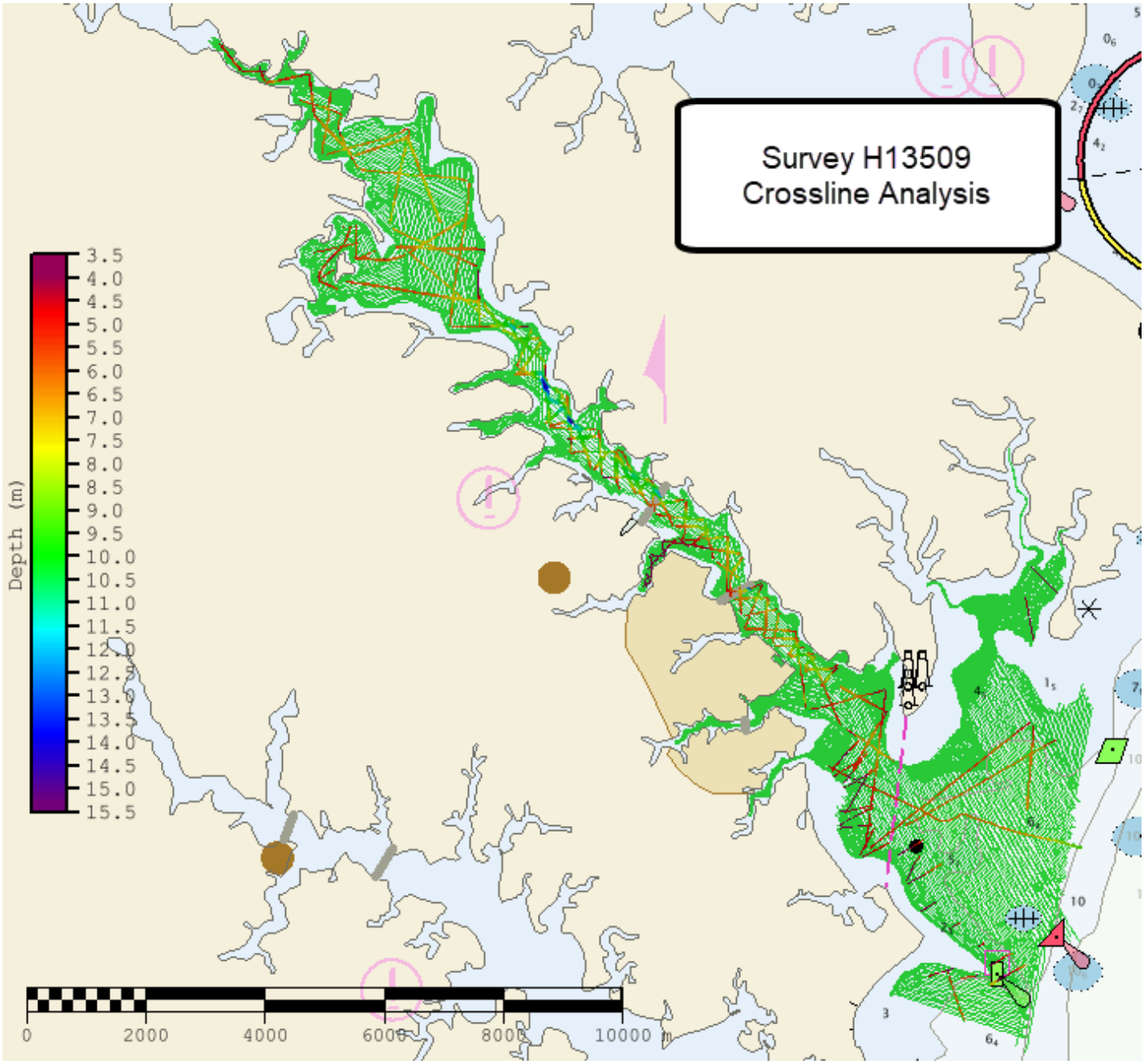
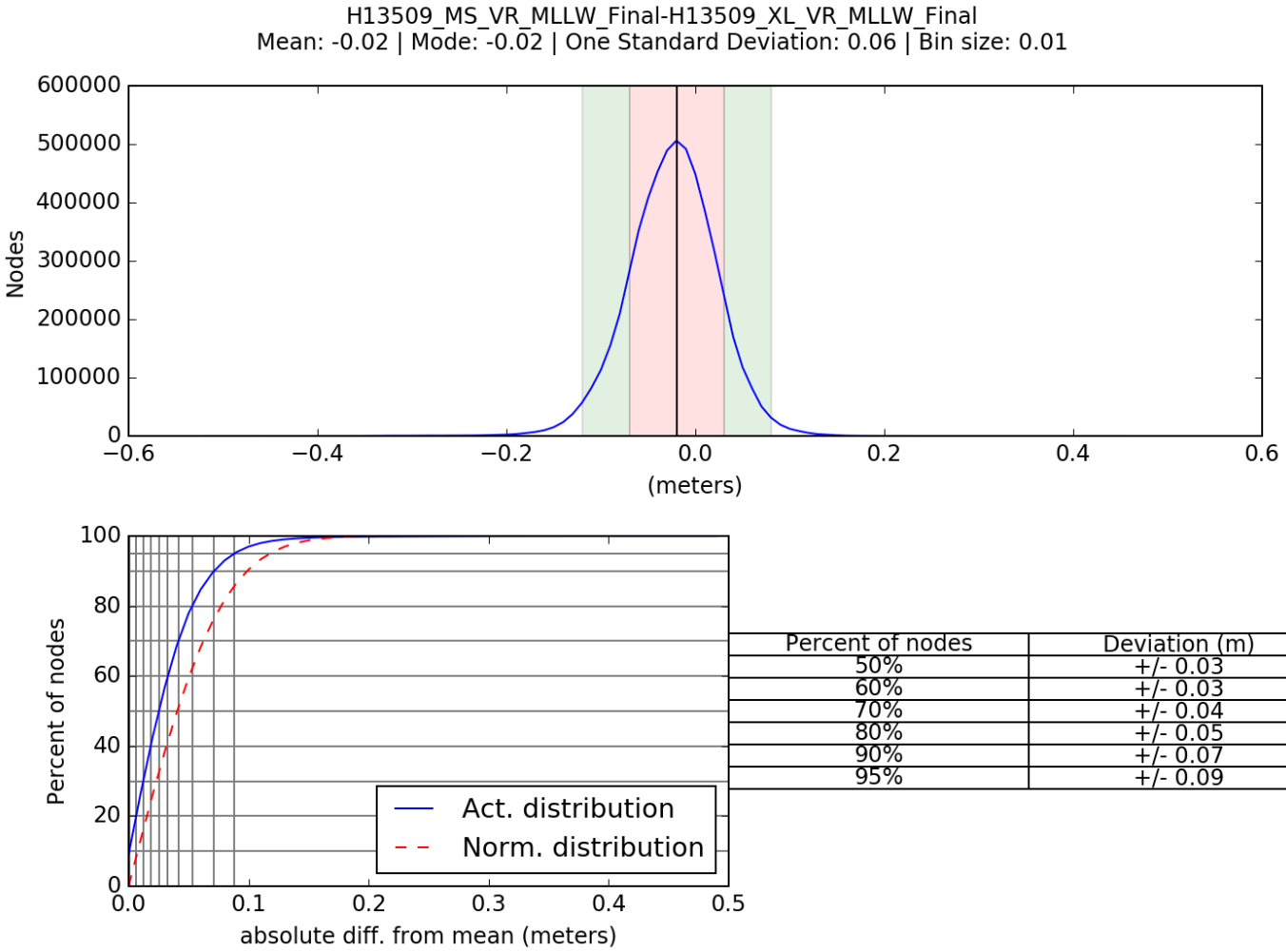


Figure 7: H13509 crossline surface overlaid on mainscheme tracklines.



Percent of nodes	Deviation (m)
50%	+/- 0.03
60%	+/- 0.03
70%	+/- 0.04
80%	+/- 0.05
90%	+/- 0.07
95%	+/- 0.09

Figure 8: Pydro derived plot showing absolute difference.

