H13517

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

DESCRIPTIVE REPORT

Type of Survey:	Basic Hydrographic Survey
Registry Number:	H13517

LOCALITY

State(s):	Maryland
General Locality:	Central Chesapeake Bay
Sub-locality:	Eastern Neck Island to Swan Creek

2023

CHIEF OF PARTY
Dorena S. Vogel

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Date:

U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	REGISTRY NUMBER:
HYDROGRAPHIC TITLE SHEET	**H13517**

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:	**Eastern Neck Island to Swan Creek**
Scale:	**5000**
Dates of Survey:	**09/12/2022 to 04/27/2023**
Instructions Dated:	**08/23/2022**
Project Number:	**OPR-E347-KR-22**
Field Unit:	**Leidos**
Chief of Party:	**Dorena S. Vogel**
Soundings by:	**Multibeam Echo Sounder**
Imagery by:	**Side Scan Sonar Multibeam Echo Sounder Backscatter**
Verification by:	**Atlantic Hydrographic Branch**
Soundings Acquired in:	**meters at Mean Lower Low Water**

Remarks:

Contract: 1305M220DNCNJ0056/TO-0003. Contractor: Leidos, 221 Third Street, Newport, RI 02840 USA. Subcontractors: Northstar Marine, Inc., 36 Clermont Drive, Clermont, NJ 08210; OARS, 8705 Shoal Creek Blvd, Suite 109, Austin, TX 78757. Leidos Doc. 22-TR-027. All times were recorded in UTC. Final data are corrected to North American Datum of 1983 (NAD83) 2011 realization 2010 (NAD83(2011)2010.0), UTM Zone 18N.

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 H13517

Project: OPR-E347-KR-22

Locality: Central Chesapeake Bay

Sublocality: Eastern Neck Island to Swan Creek

Scale: 1:5000

September 2022 - April 2023

Leidos

Chief of Party: Dorena S. Vogel

A. Area Surveyed

H13517 was located within the Central Chesapeake Bay, Maryland. Southern limits extend approximately 6.2km east of Love Point, MD and northern limits extend approximately 2.6km west of Swan Point, MD (Figure 1). The survey was conducted in accordance with coverage requirements listed in the Project Instructions (PI) OPR-E347-KR-22.

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
39° 8' 44.78" N 76° 18' 40.75" W	39° 1' 28.06" N 76° 14' 10.53" W

