H13473

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

DESCRIPTIVE REPORT

Type of Survey:	Navigable Area
Registry Number:	H13473

LOCALITY

State(s):	Wisconsin
General Locality:	Green Bay, WI
Sub-locality:	West of Little Sturgeon Bay

2021

CHIEF OF PARTY
David Neff, C.H.

LIBRARY & ARCHIVES

Date:

U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	REGISTRY NUMBER:
HYDROGRAPHIC TITLE SHEET	**H13473**

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:	**Green Bay, WI**
Sub-Locality:	**West of Little Sturgeon Bay**
Scale:	**10000**
Dates of Survey:	**06/04/2021 to 09/02/2021**
Instructions Dated:	**04/26/2021**
Project Number:	**OPR-Y390-KR-21**
Field Unit:	**eTrac**
Chief of Party:	**David Neff, C.H.**
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:

All times are UTC. The purpose of this survey is to update existing NOS nautical charts. H13473 covers approximately 46 square nautical miles West of Little Sturgeon Bay, Wisconsin.

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, Low Water Datum 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 H13473

Project: OPR-Y390-KR-21

Locality: Green Bay, WI

Sublocality: West of Little Sturgeon Bay

Scale: 1:10000

June 2021 - September 2021

eTrac

Chief of Party: David Neff, C.H.

A. Area Surveyed

eTrac Inc. conducted hydrographic survey operations West of Little Sturgeon Bay, Wisconsin. H13473 covers approximately 46 square nautical miles of survey area. 1498 linear nautical miles were acquired during the survey.

Survey was conducted within these limits between June 04, 2021 (DN155) and September 02, 2021 (DN245).

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
45° 0' 17.9" N 87° 31' 29.46" W	44° 49' 53.35" N 87° 33' 10.14" W

Table 1: Survey Limits

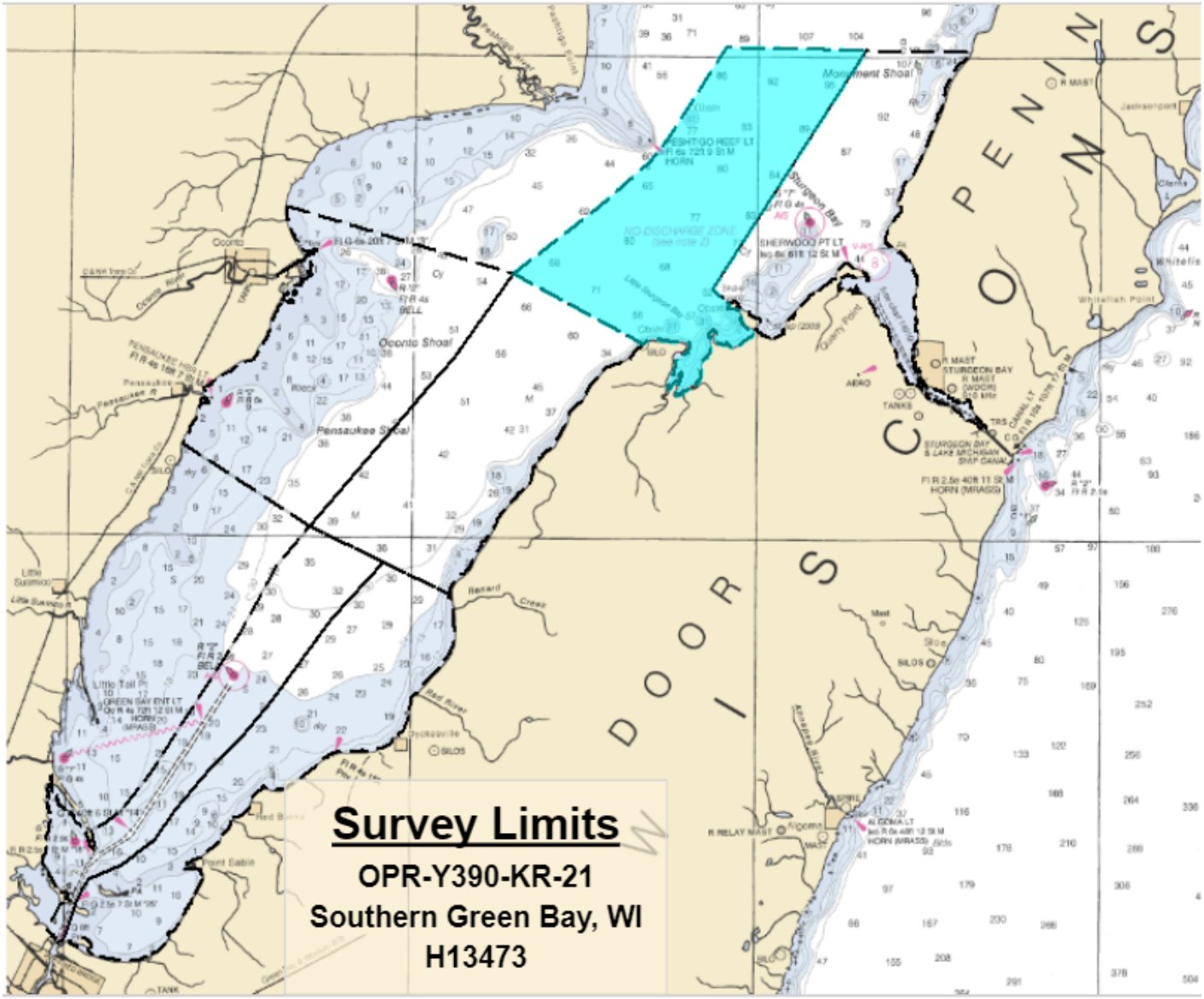

Figure 1: Survey Limits Overview (light blue area)

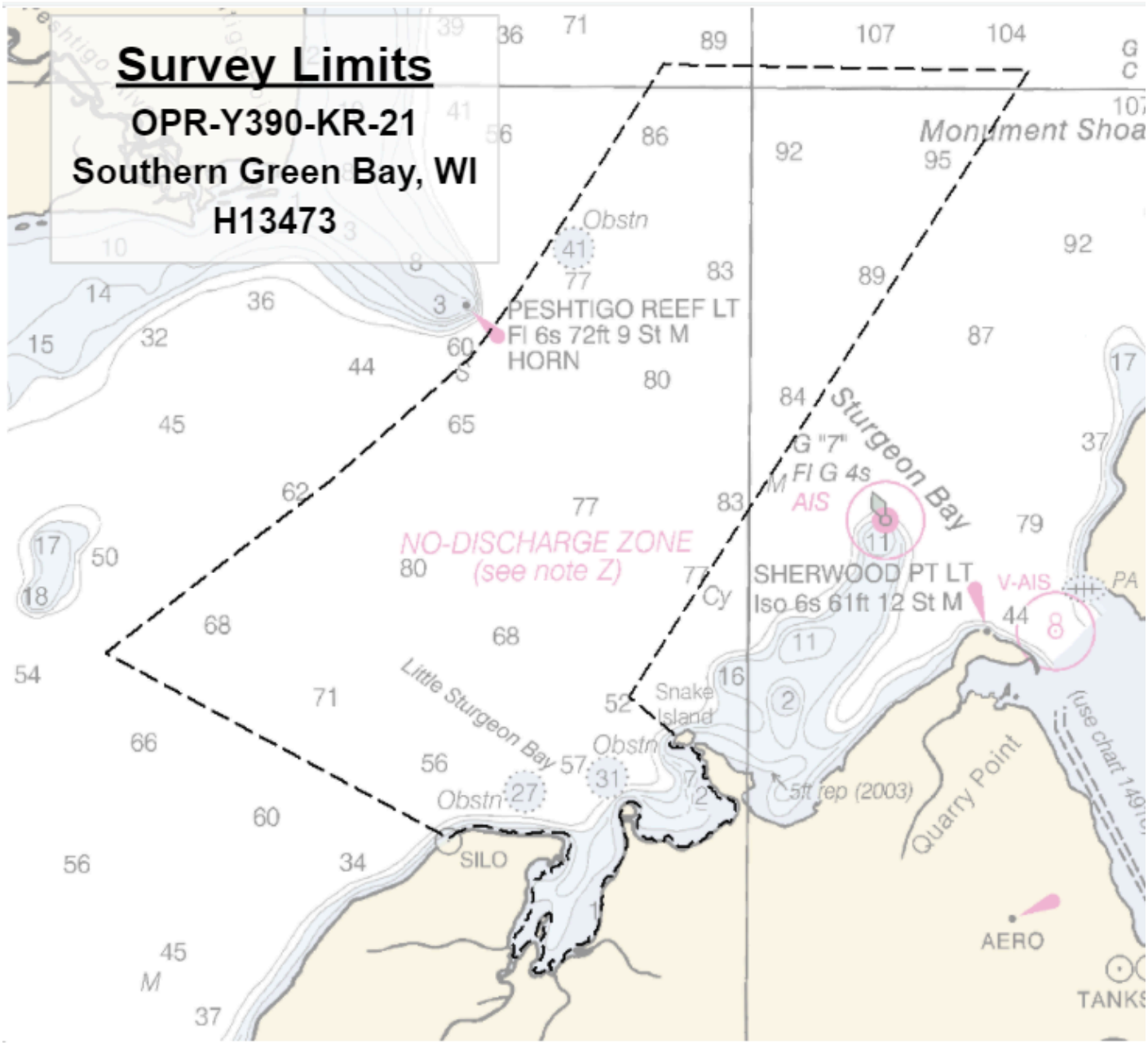

Figure 2: Survey Limits (black line)

All data were acquired in accordance with the requirements in the Project Instructions and specifications set forth in the Hydrographic Survey Specifications and Deliverables 2021 Edition (HSSD 2021).

A.2 Survey Purpose

The purpose of this survey is to update existing National Ocean Service (NOS) nautical charts.

A.3 Survey Quality

The entire survey is adequate to supersede previous data.

Survey H13473 is accurate to International Hydrographic Organization (IHO) Order 1a as required per the HSSD 2021.

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 8370 LNM. Transit mileage, system calibration mileage and data which do not meet HSSD specifications shall not count towards the completion of the LNM requiremnt. Notify the COR/ Project Manager upon nearing completion of LNM requirement. The final survey area shall be squared off and ensure the full investigation of any features within the surveyed extent.
Sheets 1, 4, 6, and 7	Complete Coverage

Table 2: Survey Coverage

Survey coverage was in accordance with the requirements listed above and in the HSSD. Note: Survey coverage did not extend to the entire assigned survey boundary as the Navigable Area Limit Line (NALL) was reached.

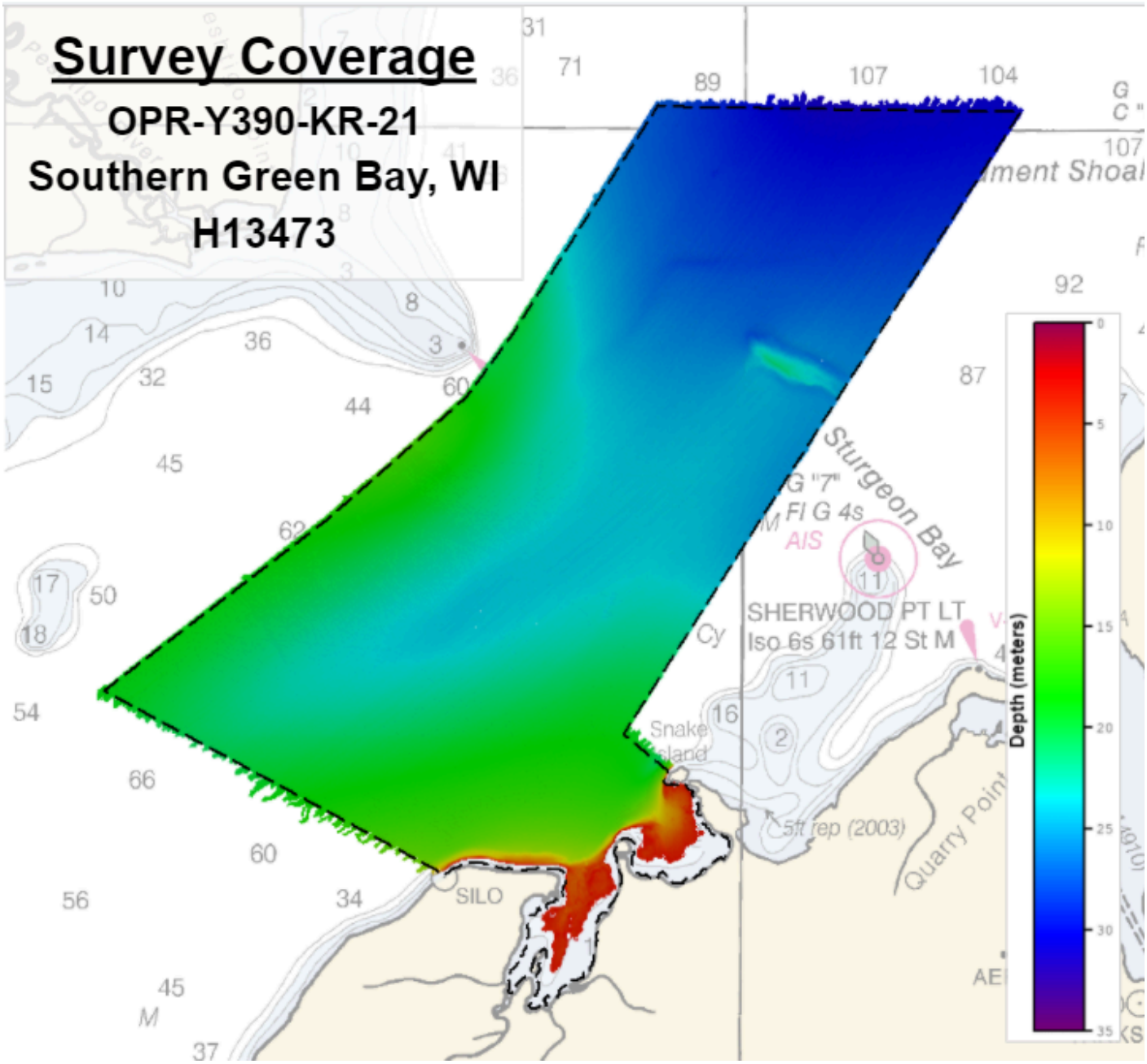

Figure 3: Survey Coverage

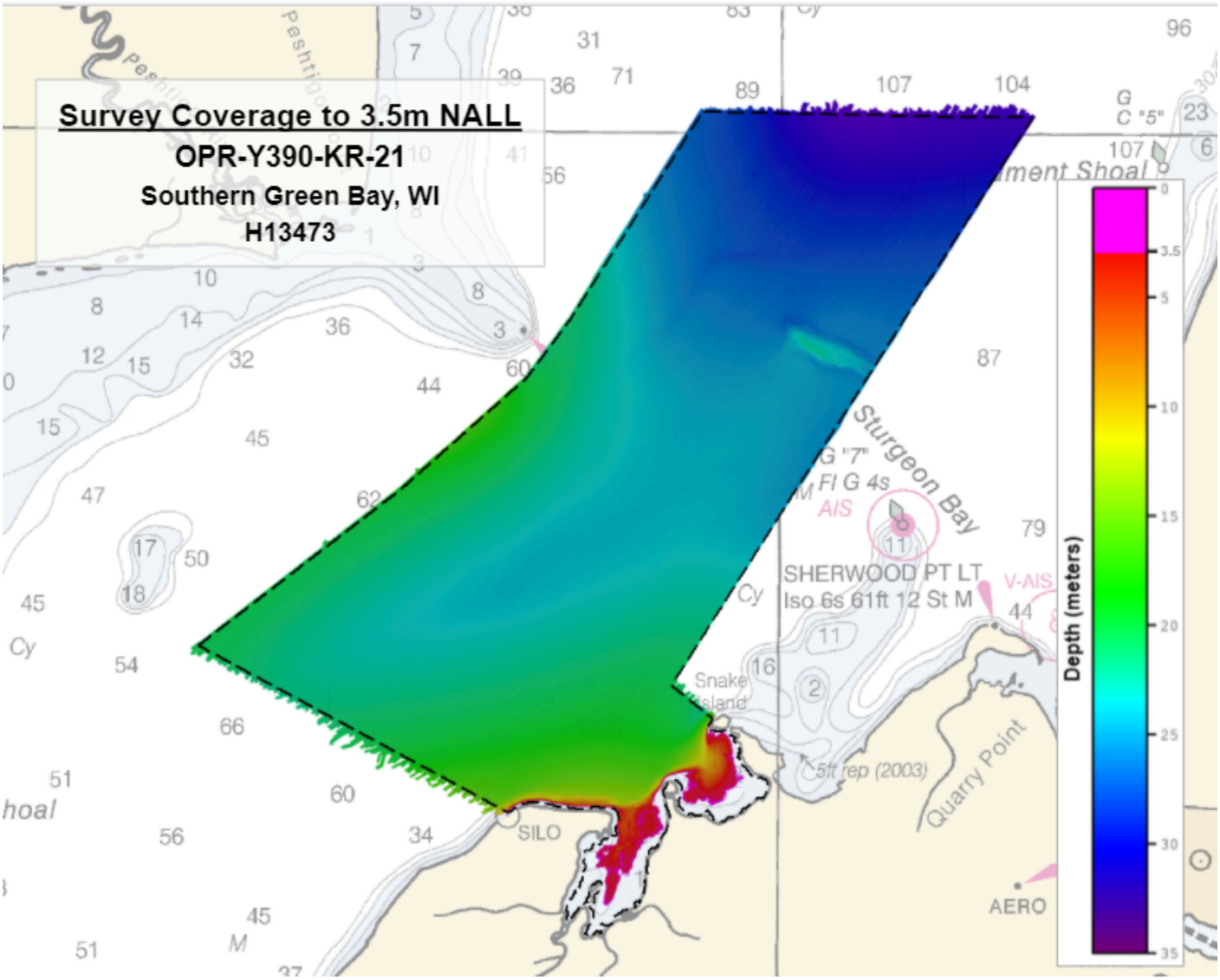

Figure 4: Survey Coverage with 3.5m NALL displayed

A.6 Survey Statistics

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

	HULL ID	*R/V Endeavor*	*R/V Rapid*	*R/V Voxel*	*Total*
LNM	**SBES Mainscheme**	0	0	0	0
	MBES Mainscheme	637.27	286.89	513.17	1437
	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	33.99	26.54	513.17	61
	Lidar Crosslines	0	0	0	0
Number of Bottom Samples					10
Number Maritime Boundary Points Investigated					0
Number of DPs					0
Number of Items Investigated by Dive Ops					0
Total SNM					0

Table 3: Hydrographic Survey Statistics

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

Survey Dates	Day of the Year
06/04/2021	155

Survey Dates	Day of the Year
07/17/2021	198
07/18/2021	199
07/19/2021	200
07/20/2021	201
07/22/2021	203
07/23/2021	204
07/24/2021	205
07/25/2021	206
08/06/2021	218
08/07/2021	219
08/08/2021	220
08/09/2021	221
08/10/2021	222
08/13/2021	225
08/14/2021	226
08/15/2021	227
08/16/2021	228
08/17/2021	229
08/18/2021	230
08/19/2021	231
08/20/2021	232
09/02/2021	245

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	*R/V Endeavor*	*R/V Rapid*	*R/V Voxel*
LOA	13.4 meters	8.5 meters	14.0 meters
Draft	0.8 meters	0.6 meters	0.6 meters

Table 5: Vessels Used

The R/V Endeavor is a 13.4 meter aluminum catamaran equipped with an over-the-side Pitman Arm with secondary tie point.