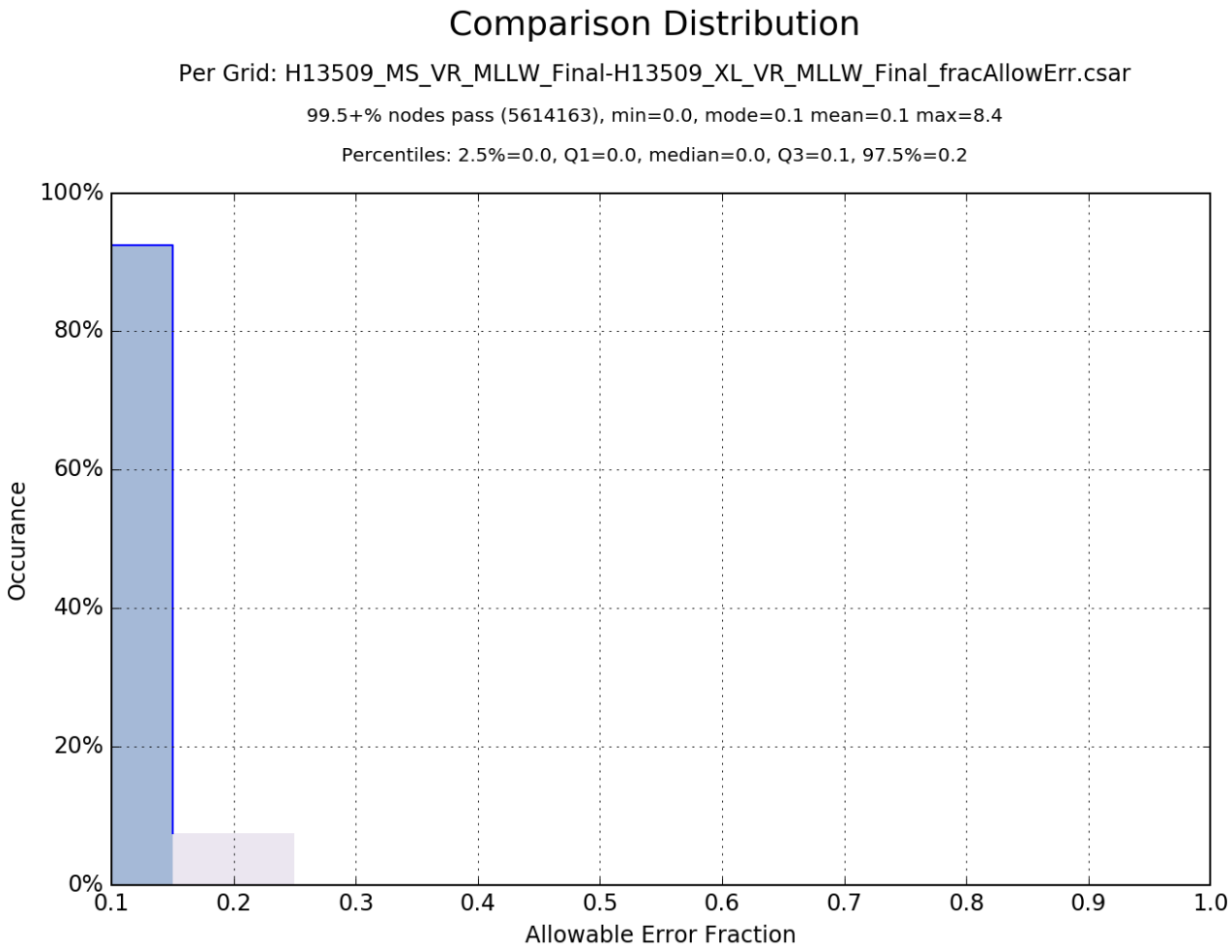


Figure 9: Pydro derived plot showing percentage-pass value of H13509 mainscheme to crossline data.

B.2.2 Uncertainty

The following survey specific parameters were used for this survey:

Method	Measured	Zoning
ERS via VDATUM	0.0 meters	0.08 meters

Table 7: Survey Specific Tide TPU Values.

Hull ID	Measured - CTD	Measured - MVP	Measured - XBT	Surface
2903, 2904	4 meters/second	N/A meters/second	N/A meters/second	.02 meters/second

Table 8: Survey Specific Sound Speed TPU Values.

Total Propagated Uncertainty (TPU) values for survey H13509 were derived from a combination of fixed values for equipment and vessel characteristics, as well as from field assigned values for sound speed uncertainties. Tidal uncertainty was provided in the project instructions for the NOAA vertical datum transformation model used for this survey.

In addition to the usual a priori estimates of uncertainty, some real-time and post-processed uncertainty sources were also incorporated into the depth estimates of this survey. Real-time uncertainties for position, navigation, attitude, and vessel motion data from Applanix POS MV were applied during acquisition and initially in post-processing. However, the SBET and RMS files, which were generated using POSPac MMS software and applied in CARIS HIPS to supersede POS MV data, have post-processed uncertainties associated with the GPS height and position.

Uncertainty values of the submitted finalized grids were calculated in Caris using "Greater of the Two" of uncertainty and standard deviation (scaled to 95%). Grid QA v5 within Pydro QC Tools was used to analyze H13509 TVU compliance. H13509 met the 2021 HSSD requirements in over 99.5 percent of grid nodes, which is shown in the histogram plot below. Pydro QC Tools 2 Grid QA was used to analyze H13509 multibeam echosounder (MBES) data density. The submitted H13509 variable-resolution (VR) surface met the 2021 HSSD density requirements as shown in the histograms below.

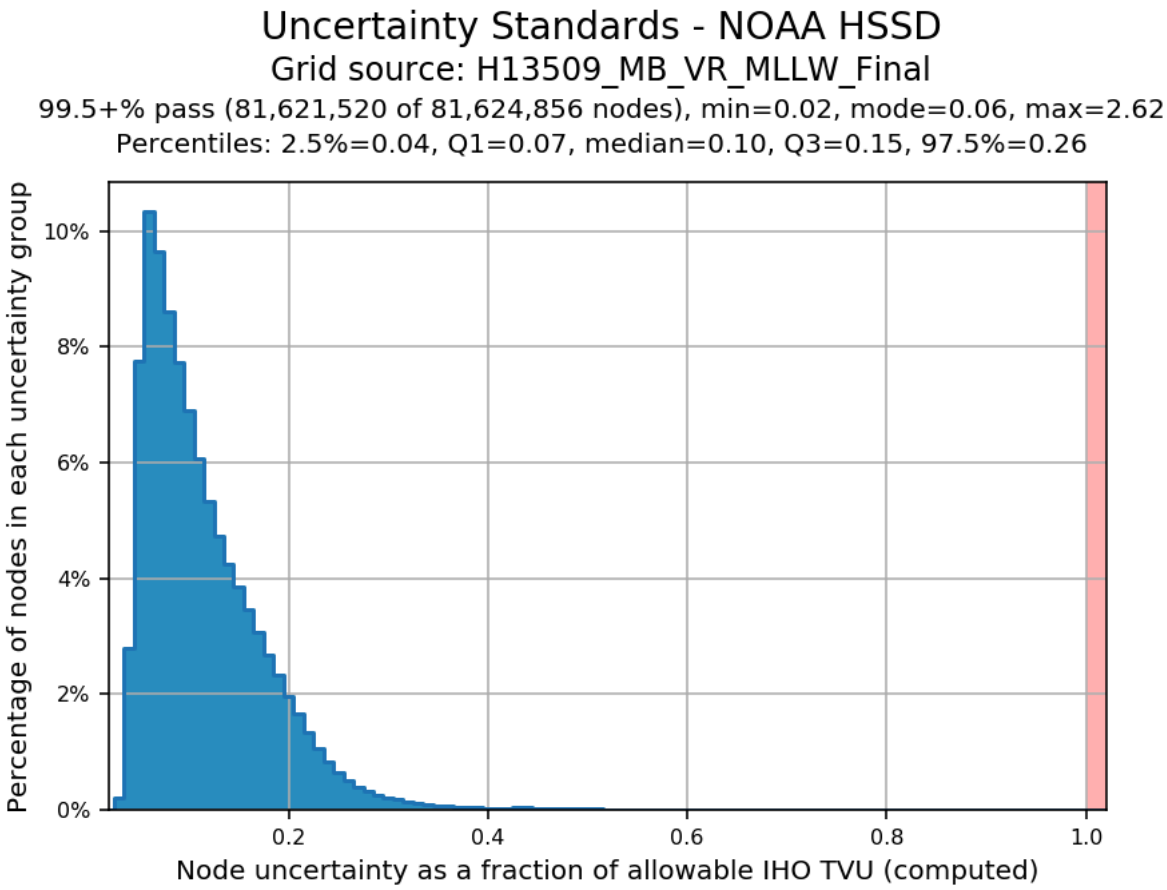


Figure 10: Pydro derived plot showing TVU compliance of H13509 finalized multi-resolution MBES data.

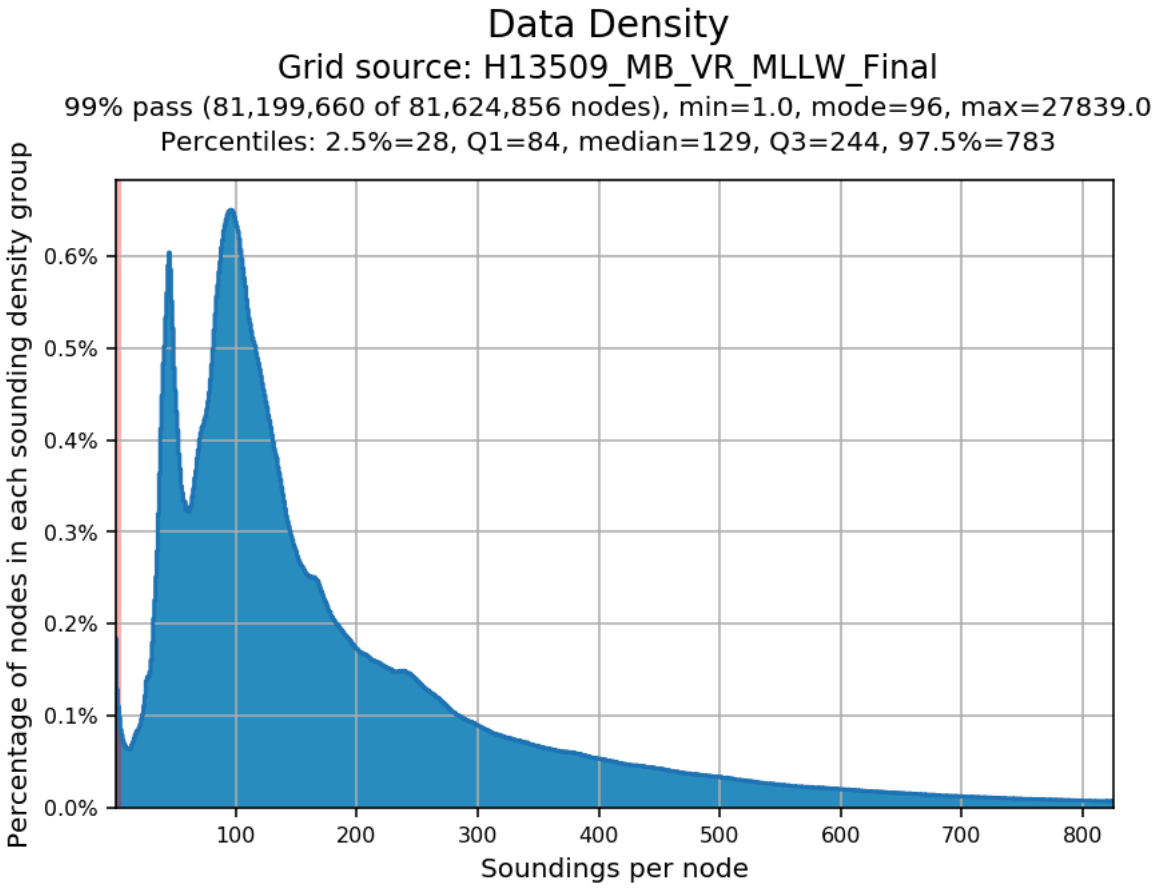


Figure 11: Pydro derived histogram plot showing HSSD density compliance of H13509 finalized variable-resolution MBES data.