Table 1: Survey Limits

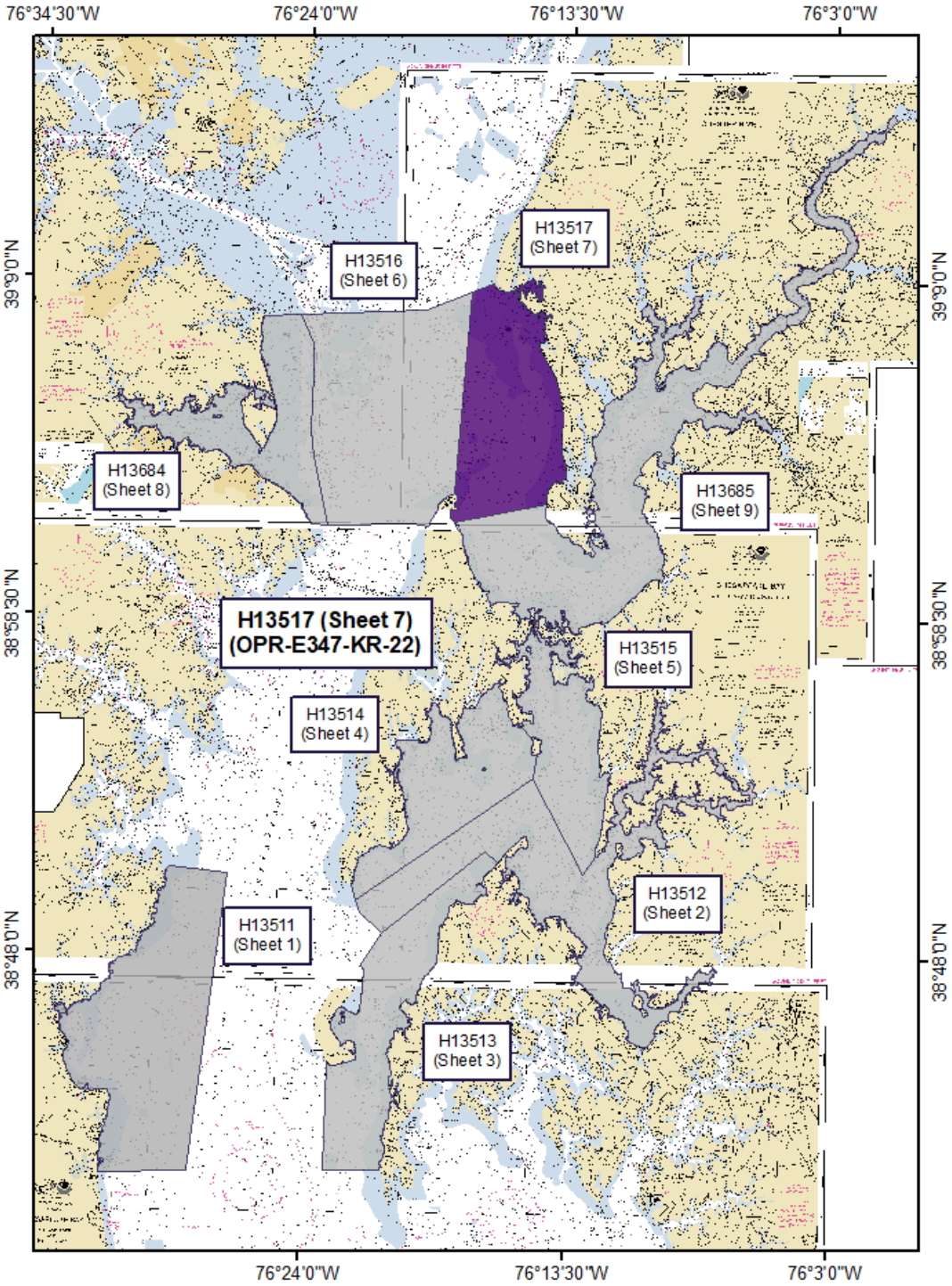

Figure 1: H13517 Survey Bounds

Survey limits were acquired in accordance with the requirements in the PI and the Hydrographic Survey Specifications and Deliverables (HSSD), March 2022.

A.2 Survey Purpose

The Chesapeake Bay is the largest estuary in North America and heavily trafficked by commercial and recreational vessels as tourism, fishing, and marine commerce are economically vital for the region. In addition to fishing and tourism traffic, commercial vessels transit through the project area to reach the Port of Baltimore, which is ranked as a top 15 port in container and tonnage, and a top 10 port for dry bulk.

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. In addition, the Ever Forward container ship ran aground near the Craighill Channel in March 2022, and was removed after 35 days. 206,230 cubic yards of material was dredged and taken to Poplar Island. The data from this project will provide modern bathymetry for updating National Ocean Service nautical charting products improving the safety of maritime traffic and commerce as well as supporting the Seabed 2030 global mapping initiative. 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.

Leidos warrants only that the survey data acquired by Leidos and delivered to NOAA under Contract 1305M220DNCNJ0056 reflects the state of the sea floor in existence on the day and at the time the survey was conducted.

H13517 was surveyed in accordance with the following documents:
1. 1305M220DNCNJ0056 signed.pdf, received 23 August 2022
2. Hydrographic Survey Specifications and Deliverables (HSSD), March 2022
3. PRF.000, received 24 August 2022
4. CSF.000, received 24 August 2022
5. OPR-E347-KR-22 Project Brief, held 07 September 2022

A.4 Survey Coverage

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

Water Depth	Coverage Required
Sheets 1, 3, 4, 5, 7, 8, and 9	Complete Coverage (Refer to HSSD Section 5.2.2.3)
Inshore limit to 8 meters water depth	Sidescan may be acquired at an altitude of 6-20% of the range scale.