The R/V Rapid is a 8.5 meter aluminum monohull equipped with both a Universal Sonar Mount (USM) starboard and port multibeam pole mount.

The R/V Voxel is a 14.0 meter aluminum catamaran equipped with an electro hydraulic actuated moonpool accessed adjustable aluminum and stainless steel custom mount.

B.1.2 Equipment

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

Manufacturer	Model	Type
R2Sonic	2024	MBES
Applanix	POS MV 320 v5	Positioning and Attitude System
R2Sonic	I2NS	Positioning and Attitude System
AML Oceanographic	SmartX	Sound Speed System
AML Oceanographic	BaseX2	Sound Speed System
AML Oceanographic	MicroX SV	Sound Speed System
AML Oceanographic	MVP-X	Sound Speed System

Table 6: Major Systems Used

Note: R/V Endeavor utilized a dual head R2Sonic 2024 multibeam echosounder system, an AML Micro.X for the surface sound speed system, an AML/eTrac MVP-X for the sound speed system, an AML Base.X2 as a spare for the sound speed system, and a POS MV 320 V5 for the positioning and attitude system.

R/V Rapid utilized a dual head R2Sonic 2024 multibeam echosounder system, an AML Micro.X for the surface sound speed system, an AML Base.X2 for the sound speed system, and a R2Sonic I2NS for the positioning and attitude system.

R/V Voxel utilized a single head R2Sonic 2024 multibeam echosounder system, an AML Micro.X for the surface sound speed system, an AML Smart.X for the sound speed system, and a POS MV 320 V5 for the positioning and attitude system.

B.2 Quality Control

B.2.1 Crosslines

A beam-to-beam statistical analysis was performed using the Cross Check tool in Qimera. 1 meter Combined Uncertainty and Bathymetric Estimator (CUBE) weighted dynamic surfaces were created incorporating only the mainscheme lines and excluded crosslines. The Cross Check tool was used to perform the beam-by-beam comparison of the crossline data to the mainscheme surface. Comparisons showed excellent agreement, well above 95% of the allowable TVU.

Below is a histogram of the crossline comparison statistics showing IHO Order 1a compliance per beam.

Note: A 1m sheetwide surface was unable to be created due to technical issues within Qimera, therefore the surface was divided into multiple parts. These surfaces were created for QC only and are not submitted as a surface deliverable.

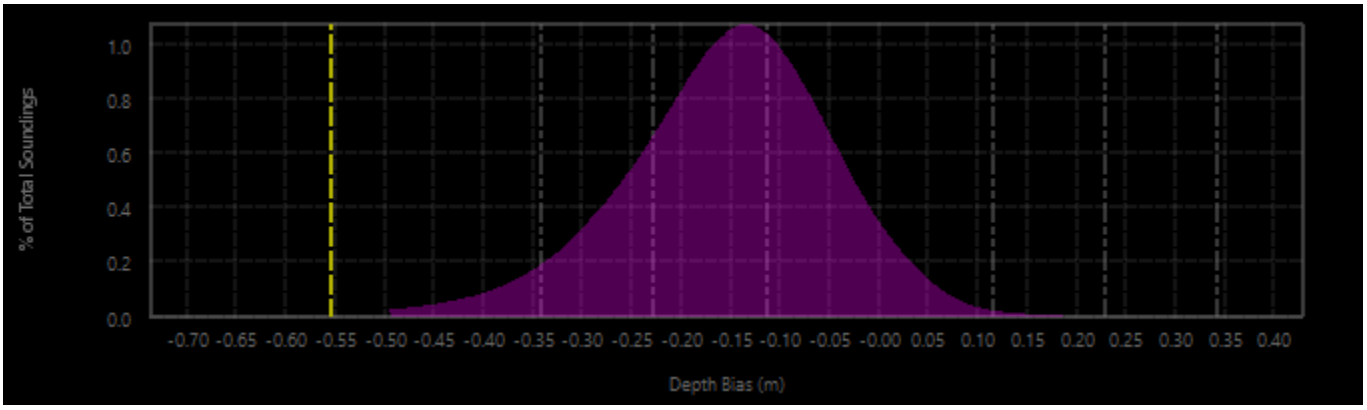

Figure 5: H13473 1m Surface Crossline Comparison (1 of 3)

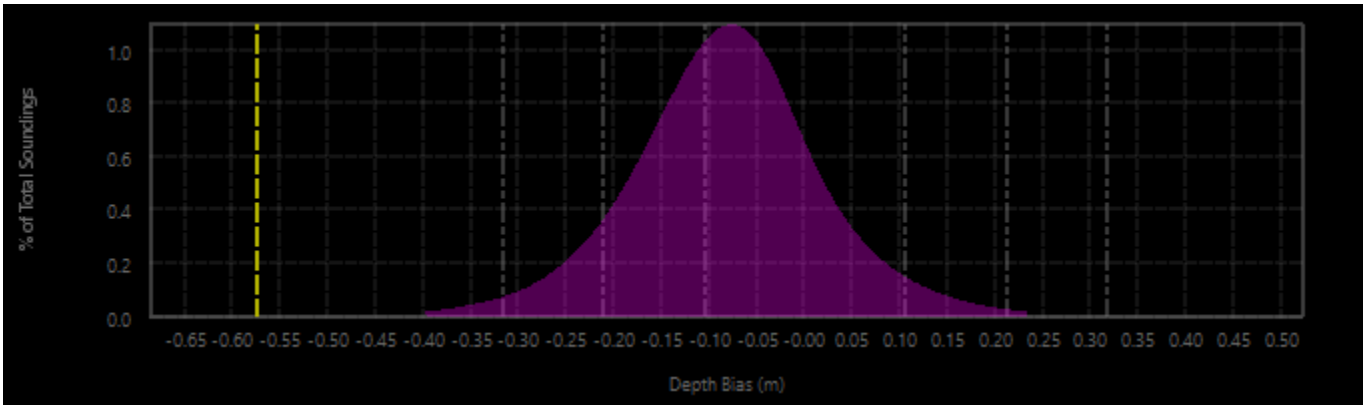

Figure 6: H13473 1m Surface Crossline Comparison (2 of 3)

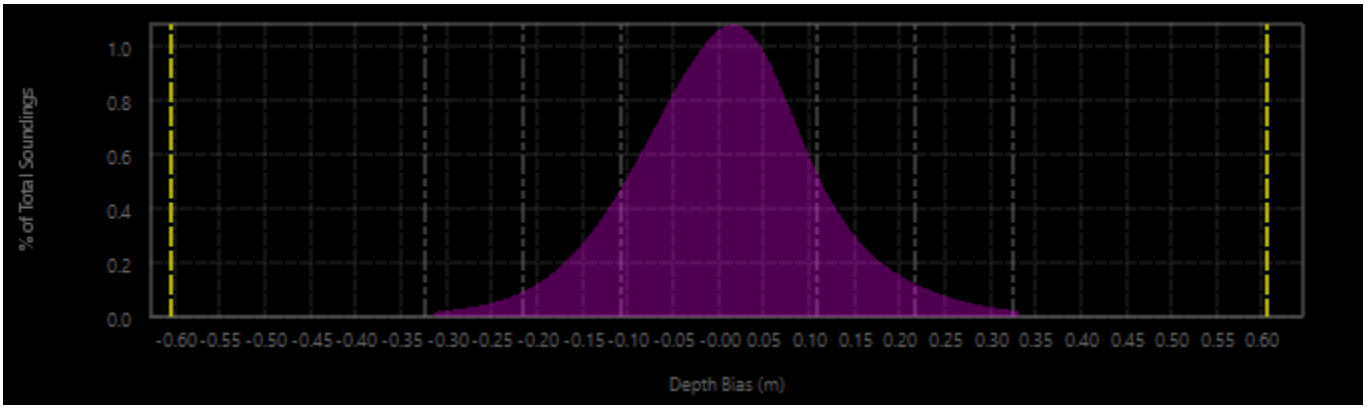

Figure 7: H13473 1m Surface Crossline Comparison (3 of 3)

B.2.2 Uncertainty

The following survey specific parameters were used for this survey:

Method	Measured	Zoning
ERS via ERTDM	0.045 meters	N/A

Table 7: Survey Specific Tide TPU Values.

Hull ID	Measured - CTD	Measured - MVP	Measured - XBT	Surface
R/V Endeavor	0.05 meters/second	N/A	N/A	0.2 meters/second
R/V Rapid	0.05 meters/second	N/A	N/A	0.2 meters/second
R/V Voxel	0.05 meters/second	N/A	N/A	0.2 meters/second

Table 8: Survey Specific Sound Speed TPU Values.

Standard deviation and uncertainty layers of the Dynamic Surface were utilized during data processing to search for features, water column noise, and systematic errors.

IHO Order 1a uncertainty specification was met by 99.5+% to 100% of the nodes.

The uncertainty of each finalized Bathymetric Attributed Grid (BAG) was generated through the NOAA QC Tools and an image of the results is located below.

For H13473 the following percentages represent the results of the TPU calculation:

Complete Coverage MBES (Finalized 1m (1 of 3) CUBE weighted Dynamic Surface in NOAA QC Tools) = 100% of nodes are within the allowable TVU.

Complete Coverage MBES (Finalized 1m (2 of 3) CUBE weighted Dynamic Surface in NOAA QC Tools) = 99.5+% of nodes are within the allowable TVU.

Complete Coverage MBES (Finalized 1m (3 of 3) CUBE weighted Dynamic Surface in NOAA QC Tools) = 100% of nodes are within the allowable TVU.

Complete Coverage MBES (Finalized 2m (1 of 3) CUBE weighted Dynamic Surface in NOAA QC Tools) = 100% of nodes are within the allowable TVU.

Complete Coverage MBES (Finalized 2m (2 of 3) CUBE weighted Dynamic Surface in NOAA QC Tools) = 100% of nodes are within the allowable TVU.

Complete Coverage MBES (Finalized 2m (3 of 3) CUBE weighted Dynamic Surface in NOAA QC Tools) = 99.5+% of nodes are within the allowable TVU.

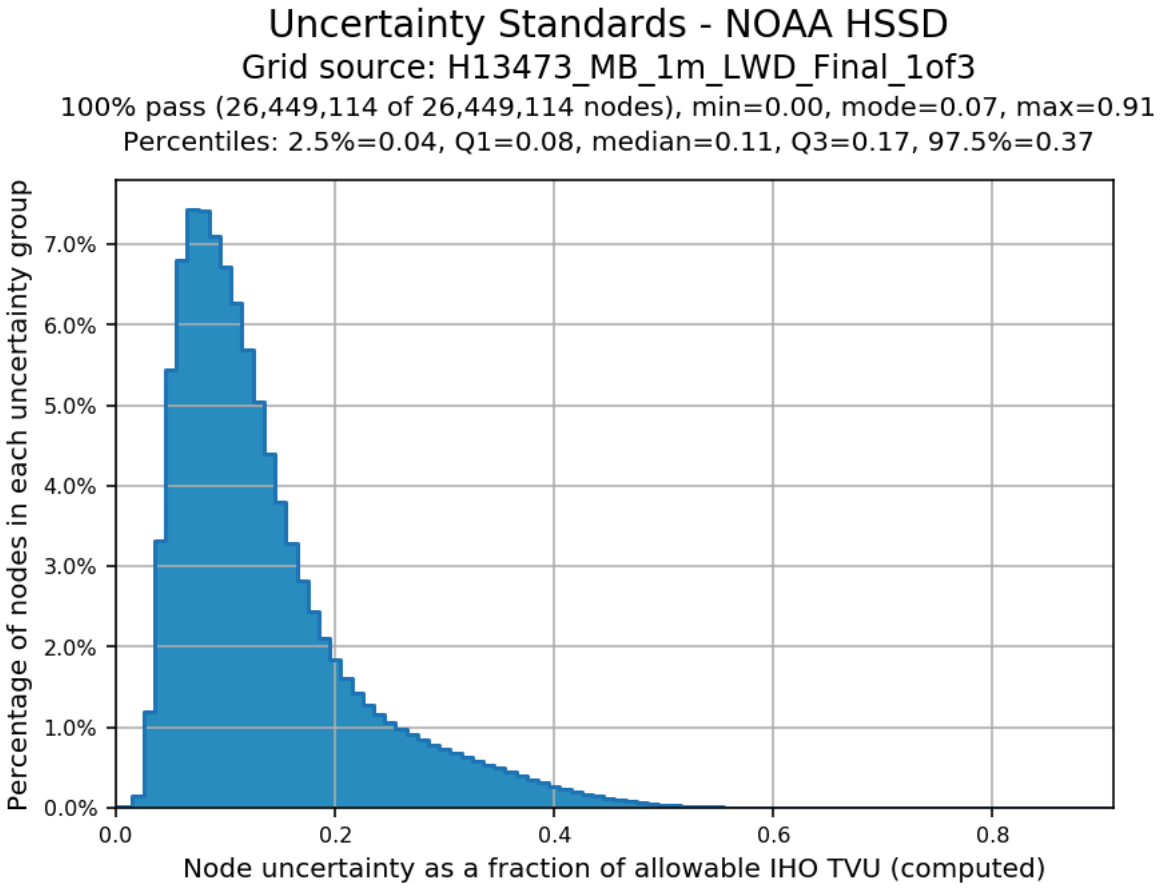

Figure 8: H13473 Finalized 1m Complete Coverage MBES TVU Statistics (1 of 3)

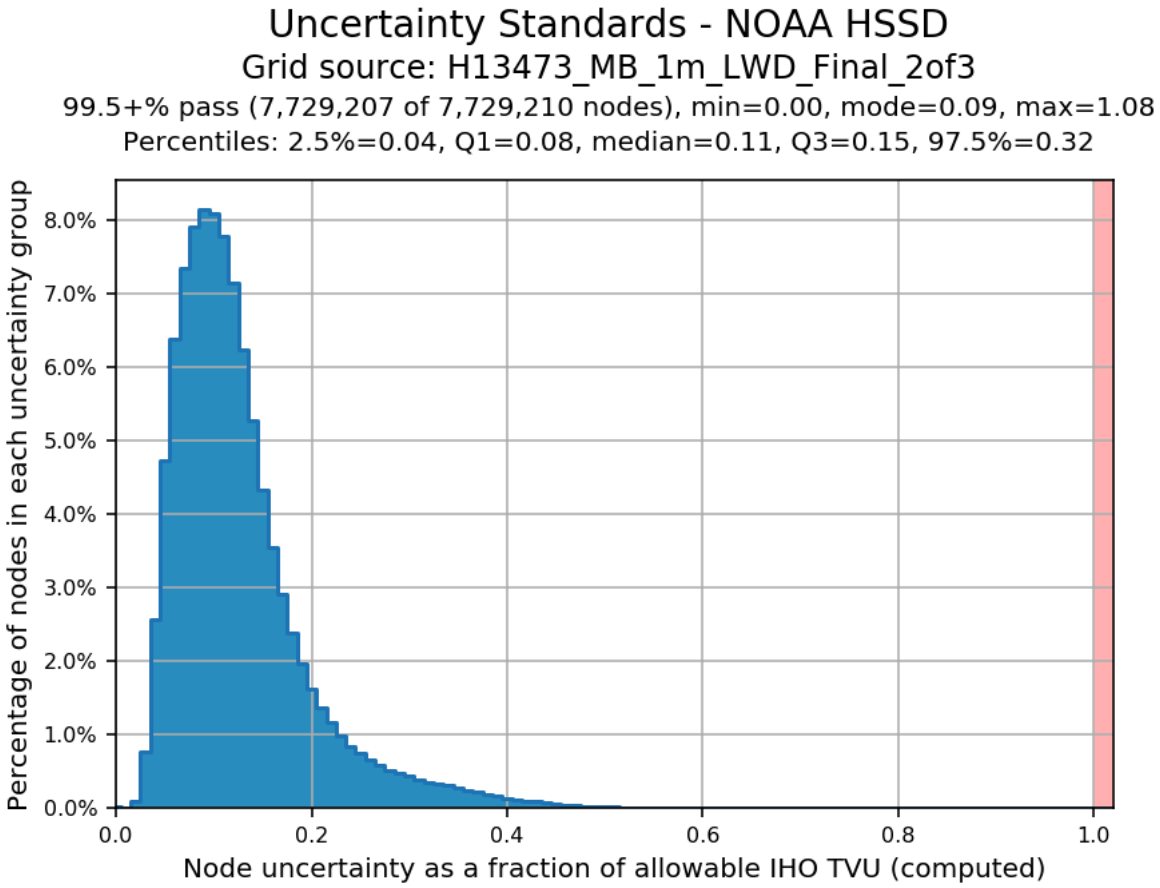

Figure 9: H13473 Finalized 1m Complete Coverage MBES TVU Statistics (2 of 3)