A query of the processed surface sound speed data indicated the value utilized was 0.2 m/sec instead of the DR documented value of 0.02 m/sec.

B.2.3 Junctions

Survey H13509 junctions with two contemporary surveys conducted by NOAA Ship Thomas Jefferson. Comparisons were made using the Compare Grids program within Pydro Explorer.

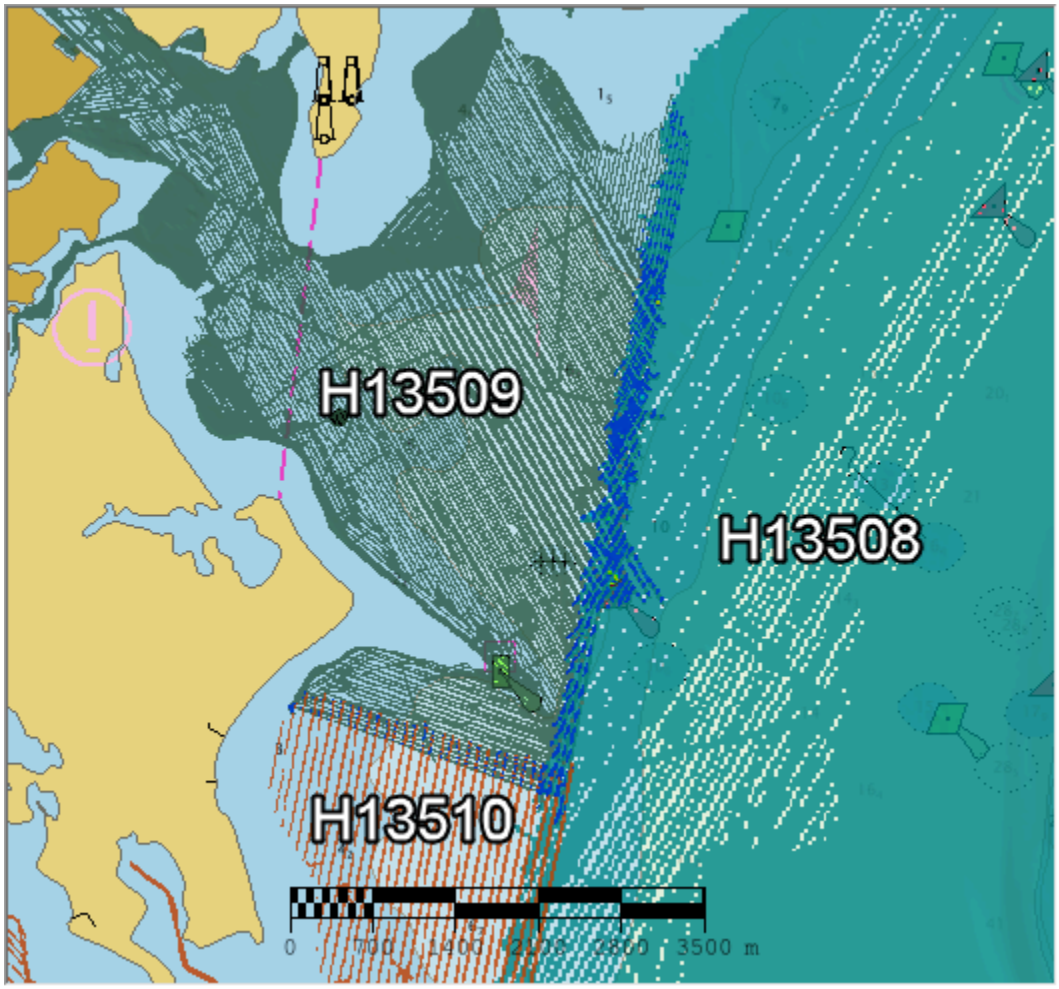


Figure 12: Overview of H13509 junctions

The following junctions were made with this survey:

Registry Number	Scale	Year	Field Unit	Relative Location
H13508	1:5000	2021	TJ	E
H13510	1:5000	2021	TJ	S

Table 9: Junctioning Surveys

H13508

The junction with survey H13509 encompassed approximately 0.13 square nautical miles along the western boundary of H13508. Pydro's Compare Grids results showed that 99.5+% of nodes in the common area met NOAA allowable error standards. Analysis of the difference surface indicated that H13509 is an average

of 0.05 meters deeper than H13508 with a standard deviation of 0.01 meters. See figures below for more information.

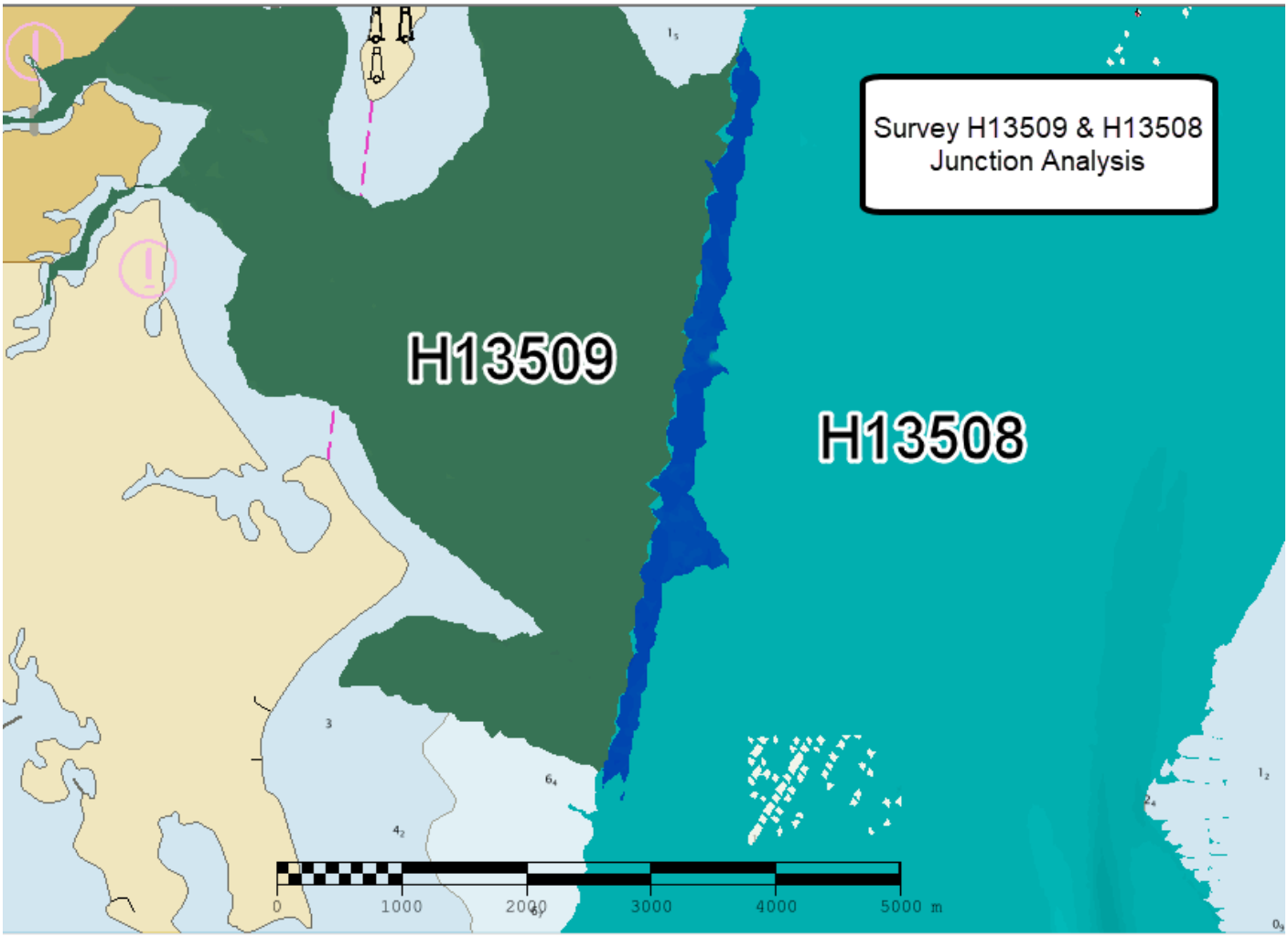
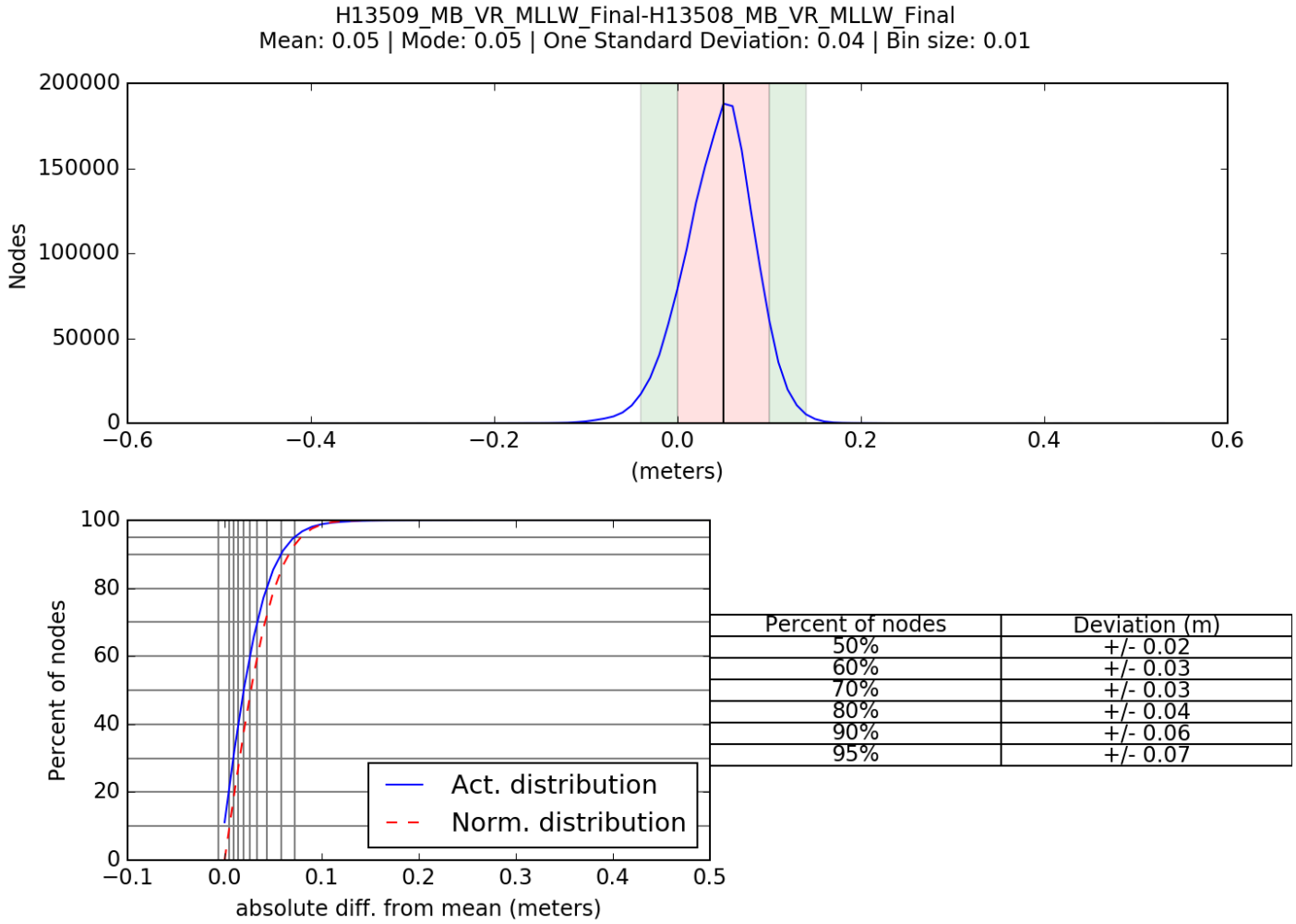