Table 2: Survey Coverage

Survey coverage achieved was in accordance with the requirements in the PI and the HSSD (Figure 2). Leidos chose to achieve the coverage requirement using Complete Coverage, Option B (100% side scan sonar coverage with concurrent multibeam). In many areas of H13517 the inshore limit of the Navigable Area Limit Line (NALL) was reached seaward of the assigned survey bounds. Leidos surveyed to the NALL as defined by HSSD Section 1.3.2; within the surveyed bounds. However, due to safety concerns for personnel and survey equipment, some areas were not fully covered with multibeam echo sounder (MBES) data to exactly the 3.5-meter depth contour. This was due limited vessel maneuverability around the shoal depth areas, at these discrete locations. In these areas the side scan sonar (SSS) swath extended shoreward of the MBES swath, and indicated that the seafloor continued to rise abruptly and in a manner that the vessel could not navigate over for further MBES coverage; while also indicating in the SSS data that there were no significant objects that would require individual cartographic representation.

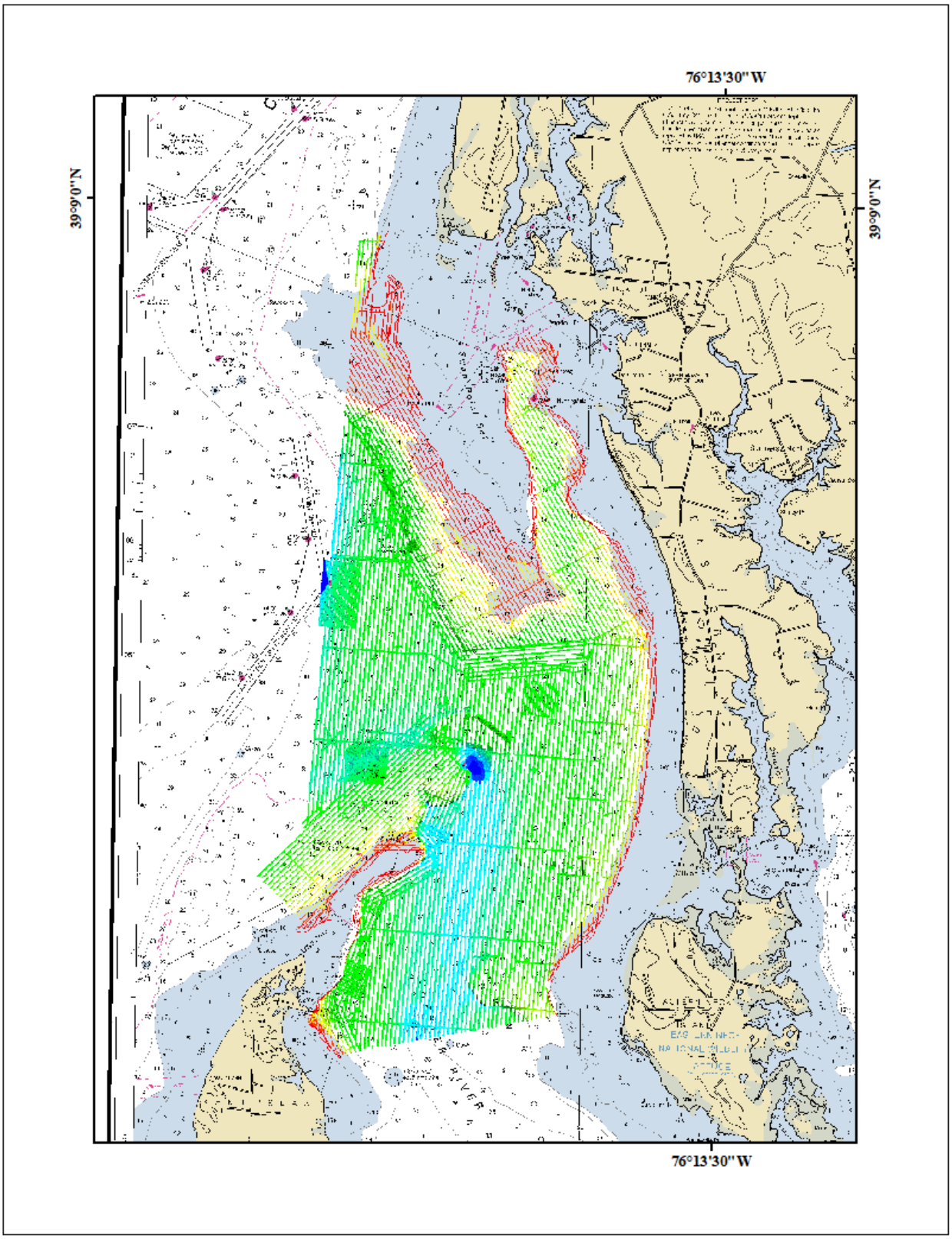

Figure 2: Final Bathymetry Coverage for H13517

A.6 Survey Statistics

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

	HULL ID	*R/V Sea Innovator I*	*R/V Oyster Bay II*	*Total*
LNM	**SBES Mainscheme**	0.0	0.0	0.0
	MBES Mainscheme	0.0	0.0	0.0
	Lidar Mainscheme	0.0	0.0	0.0
	SSS Mainscheme	0.0	0.0	0.0
	SBES/SSS Mainscheme	0.0	0.0	0.0
	MBES/SSS Mainscheme	228.7	276.43	505.13
	SBES/MBES Crosslines	10.66	12.62	23.28
	Lidar Crosslines	0.0	0.0	0.0
Number of Bottom Samples				3
Number Maritime Boundary Points Investigated				0
Number of DPs				0
Number of Items Investigated by Dive Ops				0
Total SNM				15.0

Table 3: Hydrographic Survey Statistics

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

Survey Dates	Day of the Year
09/12/2022	255
09/14/2022	257
09/16/2022	259
09/17/2022	260
09/19/2022	262
10/21/2022	294
10/22/2022	295
10/23/2022	296
11/10/2022	314
01/19/2023	19
01/25/2023	25
03/22/2023	81
03/23/2023	82
04/27/2023	117

Table 4: Dates of Hydrography

B. Data Acquisition and Processing

B.1 Equipment and Vessels

Leidos used their ISS-2000 software on a Windows platform to acquire these survey data. Survey planning and data analysis were conducted using the Leidos SABER software on Linux platforms. Side scan sonar (SSS) data were collected on a Windows platform using Klein's SonarPro software. Subsequent processing and review of the SSS data, including the generation of coverage mosaics, were accomplished using SABER.