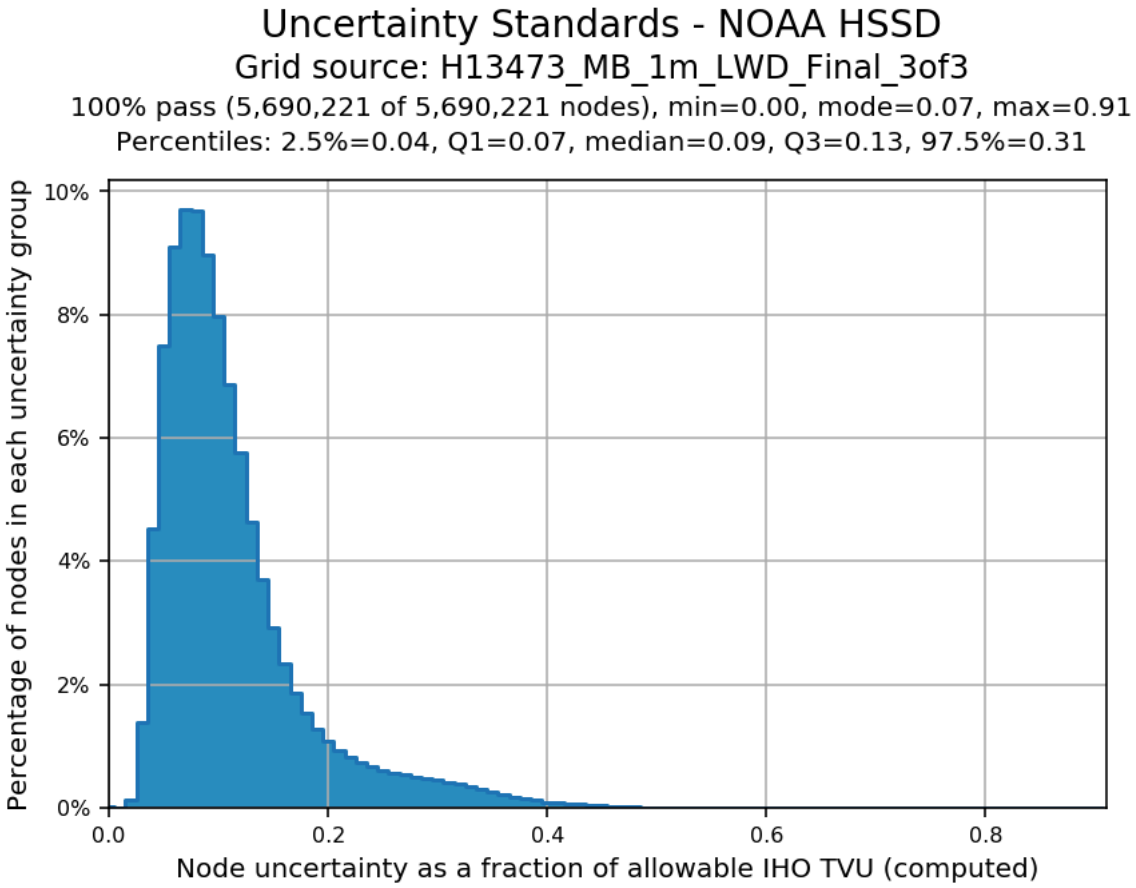

Figure 10: H13473 Finalized 1m Complete Coverage MBES TVU Statistics (3 of 3)

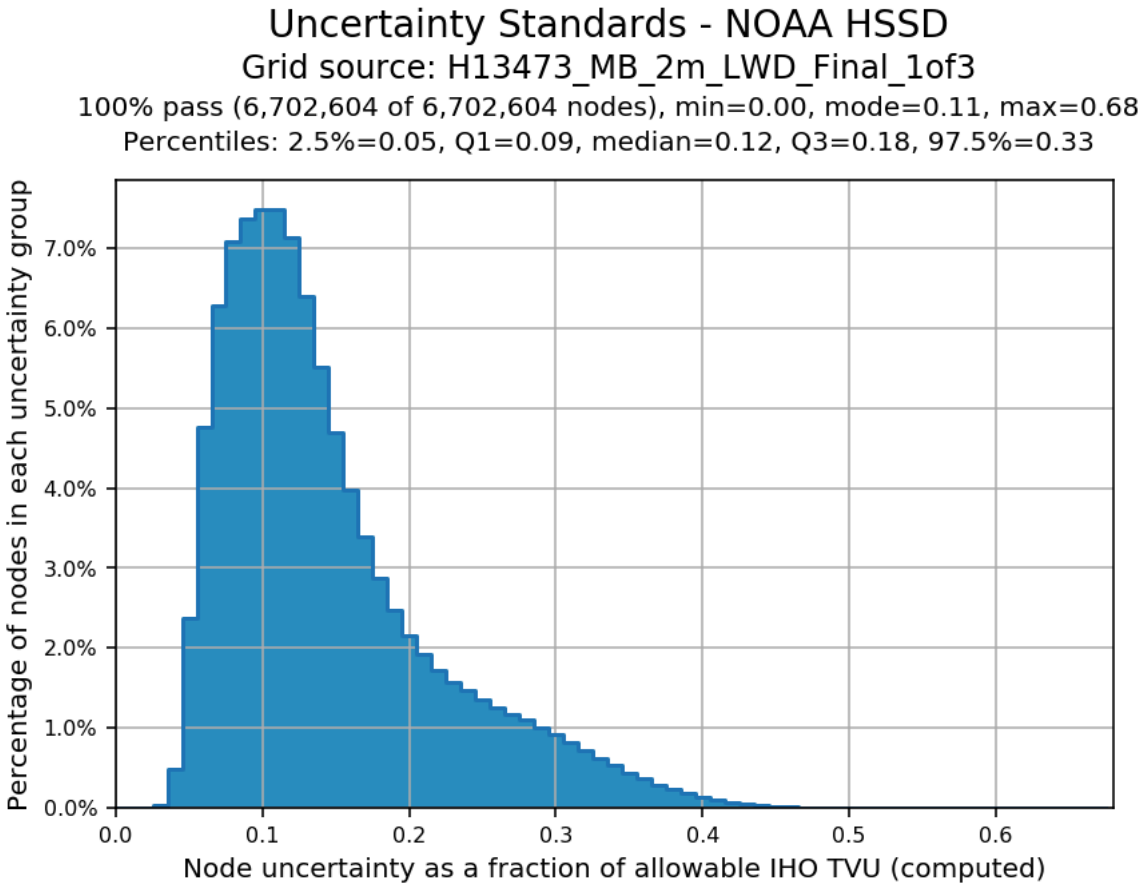

Figure 11: H13473 Finalized 2m Complete Coverage MBES TVU Statistics (1 of 3)

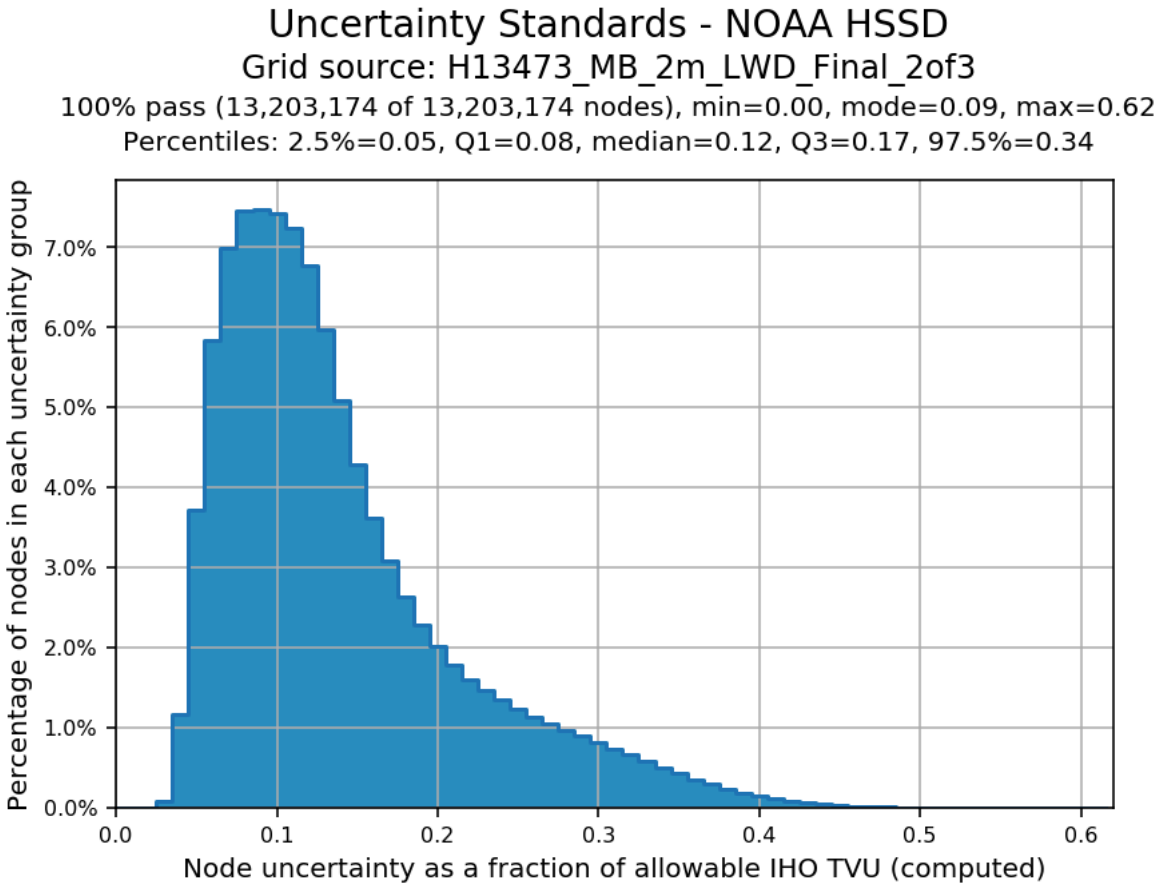

Figure 12: H13473 Finalized 2m Complete Coverage MBES TVU Statistics (2 of 3)

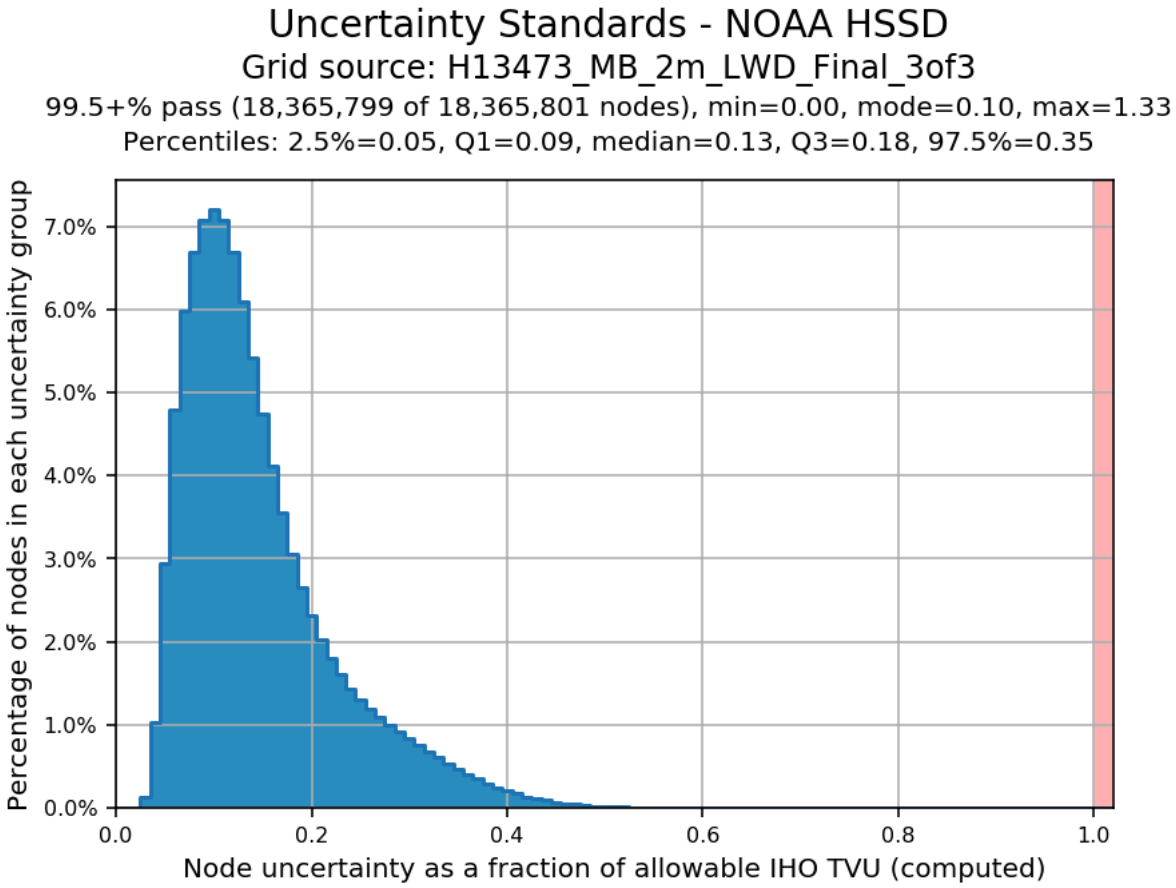

Figure 13: H13473 Finalized 2m Complete Coverage MBES TVU Statistics (3 of 3)

Survey specific sound speed TPU values reported in Table 8 are inconsistent with those applied to the processed sounding data. Both measured and surface sound speed uncertainty vary from 0.03 to 0.05 m/ sec.

The Qimera-exported BAG uncertainty values originate solely from the standard deviation of the soundings that contributed to each CUBE hypothesis, scaled to the 95% confidence interval, and do not use total propagated vertical uncertainty estimates in this calculation.

B.2.3 Junctions

Depth differences between junctioning surveys were evaluated using the JunctionTrac program, developed in-house by eTrac Inc. For each junction, each CUBE weighted dynamic surface's nodes were exported to an ASCII CSV file where the fields were (Easting, Northing, Depth) for each node. A 1 meter difference surface between the junctioning datasets was also created and exported to an ASCII CSV file where the fields were (Easting, Northing, Diff) for each node. The three ASCII CSV files were then loaded into the

JunctionTrac program and junction statistics were computed. A file was also created in this process to locate any nodes from the difference surface that exceed the allowable TVU, which was imported into Qimera and any identified points from JunctionTrac were analyzed. Note: the difference surfaces were created for comparison efforts only and are not submitted as surface deliverables.

The following junctions were made with this survey:

Registry Number	Scale	Year	Field Unit	Relative Location
H13470	1:20000	2021	eTrac	S
H13472	1:10000	2021	eTrac	E

Table 9: Junctioning Surveys

H13470

The junction comparison was performed using all overlapping data between H13473 and H13470. Below is a histogram of junction comparison statistics showing the difference between the junctioning surfaces and allowable TVU as well as difference statistics. 99.9958% of nodes were within allowable TVU.
Note: The spikes of high surface to surface difference in the image are due to overlapping data on features. The features were fully developed and addressed in H13470 and are all within the boundary limits of H13470.