Figure 13: Overview of survey junction between H13509 and H13508.



Percent of nodes	Deviation (m)
50%	+/- 0.02
60%	+/- 0.03
70%	+/- 0.03
80%	+/- 0.04
90%	+/- 0.06
95%	+/- 0.07

Figure 14: Pydro derived plot showing H13509 and H13508 comparison statistics.

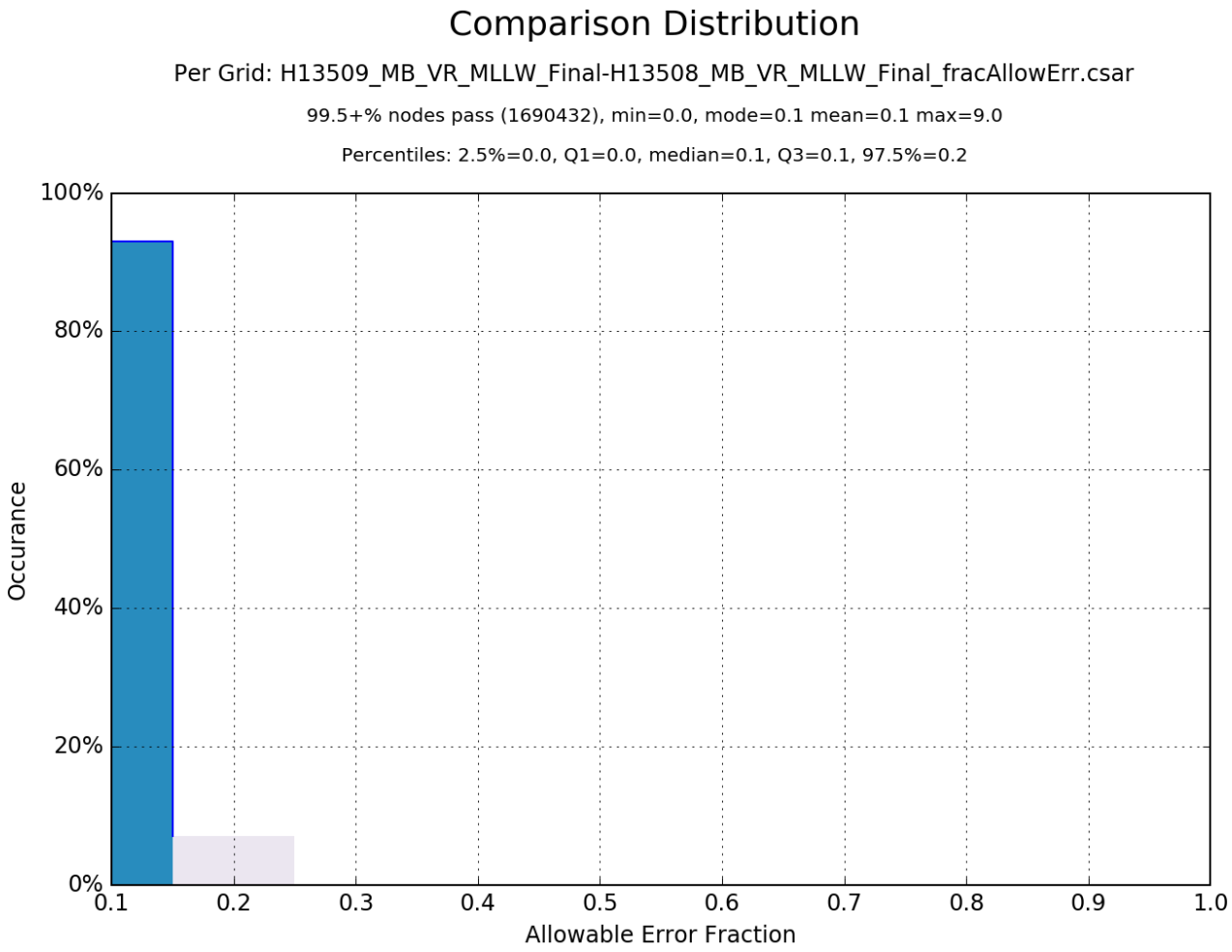


Figure 15: Pydro derived plot showing allowable error between H13509 and H13508.

H13510

Please refer to survey H13510 Descriptive Report for junction analysis.

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

Sonar Failure

During field acquisition the Thomas Jefferson launch 2904 EM2040 receiver transducer was was exhibiting signs of reduced performance. This reduced performance worsened until the unit was rendered completely inoperable. This may have contributed to excessive noisy data and increased frequency of blowouts. These data artifacts had to be manually rejected and also contributed to the number of holidays present in the survey. A replacement receive transducer unit was provided by shore side support a field calibration patch test was performed. Sonar performance and data quality improved with the new receive transducer.

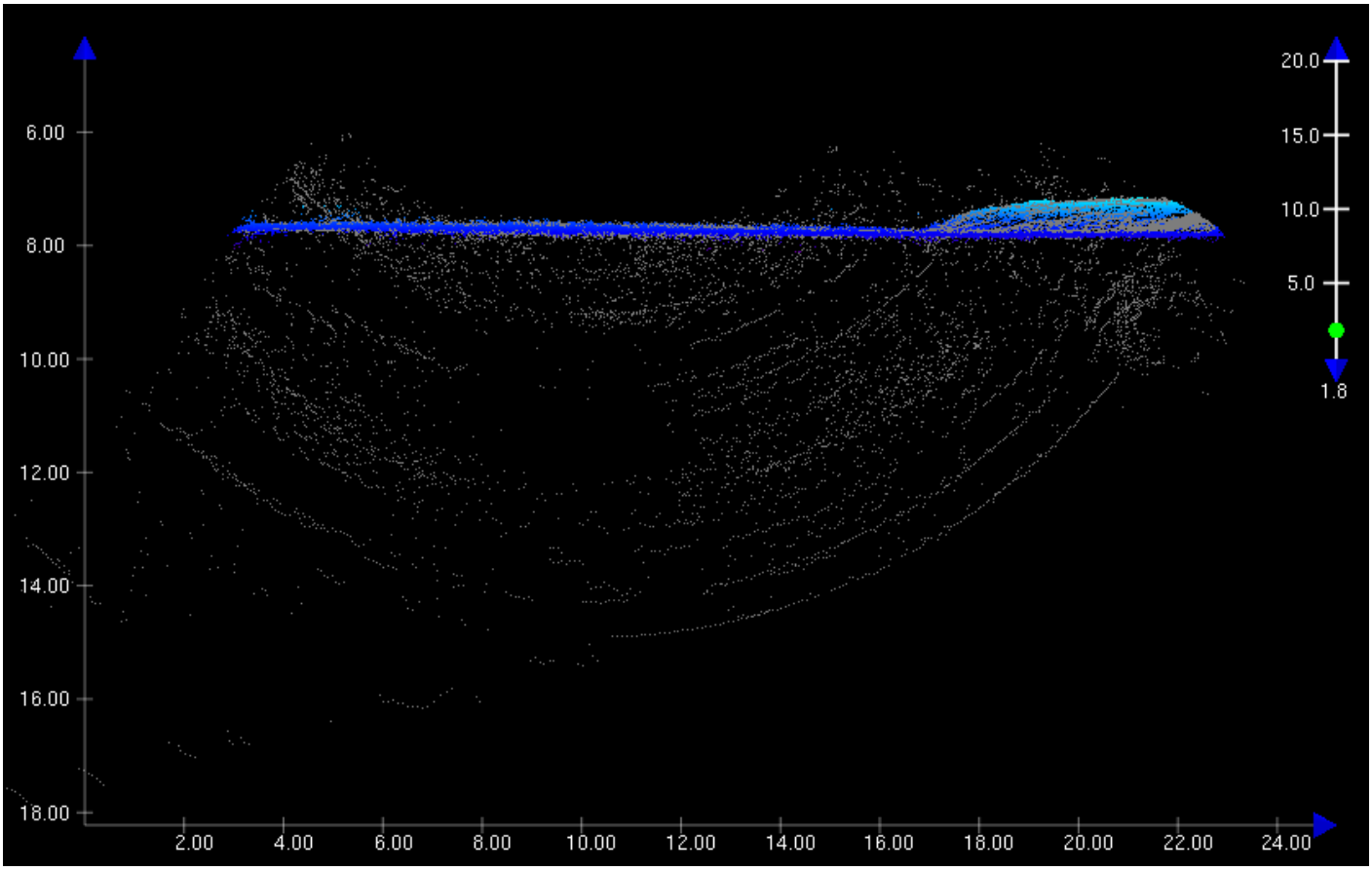


Figure 16: Subset view of H13509 data showing typical data artifact or blowout.

B.2.6 Factors Affecting Soundings

Vertical Control

Numerous lines running around and through the Severn River Bridge exhibited issues with vertical control. The exact source of the error was not determined however it appears to be related to the Smooth Best Estimate and Trajectory (SBET) from that day. Reprocessing the SBET with Smart Base selection method did not improve the vertical offset. Due to the navigational significance of the area, affected sounding out of the IHO TVU uncertainty compliance were marked as rejected and excluded from the finalized Variable Resolution (VR) surfaces for submission.

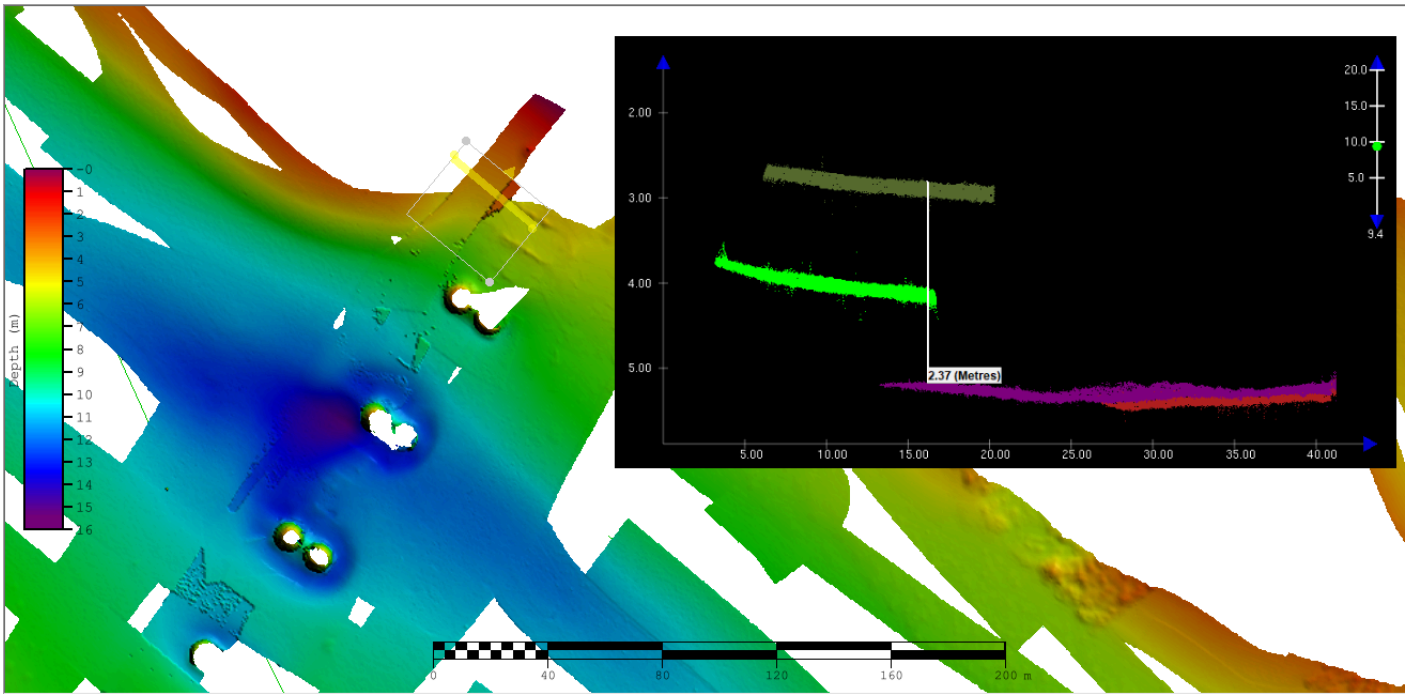


Figure 17: Overview and Subset view of H13509 data exhibiting vertical control issues. Note surface is shown at ten times vertical exaggeration.

B.2.7 Sound Speed Methods

Sound Speed Cast Frequency: 149 sound speed profiles were acquired for this survey at discrete locations within the survey area at least once every four hours, when significant changes in surface sound speed were observed, or when operating in a new area. Launch sound speed profiles were acquired using Sea-Bird 19plus SEACAT Profilers. All casts were concatenated into a master file and applied to MBES data using the "Nearest distance within time" (4 hours) profile selection method.

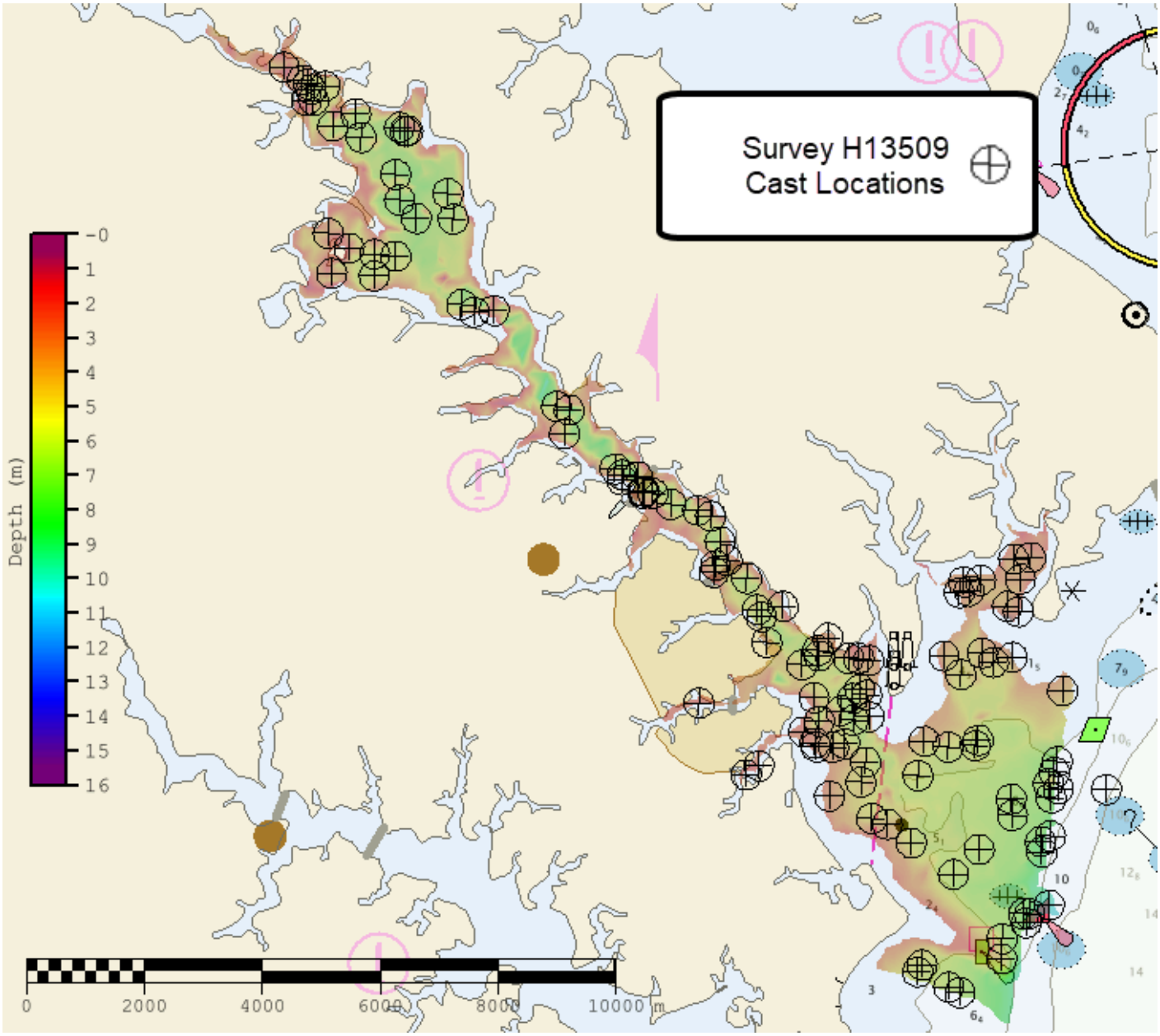


Figure 18: H13509 sound speed cast locations.

B.2.8 Coverage Equipment and Methods

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

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

The following calibrations were conducted after the initial system calibration discussed in the DAPR:

Calibration Type	Date	Reason
MBES	2021-07-15	Sonar head replacement

Table 10: Calibrations not discussed in the DAPR.

On July 15, 2021 a in-field MBES patch test calibration was performed on Thomas Jefferson launch 2904. This test was performed after replacing the vessel's EM2040 receiver transducer. For more detail on sonar issues seen prior to replacement, see section B.2.5 Equipment Effectiveness.