Criteria	Number of Nodes	Resulting %
DIFF < 10cm	2.30588E+6	77.79%
10cm < DIFF < 20cm	565296	19.07%
20cm < DIFF < 30cm	83278	2.81%
DIFF > 30cm	9947	0.34%
Total	2.9644E+6	100.00%

Figure 14: H13473 - H13470 Difference Statistics

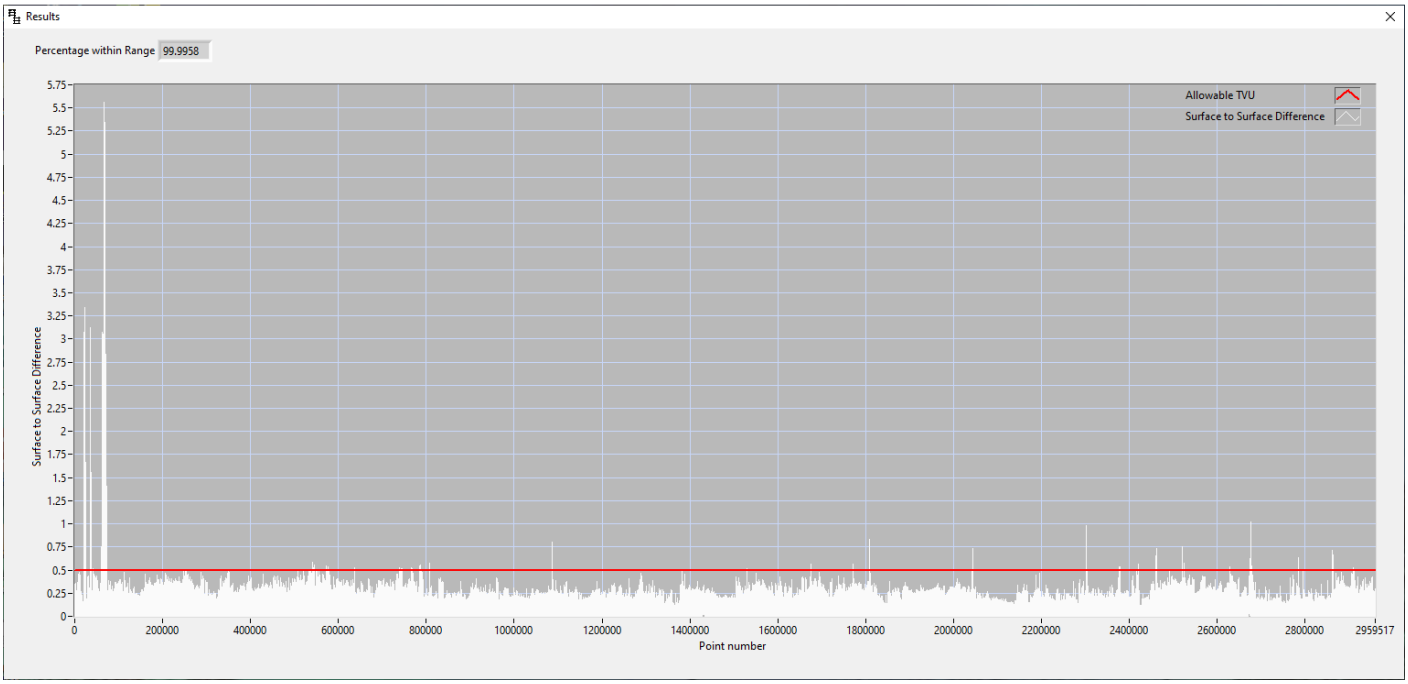

Figure 15: H13473 - H13470 Junction Comparison

H13472

The junction comparison was performed using all overlapping data between H13472 and H13473. Below is a histogram of junction comparison statistics showing the difference between the junctioning surfaces and allowable TVU as well as difference statistics. 99.9951% of nodes were within allowable TVU.
Note: The spikes of high surface to surface difference in the image are due to overlapping data on natural features (i.e. rocks and sediment).

Criteria	Number of Nodes	Resulting %
DIFF < 10cm	1.36383E+6	73.58%
10cm < DIFF < 20cm	454086	24.50%
20cm < DIFF < 30cm	31728	1.71%
DIFF > 30cm	3912	0.21%
Total	1.85356E+6	100.00%

Figure 16: H13473 - H13472 Difference Statistics

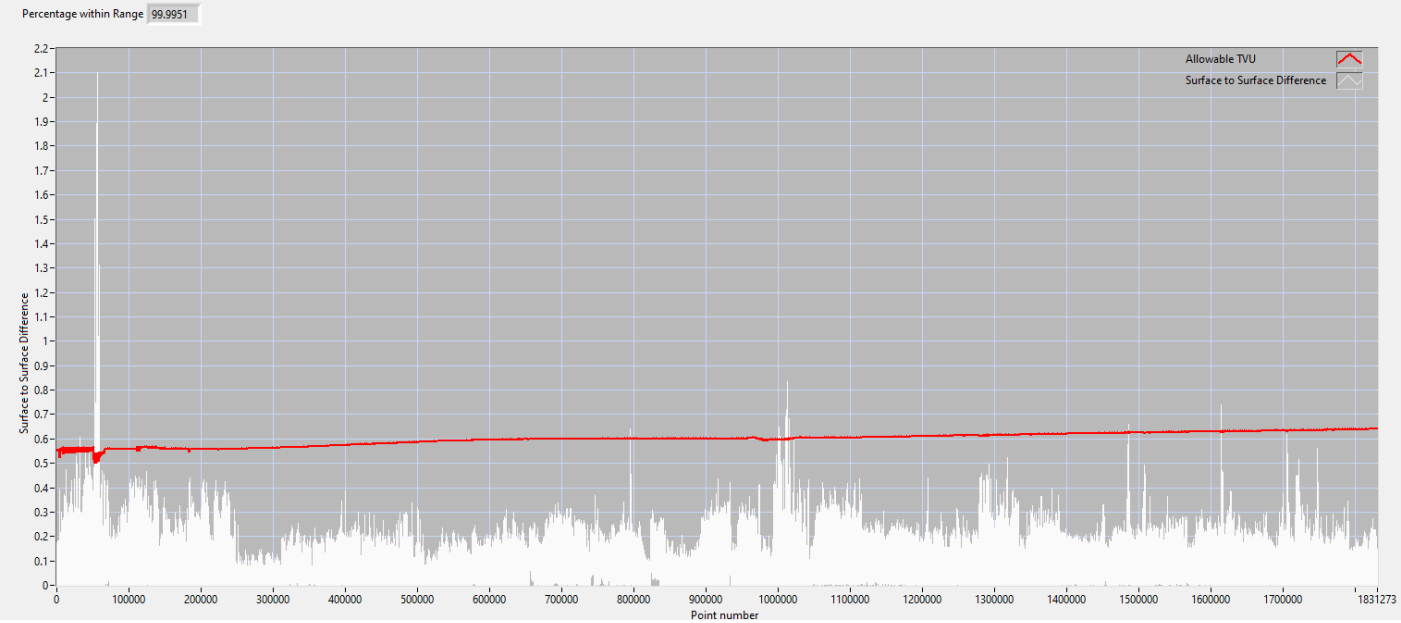

Figure 17: H13473 - H13472 Junction Comparison

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

There were no other factors that affected corrections to soundings.

B.2.7 Sound Speed Methods

Sound Speed Cast Frequency: SVP casts were generally taken every 2 hours. Occasionally casts would exceed a 2 hour frequency, however would never exceed a 4 hour frequency.

On R/V Endeavor, R/V Rapid, and R/V Voxel casts were applied in QPS Qinsy acquisition software at the time of the cast. Surface SVP measured at 1Hz was compared to surface speed from the current profile in real-time. If the surface velocity comparison was in excess of 2m/s at any time during survey operations, a new cast was taken.

Surface sound speeds were compared in real-time and profile to profile for each cast on the vessel. Additionally, the processor reviewed profiles in Qimera to remove spurious readings within a cast, compare day-to-day casts, and to check distribution over the surveyed area, in order to better understand trends for efficient acquisition planning.

B.2.8 Coverage Equipment and Methods

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

B.2.9 Data Density Evaluation

In order to determine if the density of the data met the specified 5 soundings per node, data density was evaluated using DensityTrac in the AmiTrac program, developed in-house by eTrac. Each finalized CUBE weighted dynamic surface's nodes were exported to a BBH file. The BBH file was then loaded into the DensityTrac program and density statistics were computed.

For H13473 the following percentages represent the results of the density query:

Complete Coverage MBES (Finalized 1m (1 of 3) CUBE weighted Dynamic Surface) =99.9388% of nodes are composed from at least 5 soundings.

Complete Coverage MBES (Finalized 1m (2 of 3) CUBE weighted Dynamic Surface) =99.9266% of nodes are composed from at least 5 soundings.

Complete Coverage MBES (Finalized 1m (3 of 3)CUBE weighted Dynamic Surface) =99.9614% of nodes are composed from at least 5 soundings.

Complete Coverage MBES (Finalized 2m (1 of 3) CUBE weighted Dynamic Surface) =99.9751% of nodes are composed from at least 5 soundings.

Complete Coverage MBES (Finalized 2m (2 of 3) CUBE weighted Dynamic Surface) =99.9881% of nodes are composed from at least 5 soundings.

Complete Coverage MBES (Finalized 2m (3 of 3) CUBE weighted Dynamic Surface) =99.9784% of nodes are composed from at least 5 soundings.

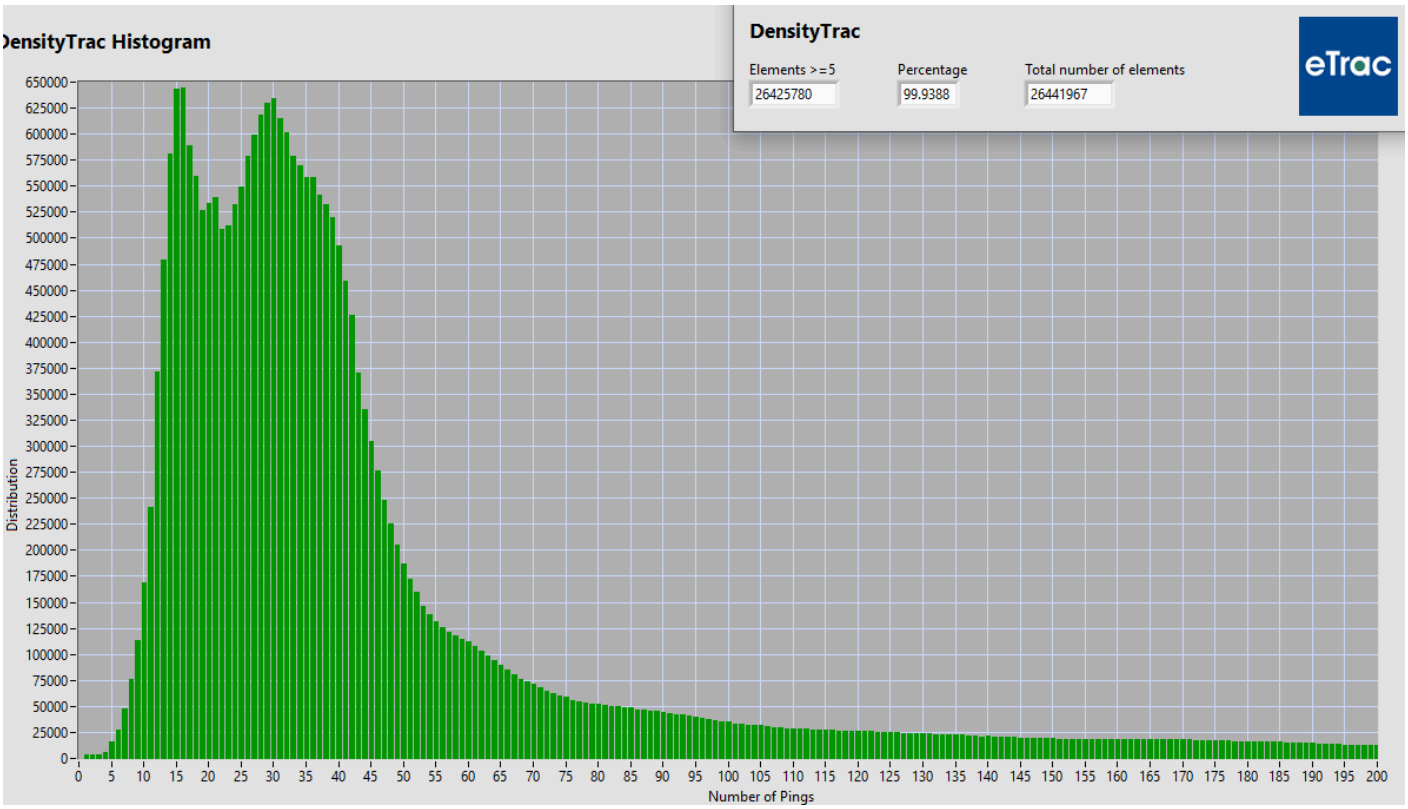

Figure 18: H13473 Finalized 1m (1 of 3) Complete Coverage MBES Density Distribution

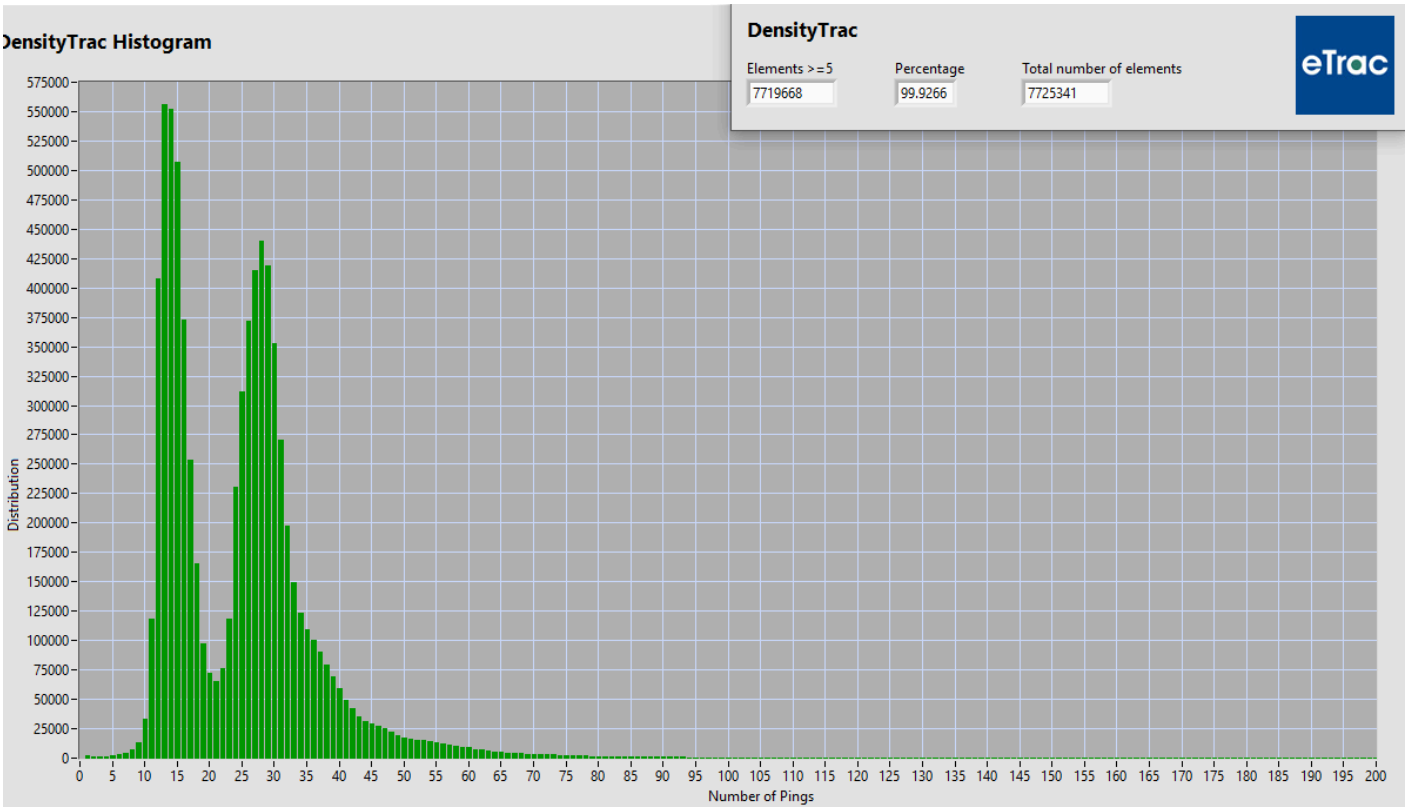

Figure 19: H13473 Finalized 1m (2 of 2) Complete Coverage MBES Density Distribution

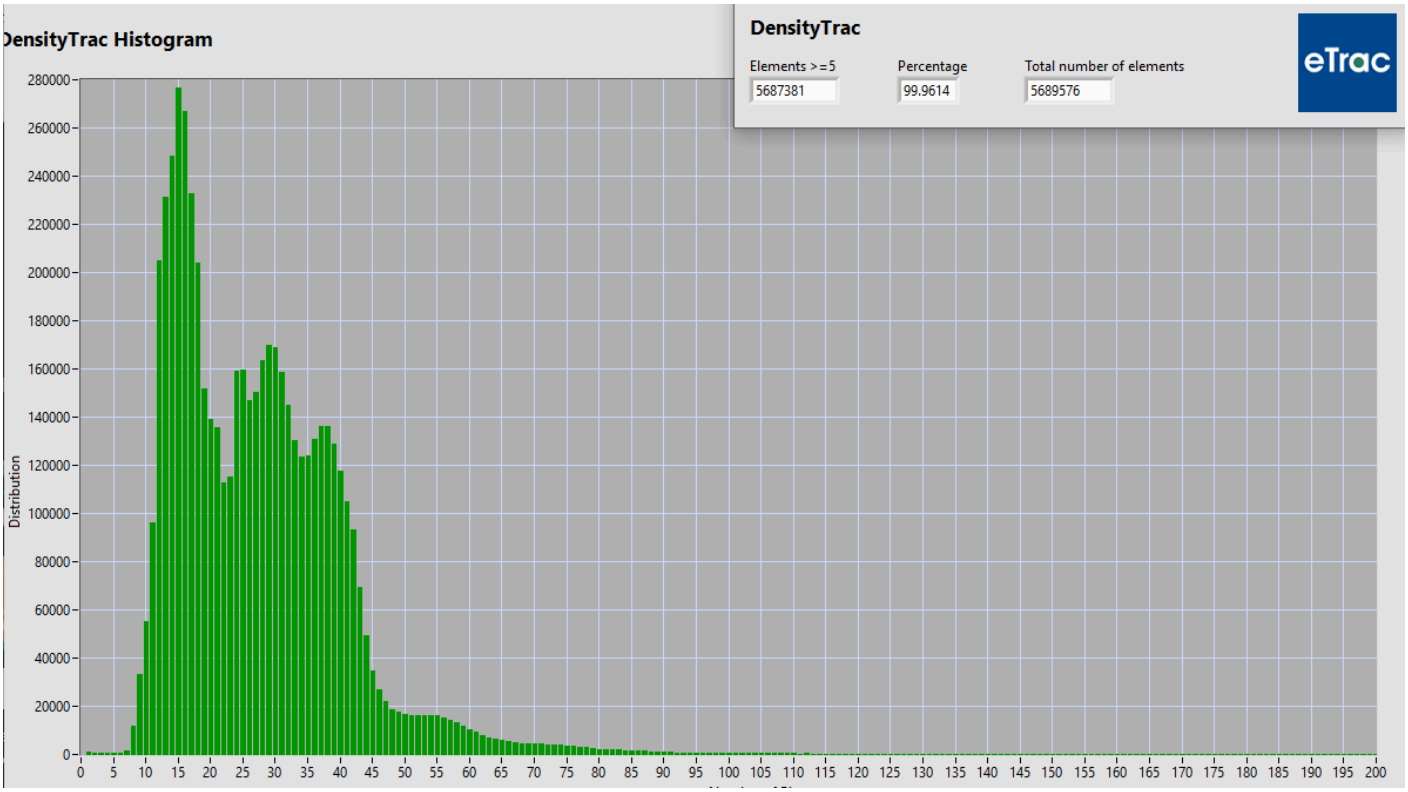

Figure 20: H13473 Finalized 1m (3 of 3) Complete Coverage MBES Density Distribution

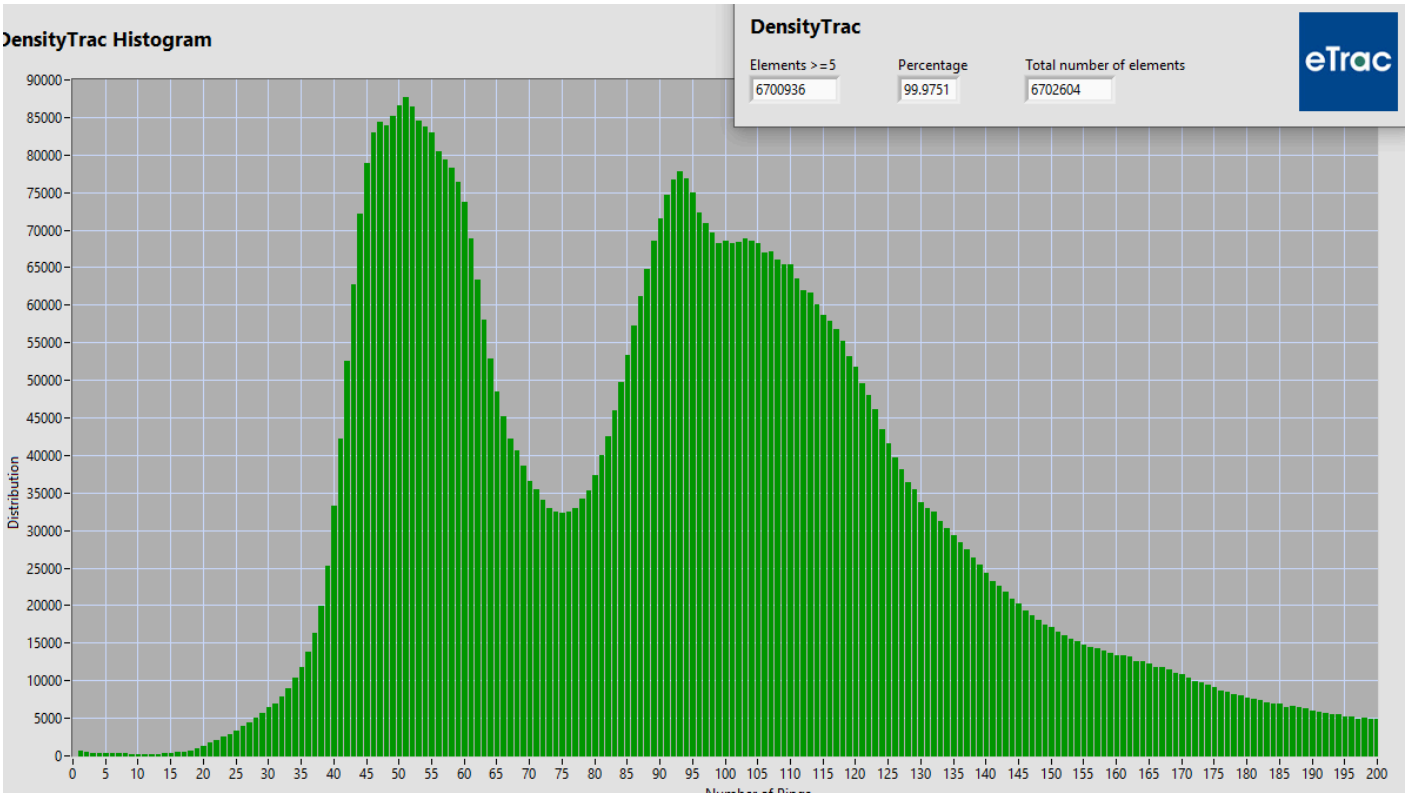

Figure 21: H13473 Finalized 2m (1 of 3) Complete Coverage MBES Density Distribution

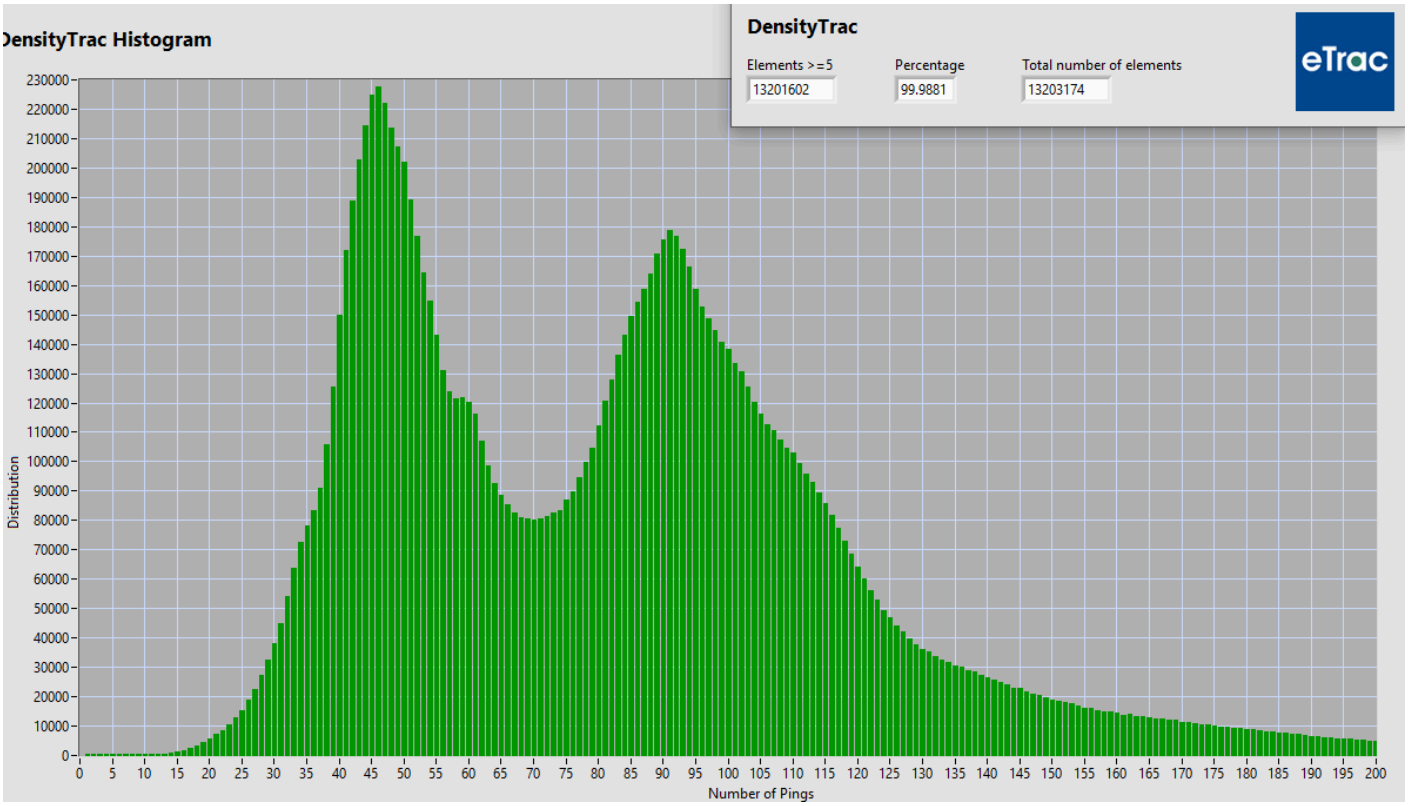

Figure 22: H13473 Finalized 2m (2 of 3) Complete Coverage MBES Density Distribution

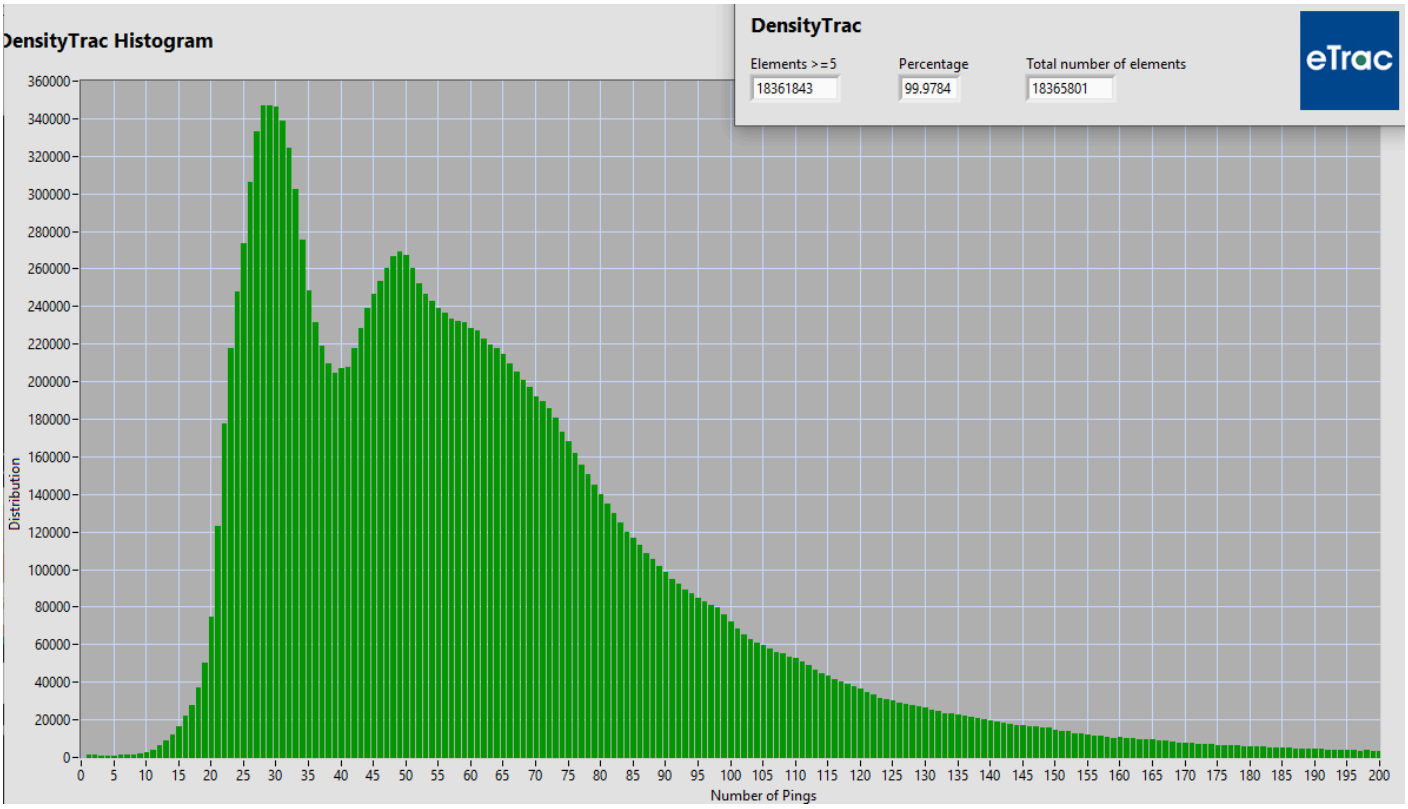

Figure 23: H13473 Finalized 2m (3 of 3) Complete Coverage MBES Density Distribution

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

Backscatter data were collected throughout the survey and are retained in the raw DB files. Every effort was made in the field to collect quality backscatter data while maintaining the primary mandate of high

quality bathymetric data. While no processing or analysis of backscatter was required, eTrac Inc. verified coverage and general quality of the backscatter data collected. A beam intensity window was monitored in Qinsy during acquisition to ensure backscatter data collection. Raw backscatter data were viewed in QPS FMGeocoder to further confirm collection criteria had been met. Shown below is an example of the unprocessed backscatter mosaic from H13473 DN228 (R/V Rapid).

Figure 24: Raw Backscatter from R/V Rapid (DN228)

B.5 Data Processing

B.5.1 Primary Data Processing Software

The following Feature Object Catalog was used: **NOAA Profile Version 2021**

Feature Object Catalog, NOAA Profile Version 2021 was used only in CARIS. Qimera was used as the primary processing software.

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
H13473_MB_1m_LWD_Final_1of3	BAG	1 meters	0.35 meters - 20.00 meters	NOAA_1m	Complete MBES
H13473_MB_1m_LWD_Final_2of3	BAG	1 meters	17.18 meters - 20.00 meters	NOAA_1m	Complete MBES
H13473_MB_1m_LWD_Final_3of3	BAG	1 meters	15.93 meters - 20.00 meters	NOAA_1m	Complete MBES
H13473_MB_2m_LWD_Final_1of3	BAG	2 meters	18.00 meters - 23.79 meters	NOAA_2m	Complete MBES
H13473_MB_2m_LWD_Final_2of3	BAG	2 meters	18.00 meters - 25.80 meters	NOAA_2m	Complete MBES
H13473_MB_2m_LWD_Final_3of3	BAG	2 meters	18.00 meters - 31.81 meters	NOAA_2m	Complete MBES

Table 10: Submitted Surfaces

1m and 2m surfaces are provided meeting complete coverage MBES with backscatter specifications for H13473.

Note: Sheetwide surfaces were unable to be created due to technical issues within Qimera.

Therefore, the 1m and 2m surfaces were divided into 3 parts each. Together the 6 surfaces cover the entirety of the survey area.

1m parent surfaces are also provided in the Surfaces_Mosaics Folder in this delivery drive package.