B.4 Backscatter

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

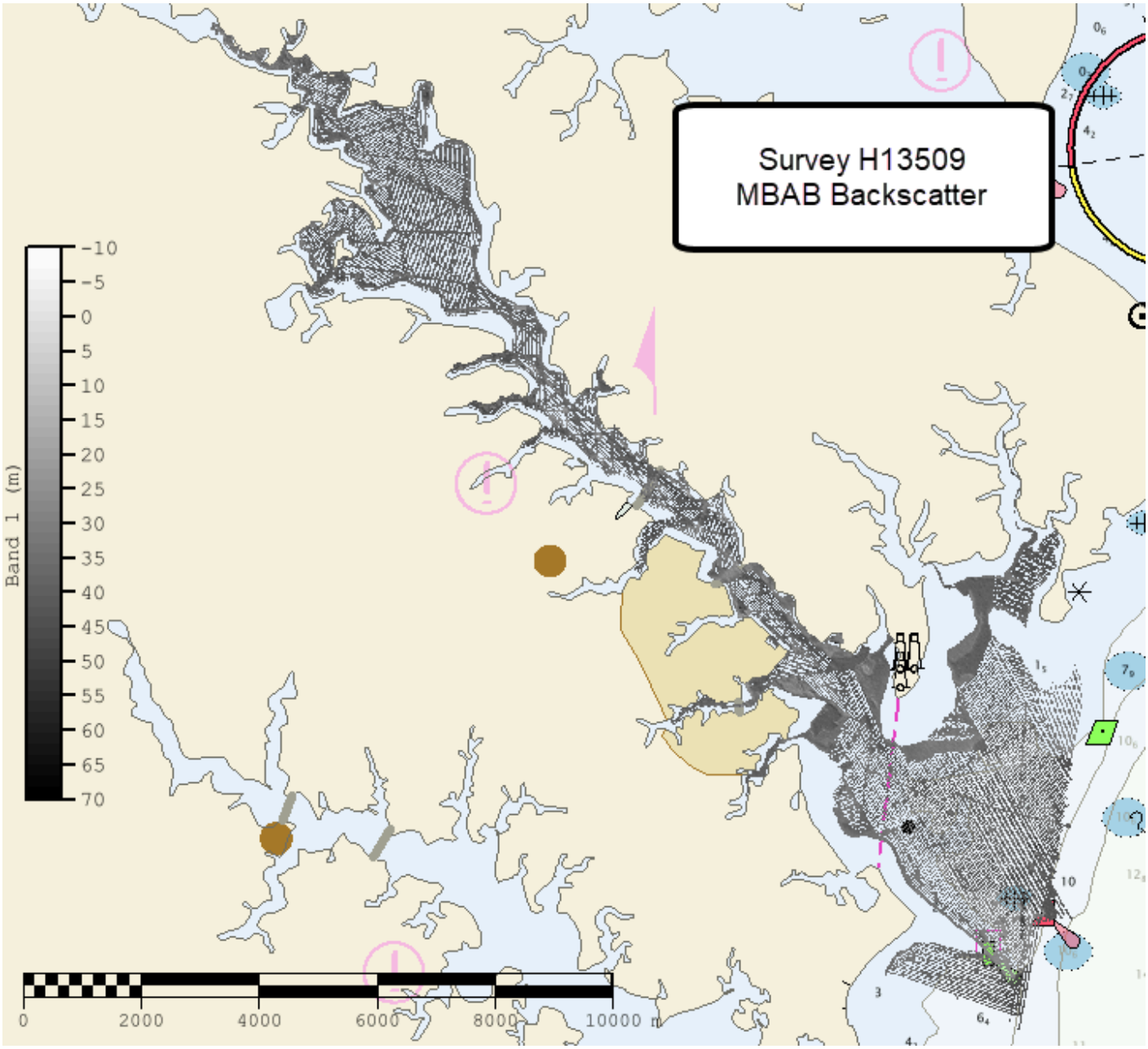


Figure 19: Overview of H13509 backscatter mosaics.

B.5 Data Processing

B.5.1 Primary Data Processing Software

The following Feature Object Catalog was used: NOAA Profile 2021.

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
H13509_MB_VR_MLLW	CARIS VR Surface (CUBE)	Variable Resolution	0.5 meters - 15.5 meters	NOAA_VR	Object Detection
H13509_MB_VR_MLLW_Final	CARIS Raster Surface (CUBE)	Variable Resolution	0.1 meters - 15.5 meters	NOAA_VR	Object Detection
H13509_SSSAB_1m_600kHz_1of2	SSS Mosaic	1 meters	-	N/A	100% SSS
H13509_SSSAB_1m_600kHz_2of2	SSS Mosaic	1 meters	-	N/A	200% SSS
H13509_MBAB_2m_2903_300kHz_1of2	MB Backscatter Mosaic	2 meters	-	N/A	Object Detection
H13509_MBAB_2m_2904_300kHz_2of2	MB Backscatter Mosaic	2 meters	-	N/A	Object Detection

Table 11: Submitted Surfaces

Submitted surfaces were generated using the recommended parameters for depth-based (Ranges) Caris variable-resolution bathymetric grids as specified in the 2021 HSSD. Pydro QC Tools Detect Fliers was used with the experimental option 7 "Noisy Margins" selected to find fliers in a finalized VR surfaces. Obvious noise was rejected by the Hydrographer in Caris Subset Editor. After data cleaning, Detect Fliers was run again and found 170 potential fliers. Upon further inspection, these flagged grid's nodes are considered to be accurate representations of the sea floor and have been retained in the submitted surfaces.

The final grid deliverable was revised from the field submitted variable resolution (VR) grid to a 50 cm single resolution (SR) grid with file name: H13509_MB_50cm_MLLW_1of1.bag. Depths range from 0.68 to 15.48 m.

C. Vertical and Horizontal Control

No Horizontal and Vertical Control Report (HVCR) is required for this survey.

C.1 Vertical Control

The vertical datum for this project is Mean Lower Low Water.

ERS Datum Transformation

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

Method	Ellipsoid to Chart Datum Separation File
ERS via VDATUM	OPR-E349-TJ-21_CMMB_alt_NAD83-MLLW_xGeoid20B.csar

Table 12: ERS method and SEP file

C.2 Horizontal Control

The horizontal datum for this project is North American Datum of 1983 (NAD 83).

The projection used for this project is Universal Transverse Mercator (UTM) Zone 18.

The following PPK methods were used for horizontal control:

- RTX

WAAS

The Wide Area Augmentation System (WAAS) was used for real-time horizontal control during data acquisition.

D. Results and Recommendations

D.1 Chart Comparison

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
US5MD32M	1:10000	19	06/17/2021	06/15/2021
US5MD22M	1:25000	14	03/26/2021	03/26/2021

Table 13: Largest Scale ENCs

ENC US5MD13M with Scale 40000, Edition 31, Update Application Date 12/03/2021 and Issue Date 12/08/2022 covered the southeastern point of the survey with an approximate 900 m overlap of data coverage. Charted sounding was within range of survey data.

D.1.2 Shoal and Hazardous Features

No shoals or potentially hazardous features exist for this survey.

D.1.3 Charted Features

Limited shoreline verification was conducted in accordance with applicable sections of NOAA 2021 HSSD and FPM using the Project Reference File (PRF) and Composite Source File (CSF) provided with the Project Instructions. In the field, all assigned features that were safe to approach, were addressed as required with S-57 attribution and recorded in the H13509 Final Feature File to best represent the features at chart scale. This file also includes new features found in the field as well as recommendations to update, retain or delete assigned features. There were 18 features without discrepancies that were assigned, with the investigation requirement of, "visually confirm feature object existence". There were no discrepancies throughout these features and are not included in the FFF.

D.1.4 Uncharted Features

Forty five uncharted features were identified and investigated. Reference the FFF attached to this report for more information.

D.1.5 Channels

There are five designated Channels within survey H13509, however two were not investigated due time constraints and other survey priorities. The two unsurveyed channels were also noted as being inshore the NALL and of lesser priority than other channels in the area. In most areas derived survey depths and charted soundings showed general agreement. The designated channel leading to Mill Creek has a reported depth

of 7 feet, however survey revealed depths as shallow as 2-3 feet. A more detailed comparison of derived survey depths and charted depths within these channels is made in the images below.

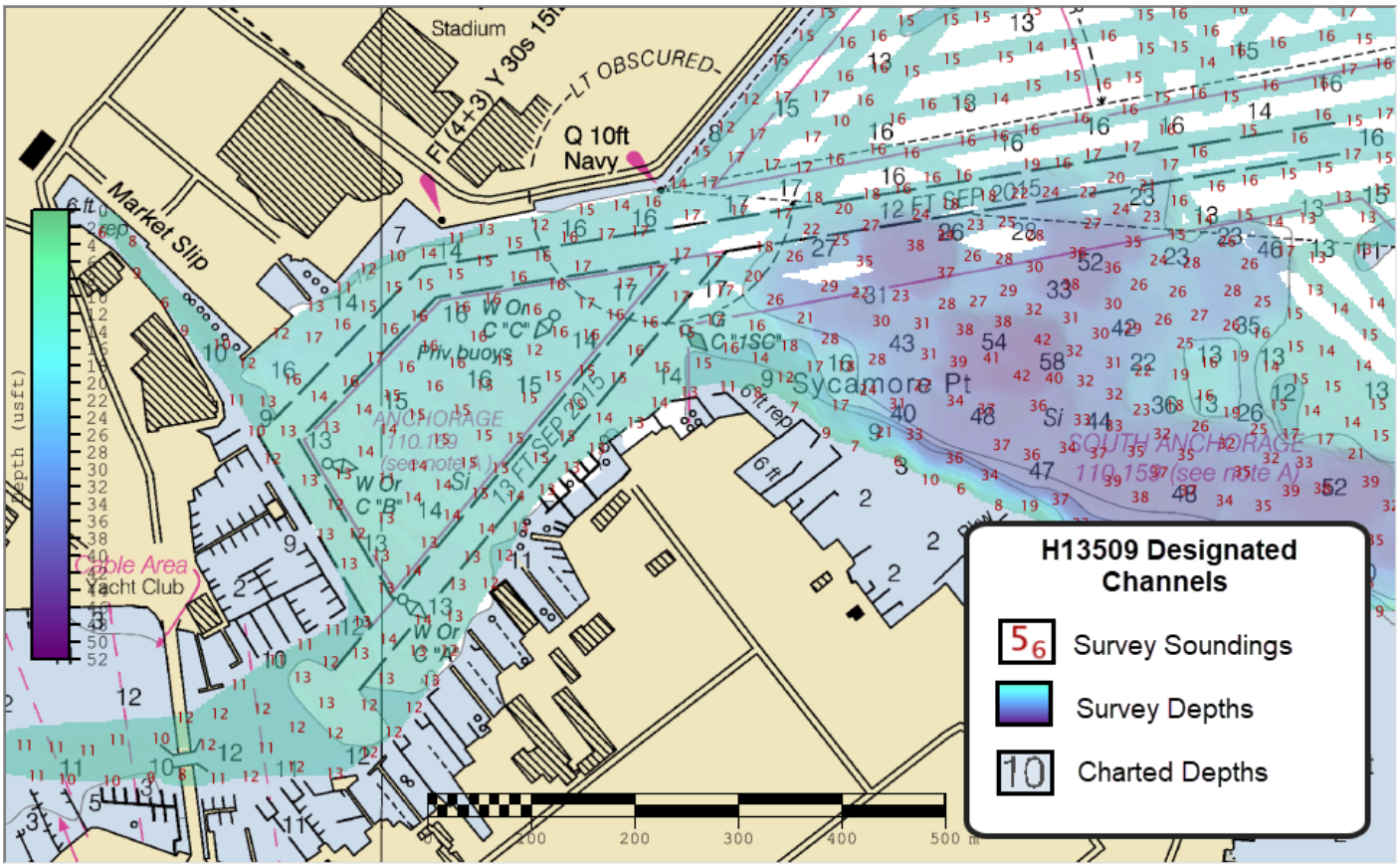


Figure 20: Comparison of derived survey soundings and charted depths in designated channel leading to Spa Creek.

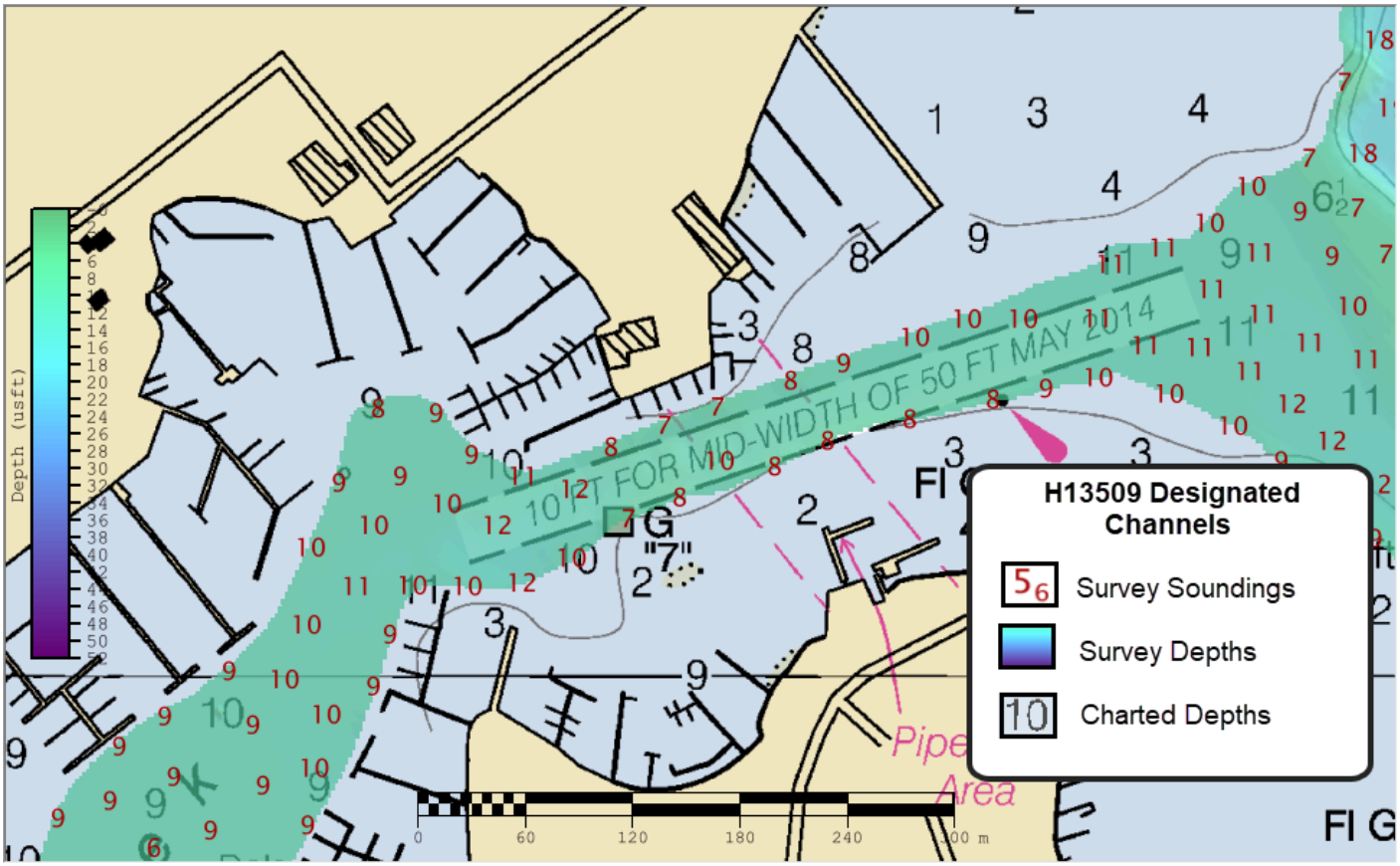


Figure 21: Comparison of derived survey soundings and charted depths in designated channel leading to Back Creek.

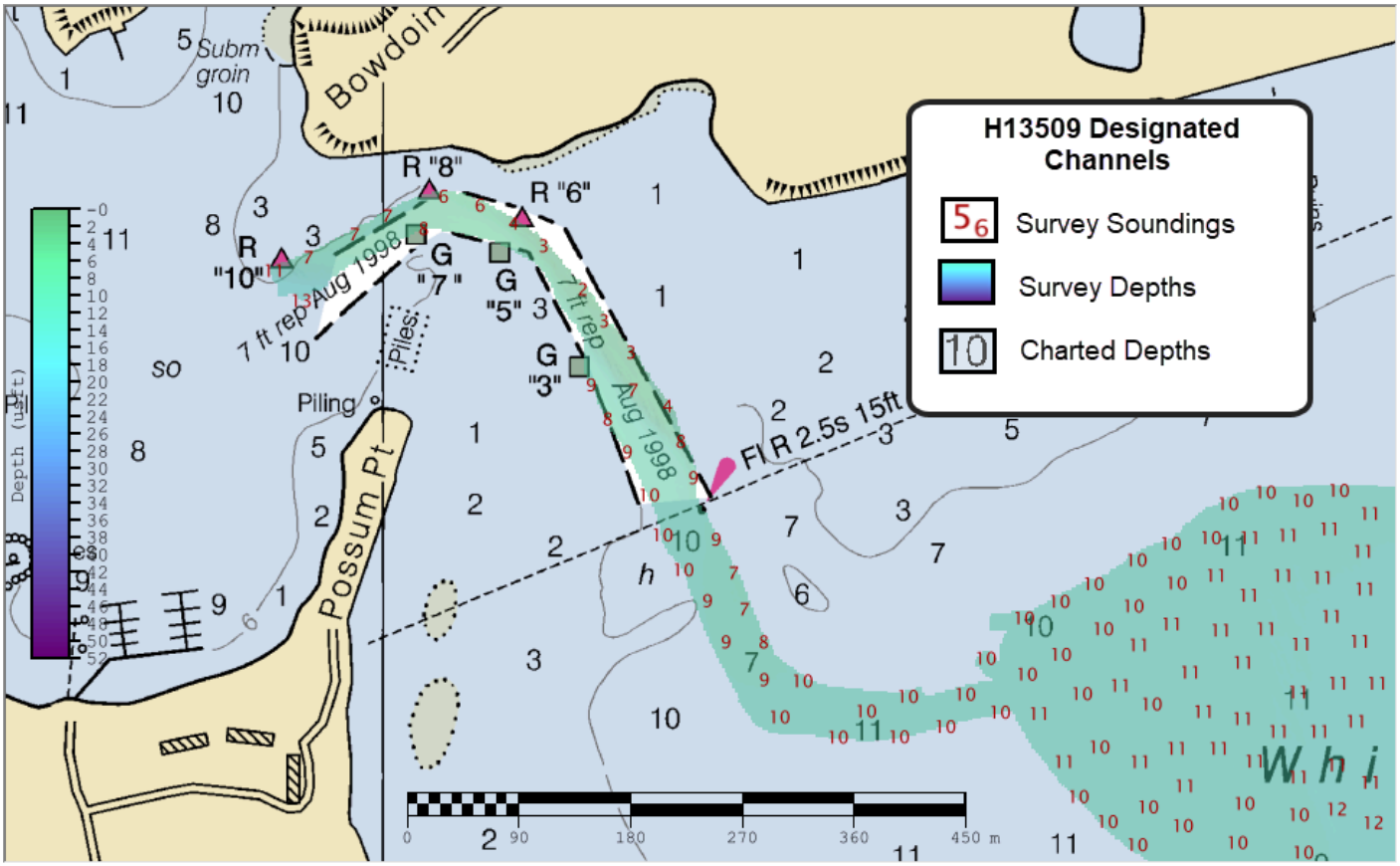


Figure 22: Comparison of derived survey soundings and charted depths in designated channel leading to Mill Creek. Note this area was latter reassigned to NRB.

D.2 Additional Results

D.2.1 Aids to Navigation

Approximately 147 Aids to Navigation (ATONs) are located within the assigned limits of survey H13509. One hundred and forty six were confirmed to be on station and serving their intended purpose while 1 ATON was not seen and marked for deletion.