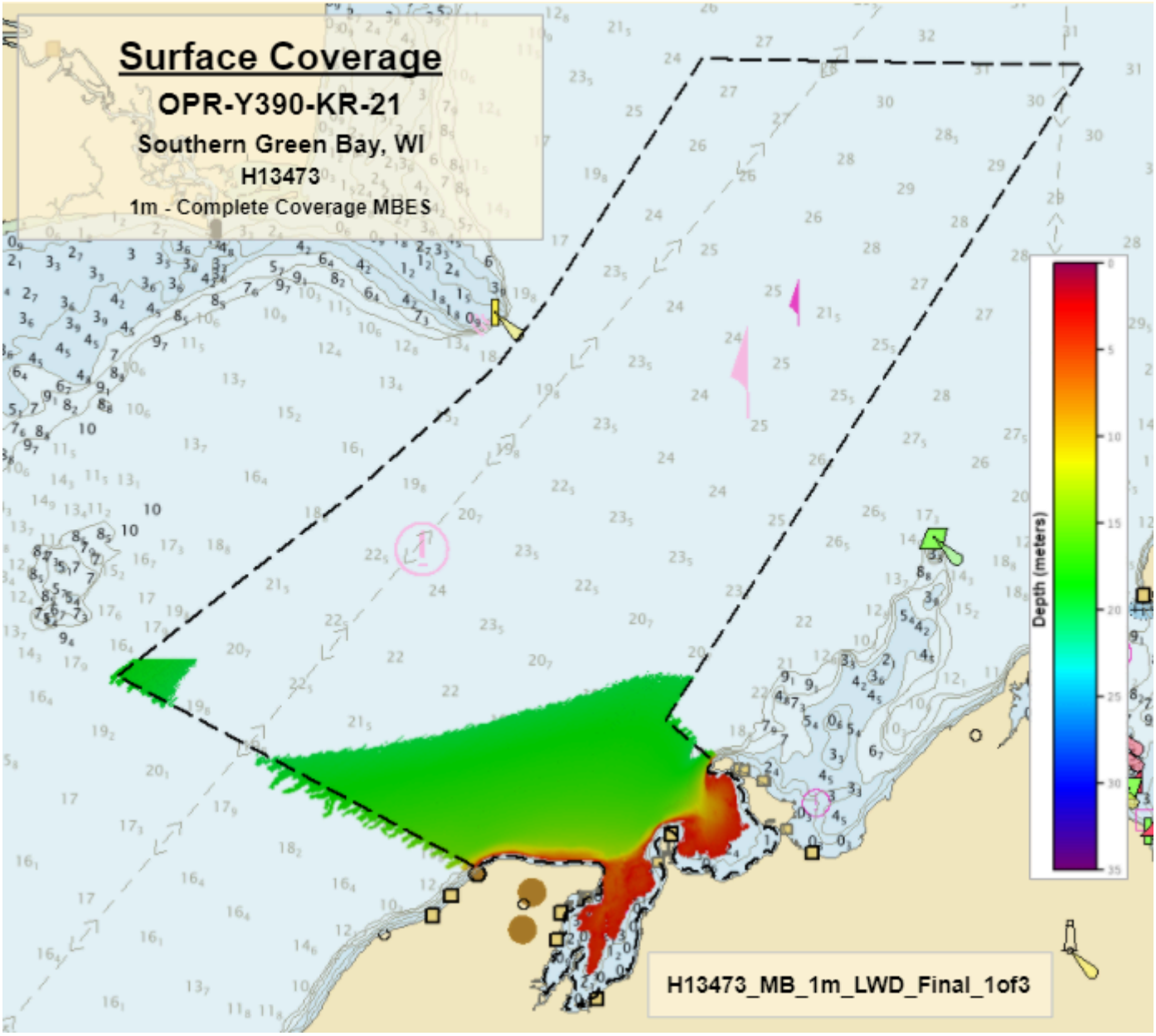

Figure 25: H13473 Finalized 1m CUBE weighted Dynamic Surface Coverage (1 of 3)

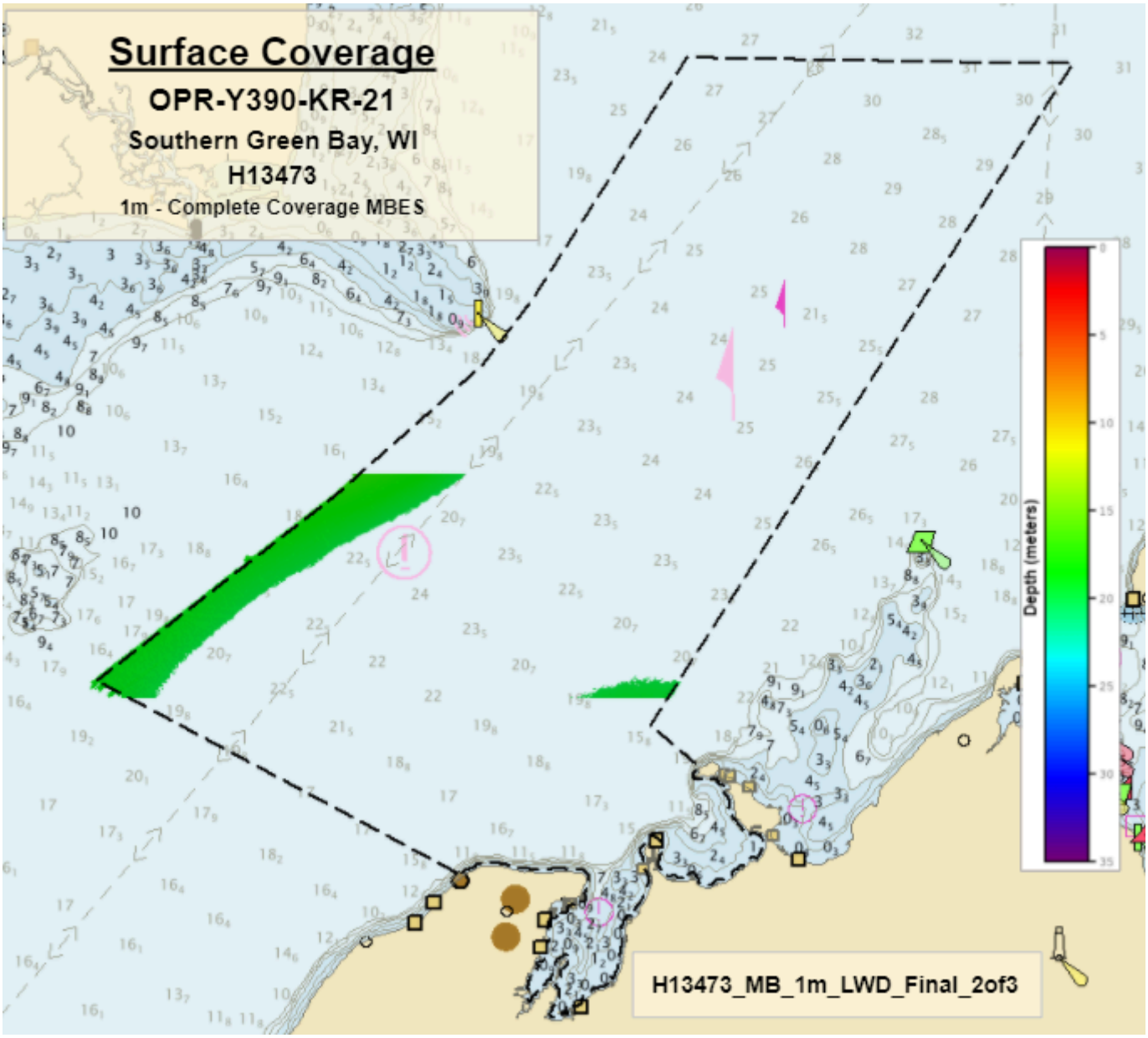

Figure 26: H13473 Finalized 1m CUBE weighted Dynamic Surface Coverage (2 of 3)

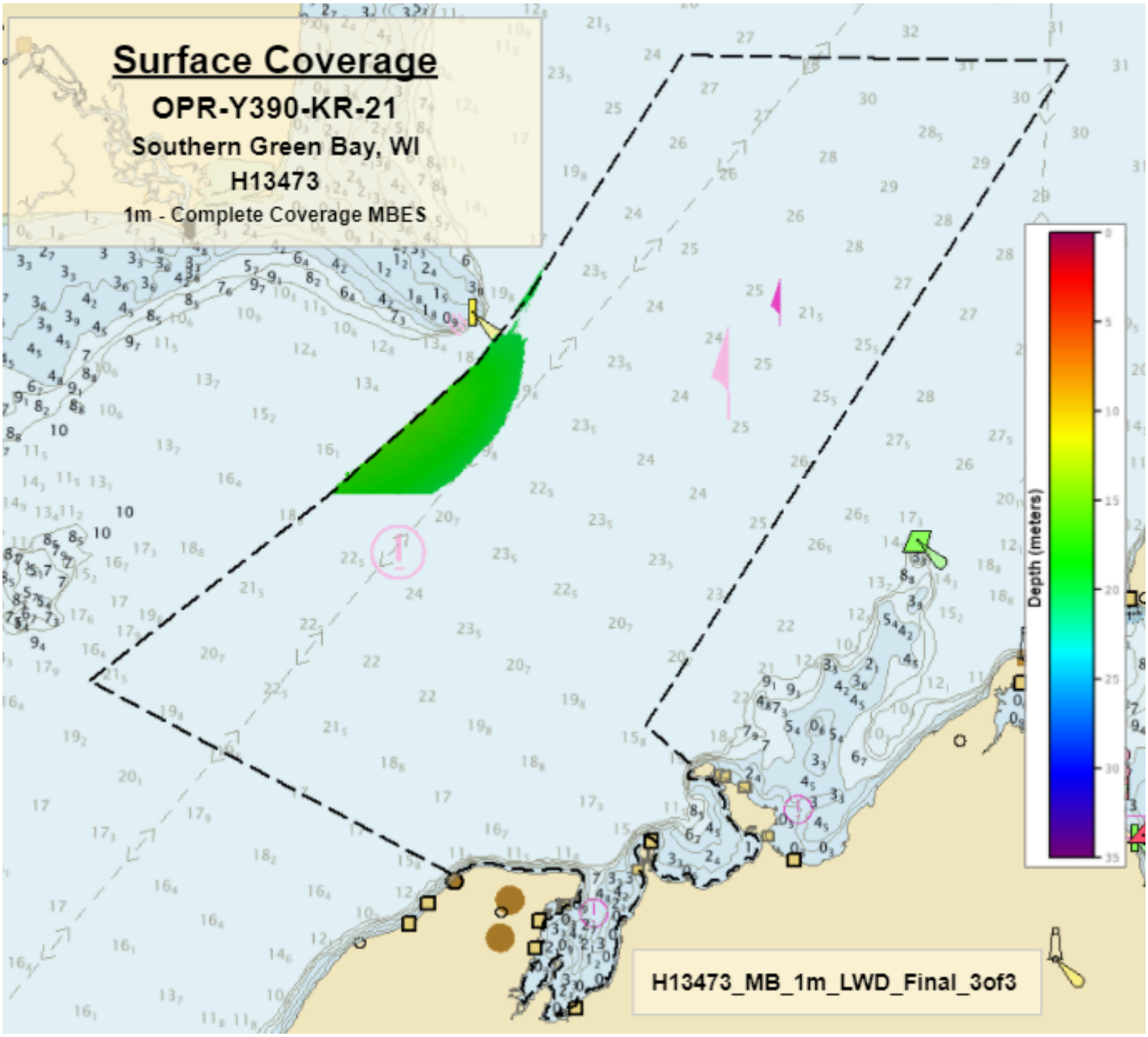

Figure 27: H13473 Finalized 1m CUBE weighted Dynamic Surface Coverage (3 of 3)

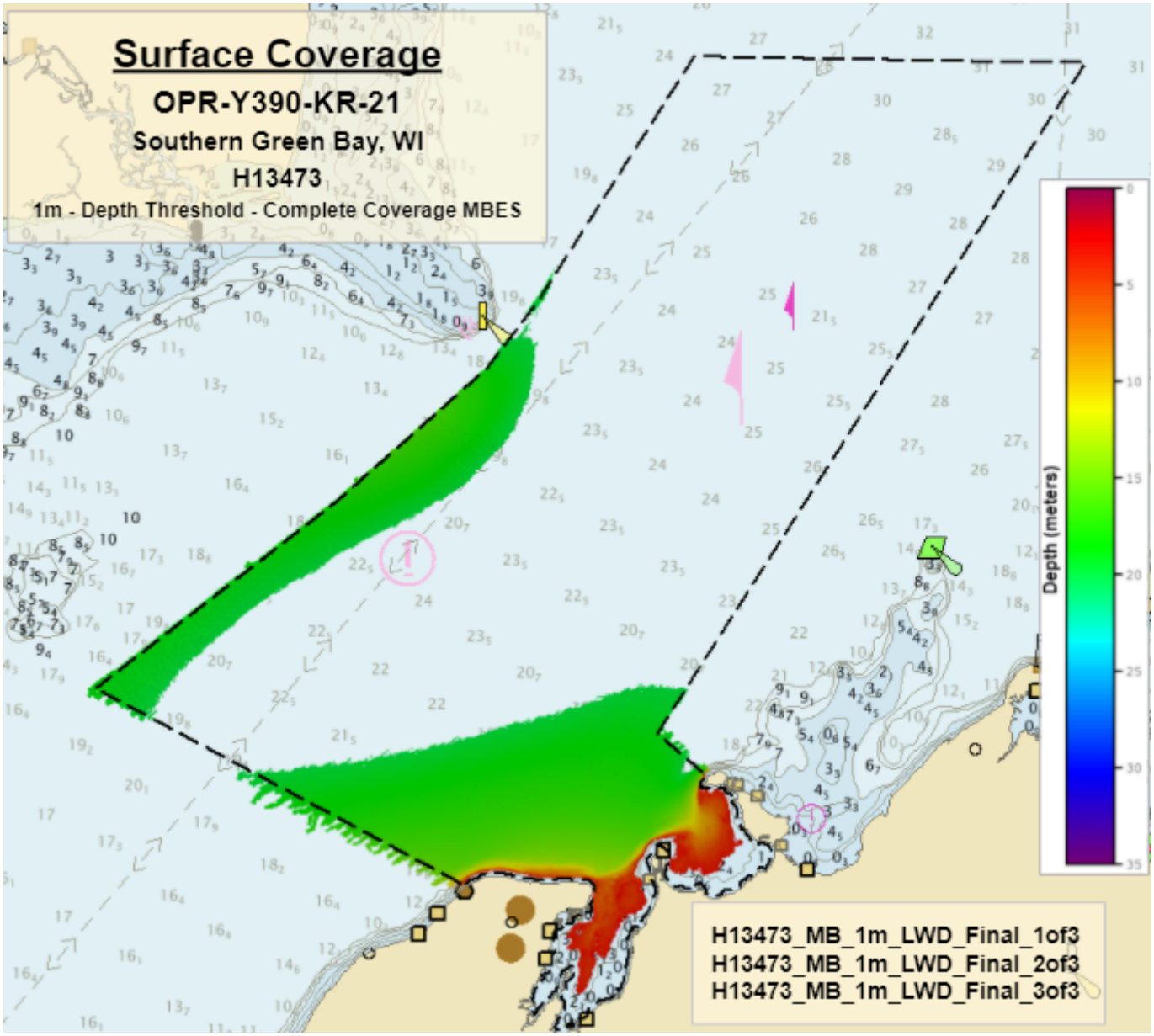

Figure 28: H13473 Finalized 1m CUBE weighted Dynamic Surface Coverage (All 3 partial surfaces displayed)

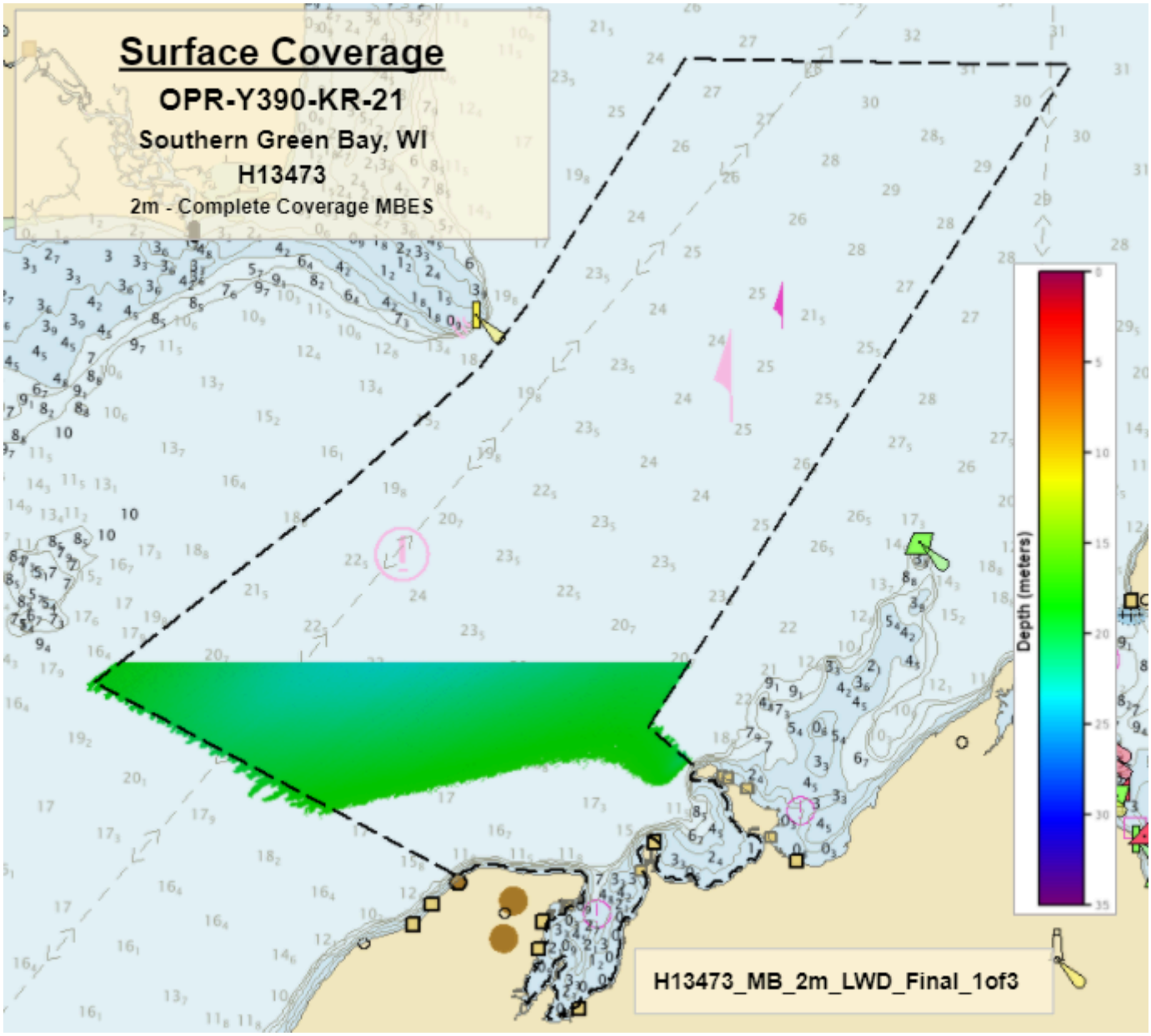

Figure 29: H13473 Finalized 2m CUBE weighted Dynamic Surface Coverage (1 of 3)