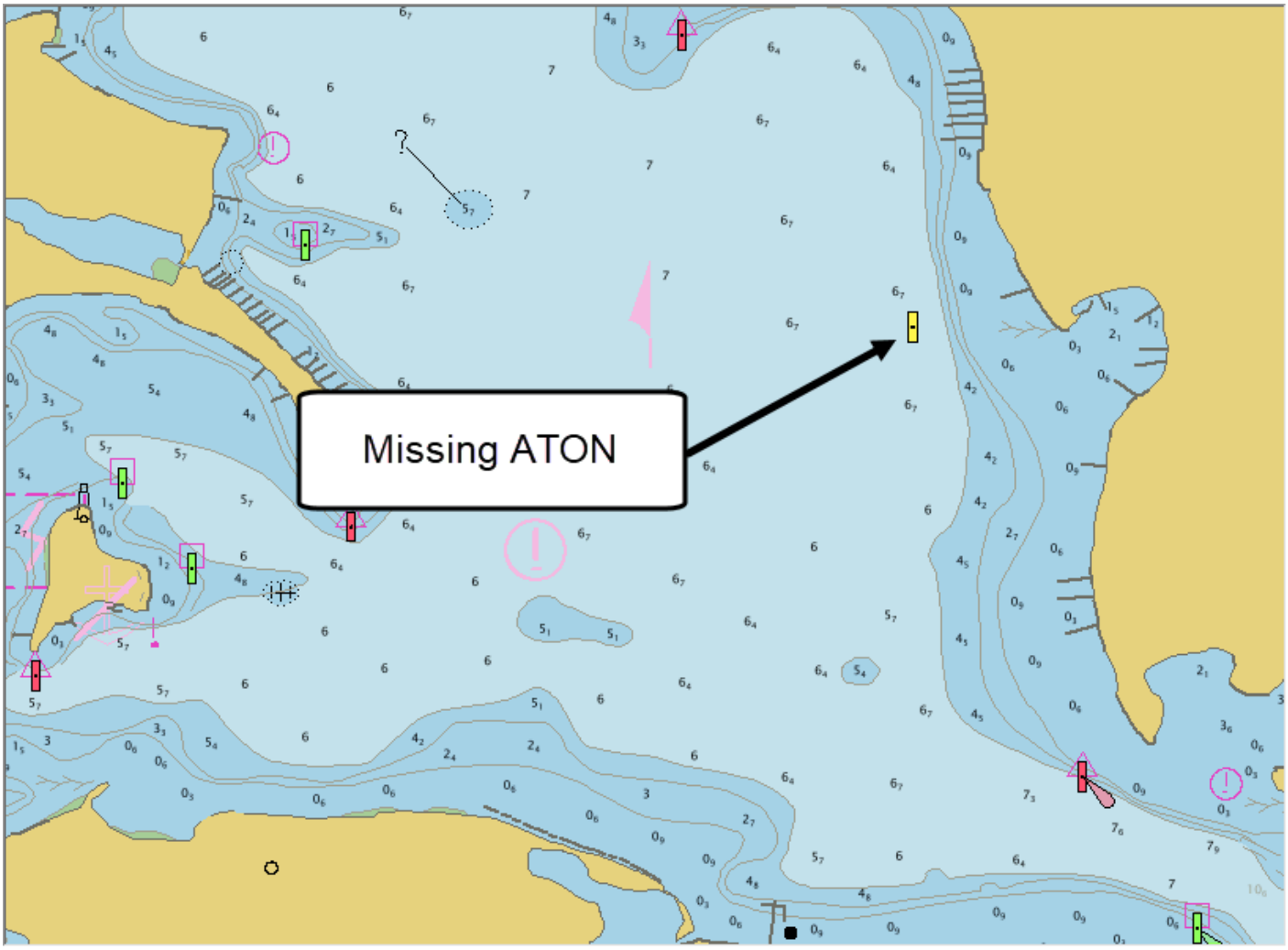


Figure 23: At the time of survey, marked ATON was not seen by survey field party.

AHB submitted an ATON Discrepancy Report Form to the USCG Navigation Center on April 10, 2023. Followup with USCG was conducted via phone conversation on said day.

D.2.2 Maritime Boundary Points

No Maritime Boundary Points were assigned for this survey.

D.2.3 Bottom Samples

Eleven bottom samples were assigned within the H13509 sheet limits, however during acquisition 4 samples did not yield a return. The results of the remaining 7 bottom samples acquired are included in the H13509 Final Feature File submitted with this report. See image below for an example of a typical bottom sample for this survey.

Figure 24: Example of typical H13509 bottom sample.

AHB added the four (4) empty sampler bottom samples to the FFF according to HSSD 2021 Section 7.5.1, making the total number of bottom samples eleven (11) in the FFF.

D.2.4 Overhead Features

Overhead features exist for this survey, but if no discrepancies were found during field investigations they were exluded from the FFF. See section D.1.3 Charted Features for more information.

D.2.5 Submarine Features

The H13509 survey area contains a abundance of small mound of various size. The field party was unable to determine the cause or use of these features. However it should be noted they primarily occur within close proximity to the designated Naval anchorage areas.

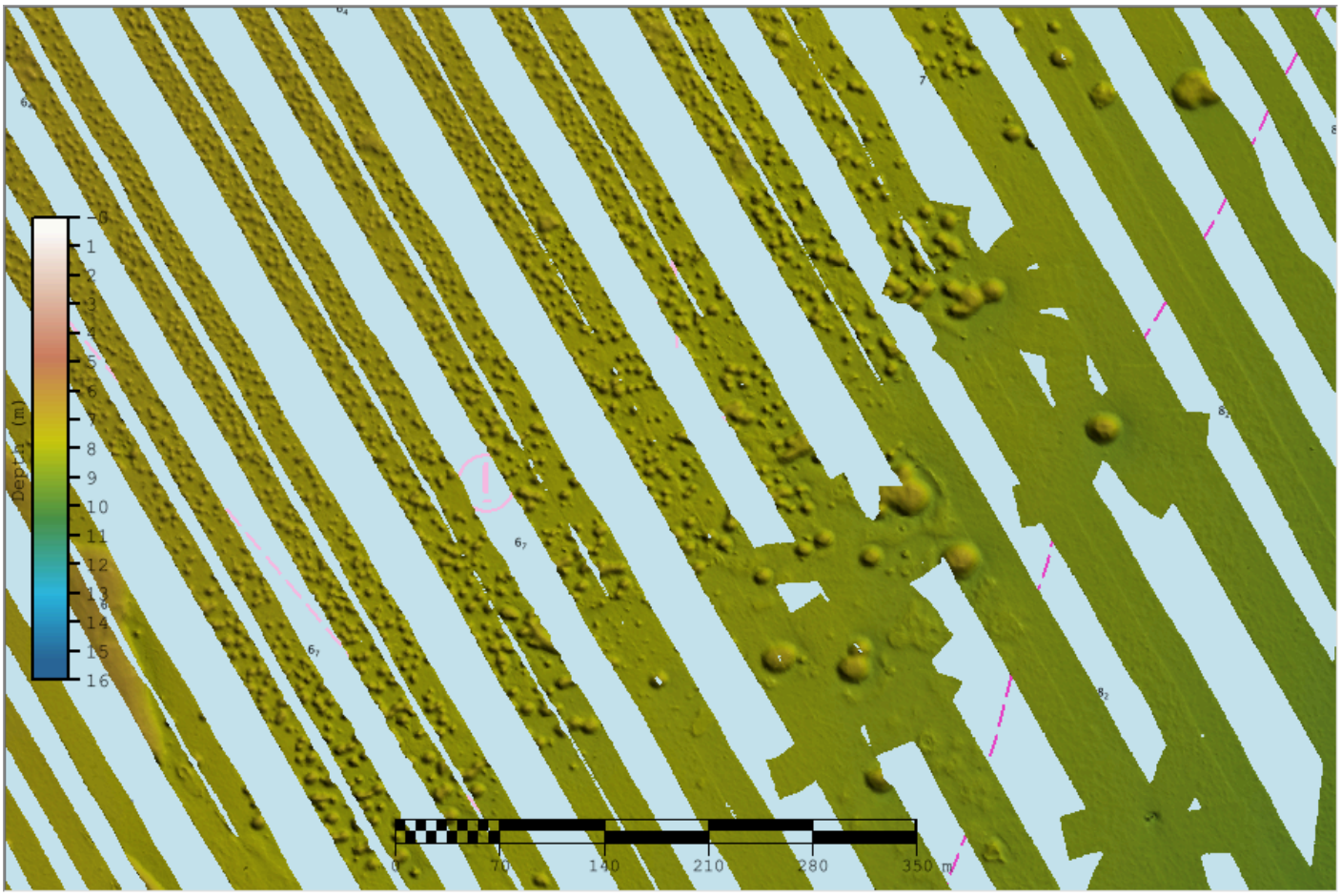


Figure 25: Example area with abundance of sea floor mounds.

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

In many areas in this sheet, new shoreline features such as docks and pilings have been constructed. At the time of survey, Thomas Jefferson did not have an accurate method of positioning these features and the task load of doing so was not of high survey priority. We recommend that this area be resurveyed by NOAA's Remote Sensing Division and new photogrammetry be used to create revised shoreline data.

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.

Approver Name	Approver Title	Approval Date	Signature
Matthew J. Jaskoski CDR/NOAA	Commanding Officer	03/18/2022	JASKOSKI.MATTHEW.JACOB.1275636262 2022.03.21 09:36:37 -04'00'
Michelle M. Levano LT/NOAA	Operations Officer	03/18/2022	Digitally signed by LEVANO.MICHELLE.MARIE.1516645888 Date: 2022.03.17 14:13:48 -04'00'
Erin K. Cziraki	Chief Survey Technician	03/18/2022	CZIRAKI.ERIN.KAYE.1550015338 Digitally signed by CZIRAKI.ERIN.KAYE.1550015338 Date: 2022.03.17 16:03:18 Z
Audrey E. Jerauld	Senior Survey Technician	03/18/2022	JERAULD.AUDREY.ELIZABETH.1170496260 2022.03.17 11:18:52 -04'00'

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