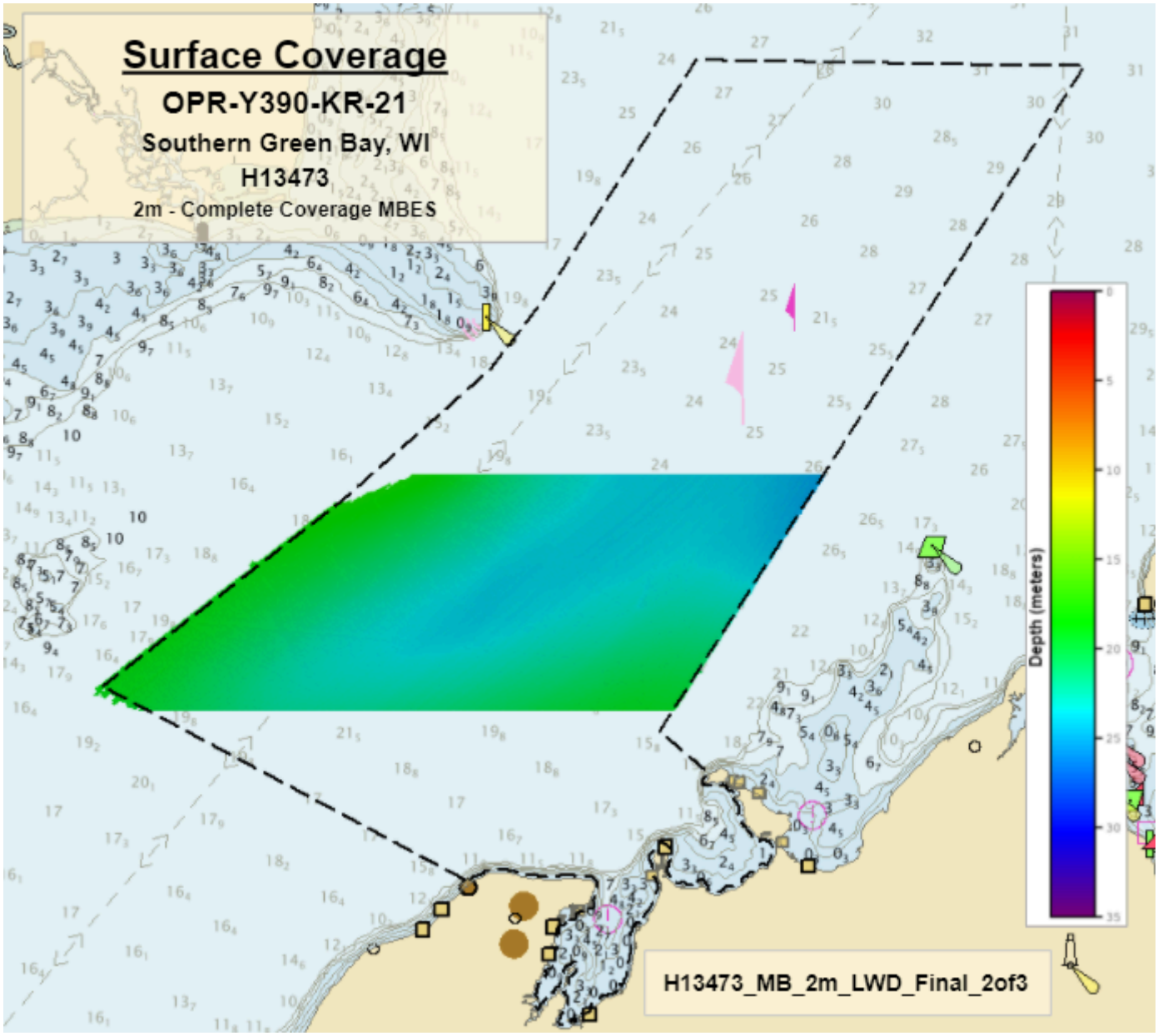

Figure 30: H13473 Finalized 2m CUBE weighted Dynamic Surface Coverage (2 of 3)

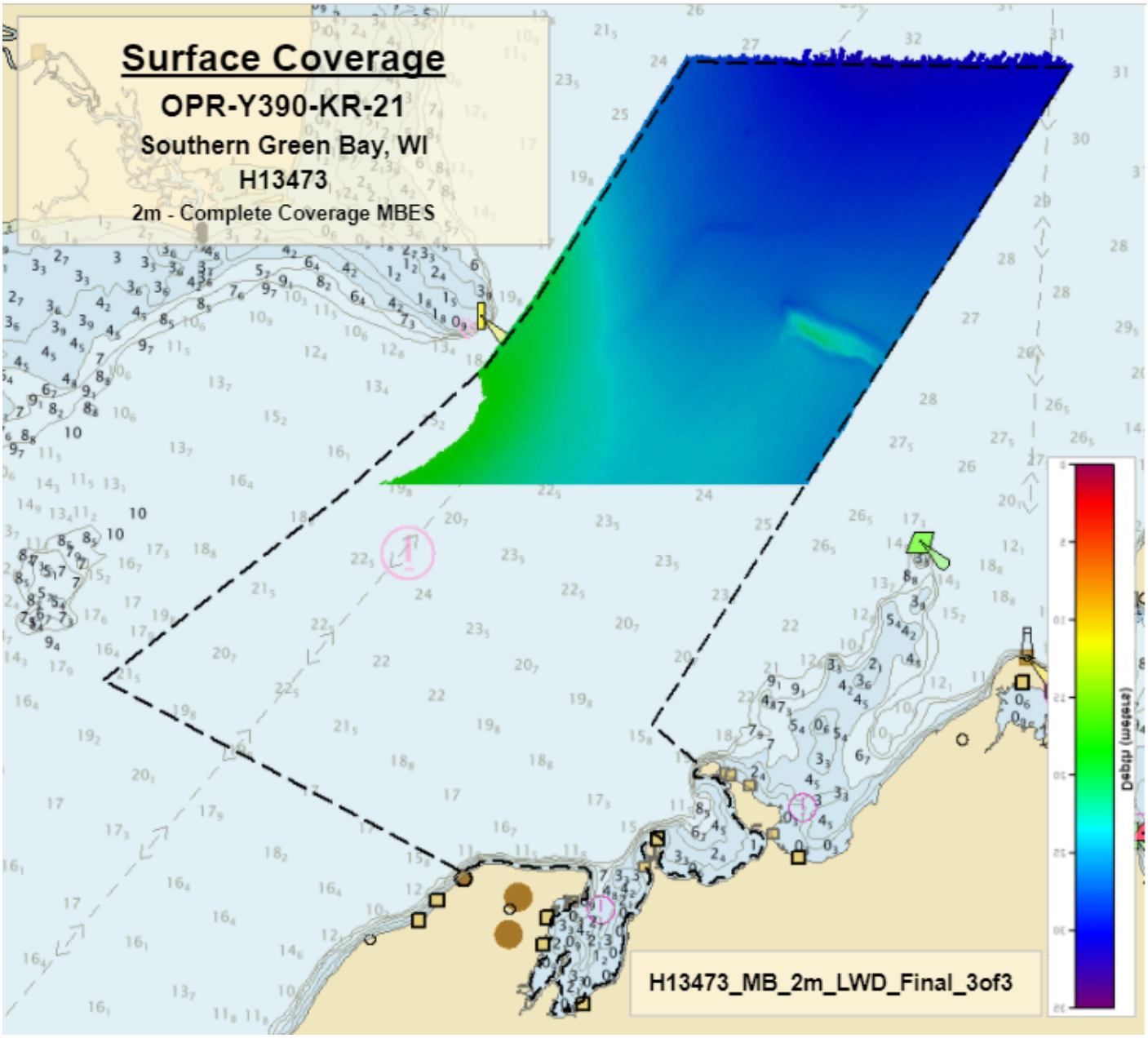

Figure 31: H13473 Finalized 2m CUBE weighted Dynamic Surface Coverage (3 of 3)

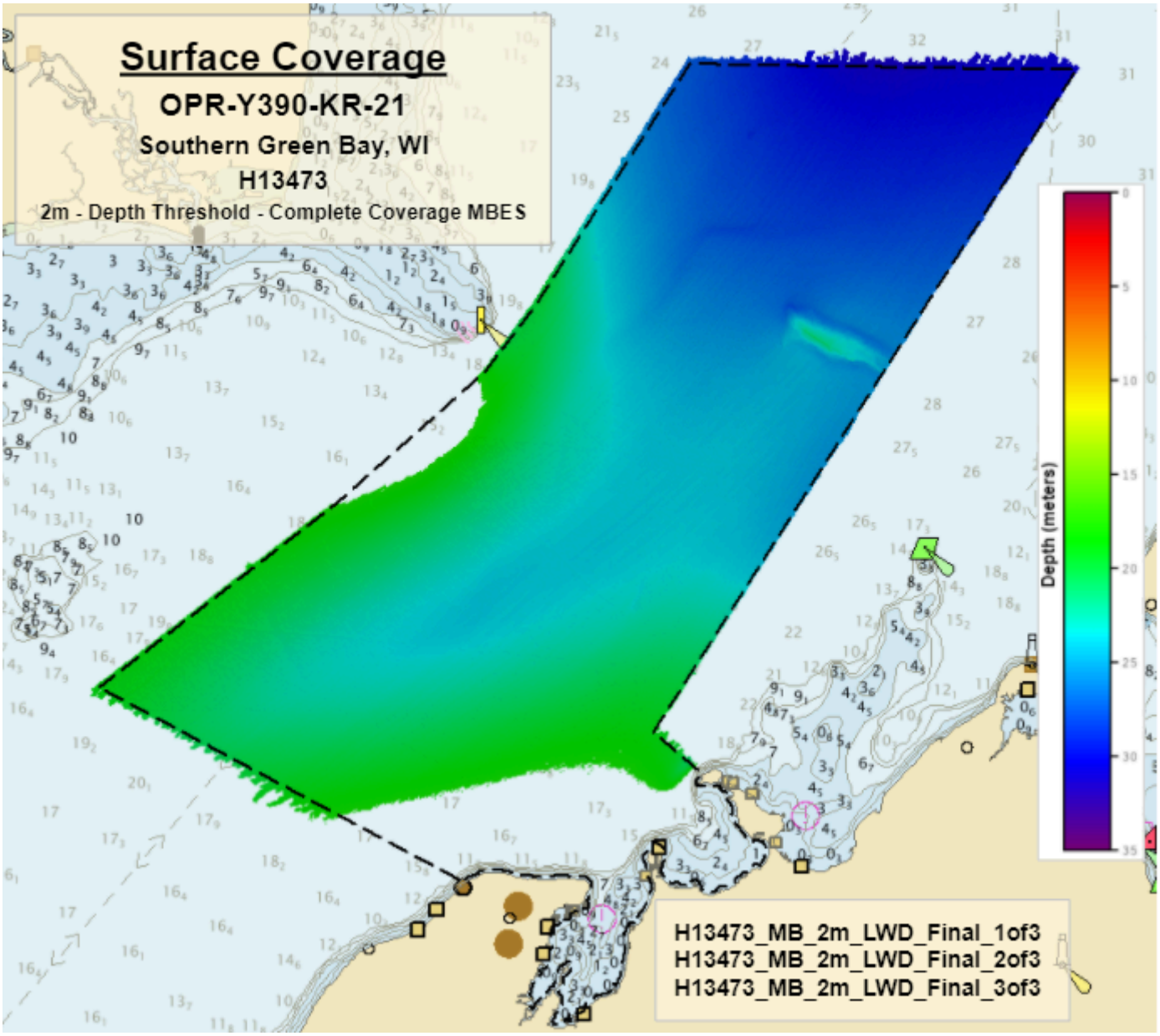

Figure 32: H13473 Finalized 2m CUBE weighted Dynamic Surface Coverage (All 3 partial surfaces displayed)

To improve grid management, the six (6) subdivided grids were combined into two depth limited 1m and 2m resolution BAGs by AHB personnel. The final grid deliverables for use in chart updates and archive at NCEI are a H13473_MB_1m_LWD_1of2.bag and a H13473_MB_2m_LWD_2of2.bag.

C. Vertical and Horizontal Control

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

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	OPR_Y390_KR_21_NAD83_to_LWD_IGLD85_exp.qgfvom

Table 11: ERS method and SEP file

In order to reference soundings to Low Water Datum, a VDatum separation model was applied to the Qinsy DB files via a separation file in the aquisition software.

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 16.

The following PPK methods were used for horizontal control:

- RTX

Applanix PosPac MMS was utilized to post process realtime positioning data utilizing Trimble's PP-RTX implementation of Trimble CenterPoint RTX to create a Smoothed Best Estimate of Trajectory (SBET).

RTK

GNSS satellite corrections were received on each vessel using the G2+ carrier signal from the Marinestar Global Correction System maintained by Fugro.

D. Results and Recommendations

D.1 Chart Comparison

A chart comparison was conducted for H13473 using Pydro CA tools, Qimera, and Caris HIPS and SIPS. Survey data were compared against the largest scale ENC to accomplish the chart comparison. The largest scale ENC does not cover the entire survey boundary so a second chart was used to complete the chart comparison. Details of the ENCs used are listed below.

US5WI05M, scale: 30000, edition: 17, update application date: 09/01/2021, issue date: 09/01/2021
US4WI03M, scale: 80000, edition: 26, update application date: 09/16/2021, issue date: 10/06/2021

Throughout survey operations sounding comparisons between the charted depths and the surveyed depths were analyzed to identify depth discrepancies. Using 1 meter CUBE weighted Dynamic surfaces, soundings were generated in the "Sounding Selection" tab of Pydro CA tools. Soundings were displayed against the charted soundings and a visual comparison was made in Caris HIPS and SIPS. Additionally, potential DtoNs and discrepancies were generated using the "DTM vs Chart" tab of Pydro CA tools. The results were displayed through CA tools and investigated in CARIS HIPS and SIPS and Qimera.

An overview image of the generated soundings on each chart is included below.

Results of the chart comparison are included in the following sections.

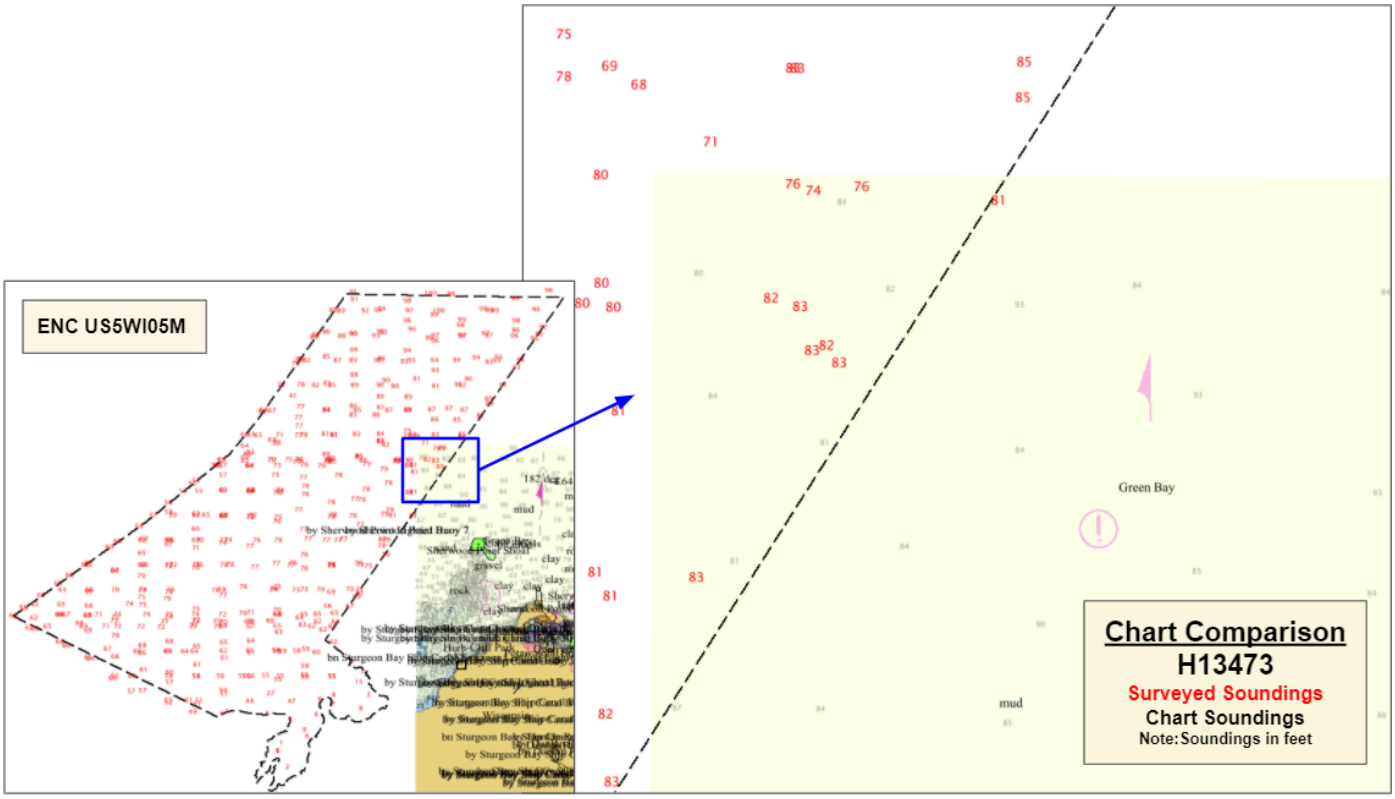

Figure 33: Generated Soundings used for Chart Comparison (US5WI05M)

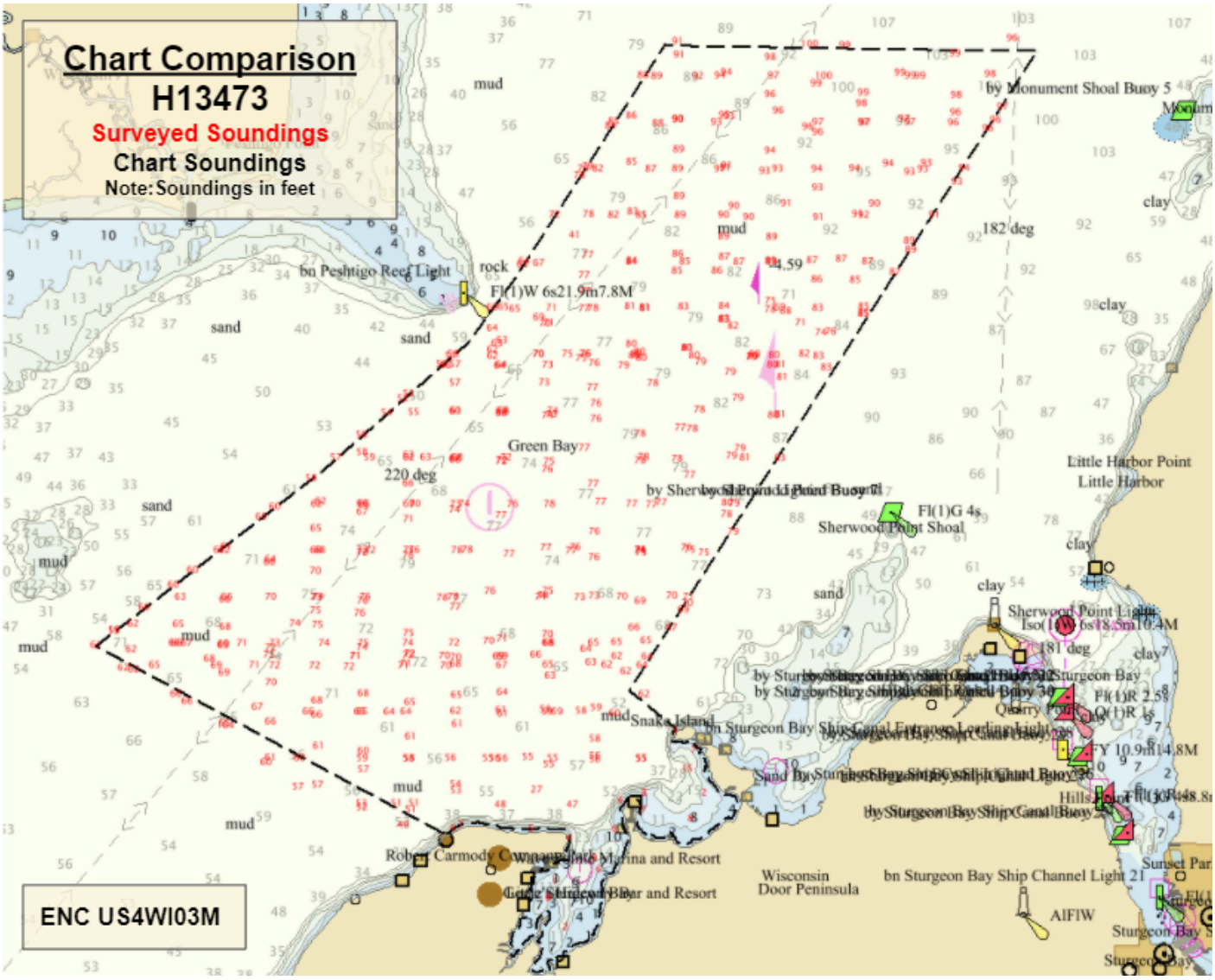

Figure 34: Generated Soundings used for Chart Comparison (US4WI03M)

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
US5WI05M	1:30000	17	09/01/2021	09/01/2021
US4WI03M	1:80000	26	09/16/2021	10/06/2021

Table 12: Largest Scale ENCs

D.1.2 Shoal and Hazardous Features

There were 5 DtoNs found in H13473, and added to the Final Feature File (FFF). Each feature in the FFF has been given a unique identifier in the "userid" field of the .000 S-57 file (format 7XXXX). Refer to the FFF for determinations and recommendations of each feature. The DtoNs were submitted in the following Danger to navigation reports:

H13473 DtoN Report #1

H13473 DtoN #2, #3, and #4

H13473 DtoN Report # 1 contains one obstruction.

H13473 DtoN #2, #3, #4 contains two area obstructions and two shoal soundings.

All DtoNs have been applied to ENC US4WI03M.

D.1.3 Charted Features

There was 1 charted features assigned to H13473 that is included in the Final Feature File (FFF). Each feature in the FFF has been given a unique identifier in the "userid" field of the .000 S-57 file (format 7XXXX). Refer to the FFF for determinations and recommendations of each feature.

D.1.4 Uncharted Features

5 new features were found in H13473. Each feature in the FFF has been given a unique identifier in the "userid" field of the .000 S-57 file (format 7XXXX). Refer to the FFF for determinations and recommendations of each feature.

Note: DtoNs are not included in the number of new features in this section. DtoNs can be found separately in section D.1.2.

Fishing traps were found in H13473. The fishing traps are all temporary equipment that are moved throughout the season, and therefore were rejected from the data set. No data gaps were observed in the delivered surfaces from rejecting the fishing traps in this survey. An image of 3 fishing traps found in H13473 is included below.

New features found in H13470 were partially covered in the H13473 MBES data. These features were fully developed and represented in H13470 and are all entirely within the boundary limits of H13470, therefore these features were not included in the H13473 FFF. An overview image of the features is included below.

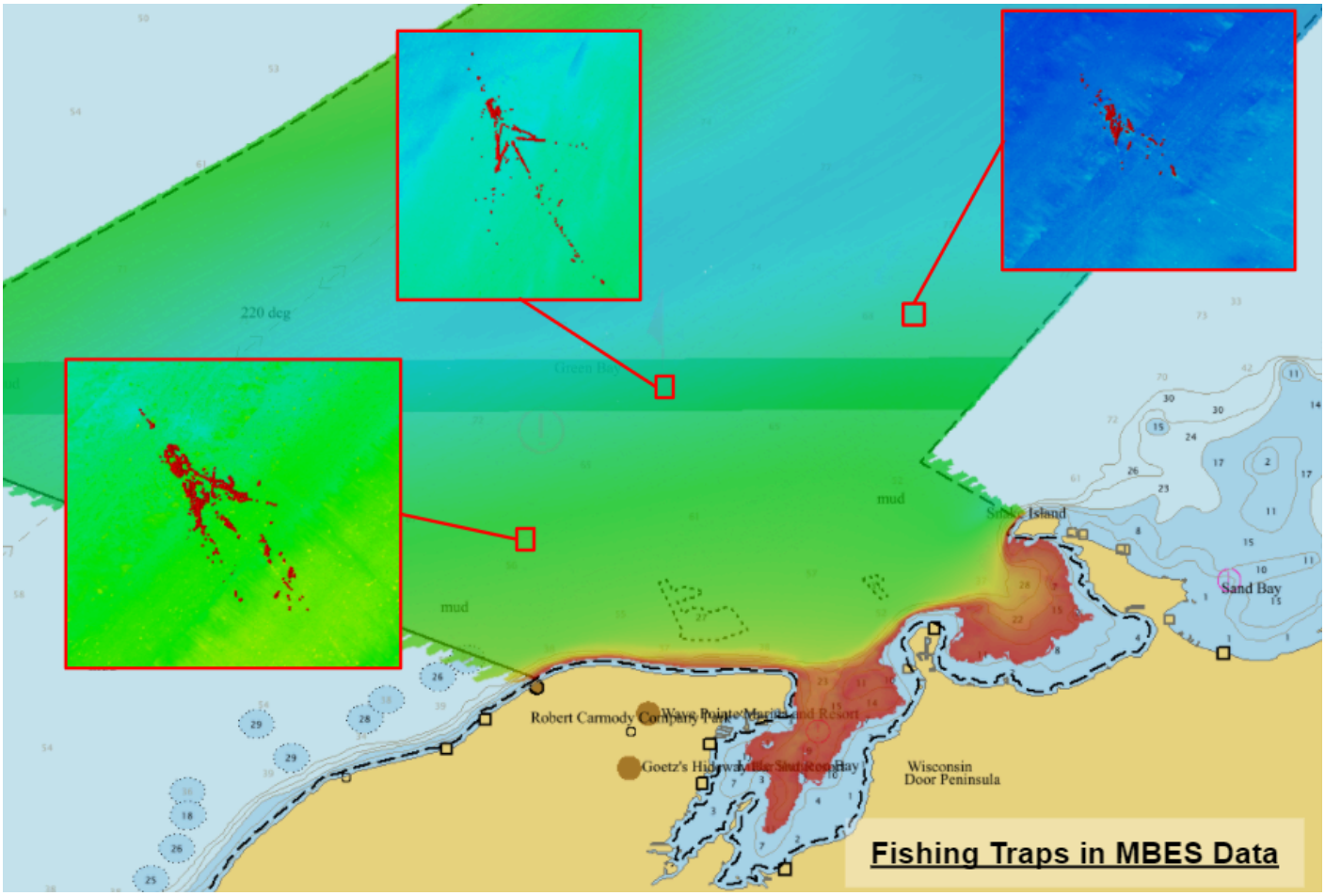

Figure 35: H13473 Fishing Traps

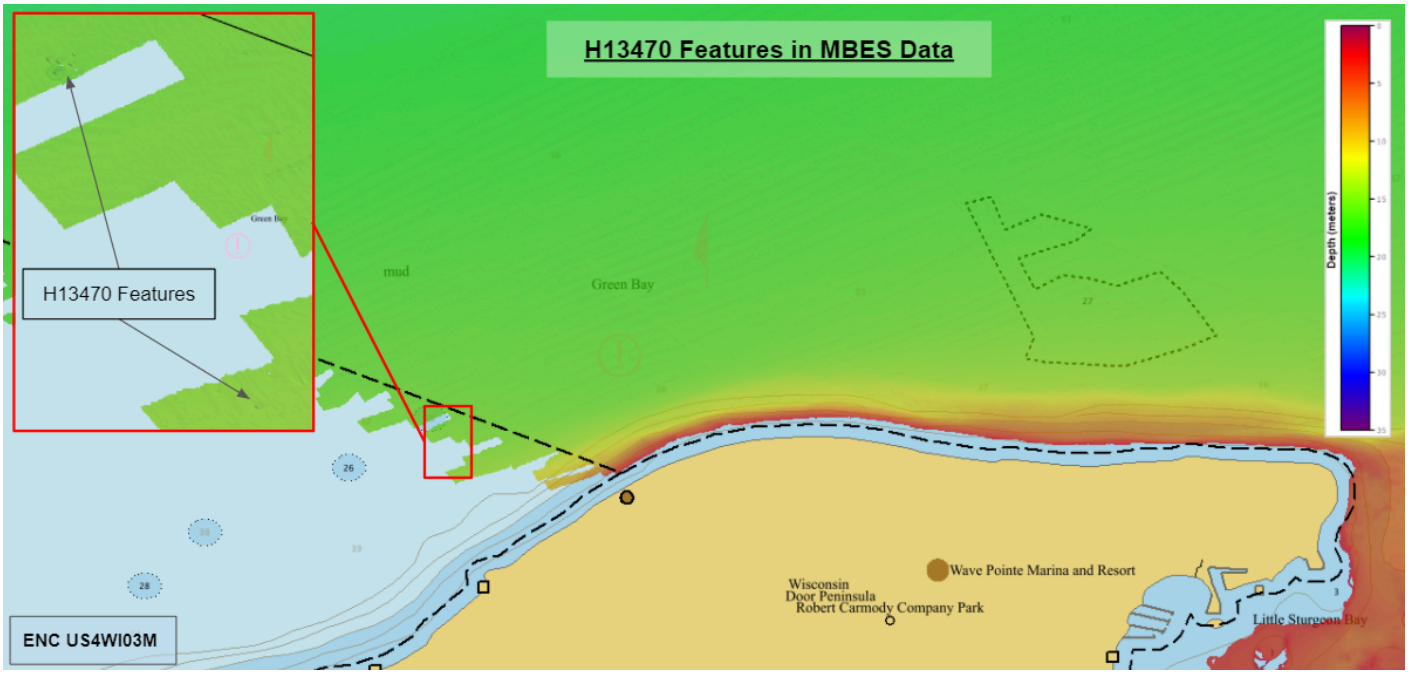

Figure 36: H13470 Features in H13473 MBES Data

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 AtoNs were assigned in H13473.

D.2.2 Maritime Boundary Points

No Maritime Boundary Points were assigned for this survey.

D.2.3 Bottom Samples

10 bottom samples were obtained in accordance with section 7.1 of the HSSD 2021 in areas designated by the field through discussions with our COR. Detailed information and images of the bottom samples are located in the Final Feature File (FFF). Each bottom sample has been given a unique identifier in the "userid" field of the .000 S-57 file (format GX).

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

In some regions, marine vegetation was picked up my the MBES. The vegetation was investigated by collecting additional lines in various directions in a few different areas throughout OPR-Y390-KR-21. The overlap of the vegetation throughout the investigation lines was not consistent and therefore could be determined to be marine vegetation moving in the water column. After the investigation was complete, the marine vegetation was rejected from the dataset by data processors. Below is an example where this occurred in this survey. No data gaps were observed in the delivered surfaces from rejecting the marine vegetation in this survey.

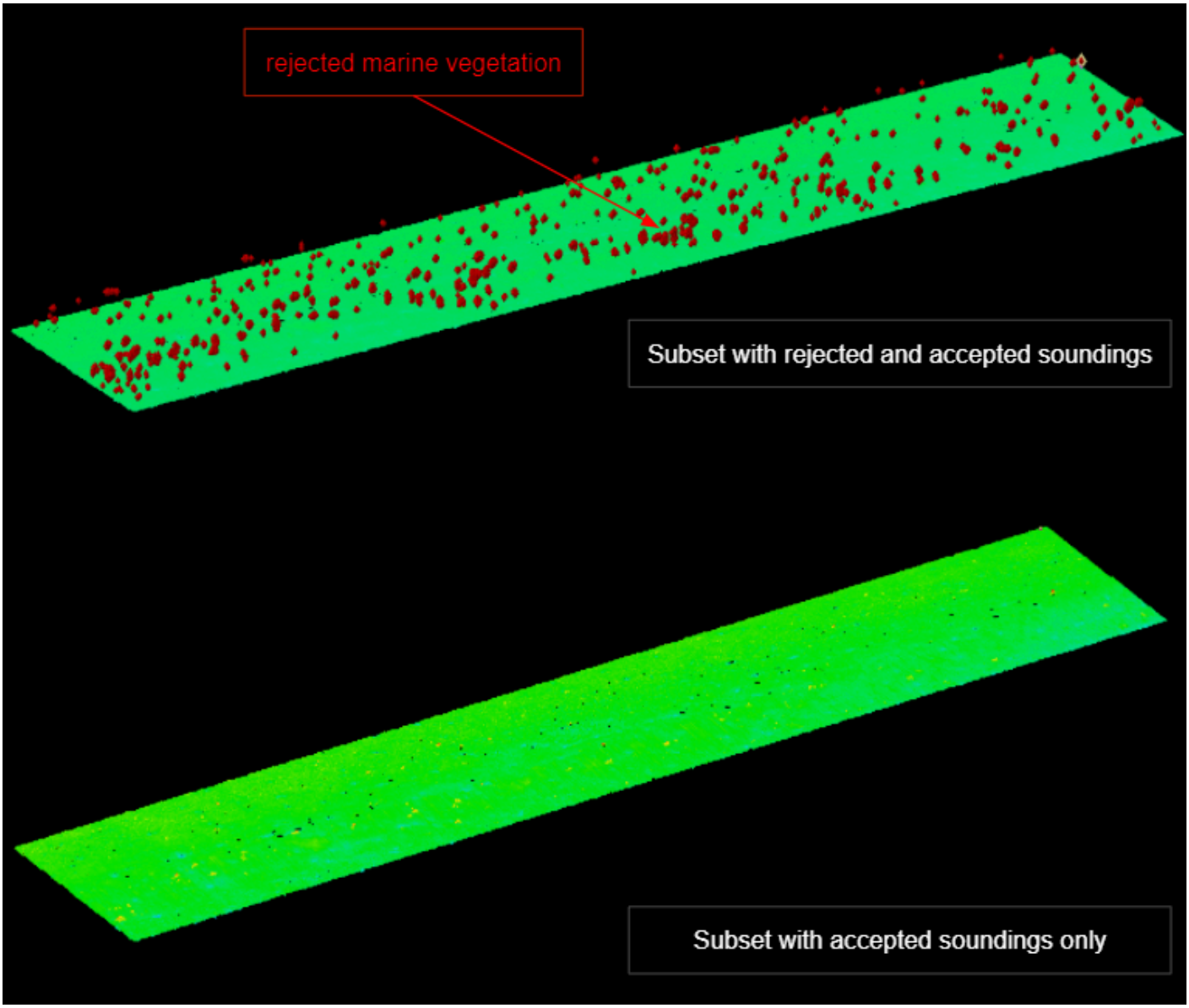

Figure 37: H13473 Marine Vegetation

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 HSSD 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
David Neff	Chief of Party	10/27/2021	David Neff Digitally signed by David Neff DN: C=US, E=david@etracinc.com, O=eTrac Inc., CN=David Neff Date: 2021.10.27 16:30:15-07'00'

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