A detailed description of the systems and vessel used to acquire and process these data is included in the Data Acquisition and Processing Report (DAPR) for OPR-E347-KR-22, delivered previously with H13511. There were no variations from the equipment configuration described in the DAPR.

B.1.1 Vessels

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

Hull ID	*R/V Sea Innovator 1*	*R/V Oyster Bay II*
LOA	135.0 feet	30.0 feet
Draft	9.0 feet	3.0 feet

Table 5: Vessels Used

Figure 3: R/V Sea Innovator 1

Figure 4: R/V Oyster Bay II

The R/V Sea Innovator I (Figure 3) was used to collect multibeam echo sounder (MBES) (RESON SeaBat T50), side scan sonar (SSS) (Klein 4000), and sound speed data during twenty four hours per day survey operations. The R/V Oyster Bay II (Figure 4) was used to collect multibeam echo sounder (MBES) (RESON SeaBat T50), side scan sonar (SSS) (Klein 4900), and sound speed data during twelve hours per day survey operations.

A detailed description of the vessels used is included in the DAPR.

B.1.2 Equipment

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

Manufacturer	Model	Type
Teledyne RESON	SeaBat T50-R	MBES
Klein Marine Systems	System 4000	SSS
Klein Marine Systems	System 4900	SSS
Applanix	POS MV 320 v5	Positioning and Attitude System
AML Oceanographic	MVP30	Conductivity, Temperature, and Depth Sensor
AML Oceanographic	BaseX	Sound Speed System
Teledyne RESON	SeaBat T50-R	MBES Backscatter

Table 6: Major Systems Used

B.2 Quality Control

B.2.1 Crosslines

Multibeam echo sounder crosslines acquired for this survey totaled 4.61% of mainscheme acquisition. The resulting crossline to mainscheme percentage met the requirement to achieve approximately four percent of mainscheme mileage for a complete coverage multibeam survey (Section 5.2.4.2 of the HSSD). H13517 requirements were for Complete Coverage, Option B, based on the classifications defined in Section 5.2.2.3 of the HSSD.

The mainscheme lines were spaced 70 meters apart, and crosslines were generally 1500 meters apart. In the field, hydrographers conducted daily comparisons of mainscheme to near nadir crossline data to ensure that no systematic errors were introduced and to identify potential problems with the survey systems. After the application of all correctors and completion of final processing in the office, separate CUBE PFM grids were built at 1-meter resolution for all data. One grid contained the full valid swath (±65° from nadir, Class 2) of mainscheme multibeam and the other included only the near nadir swath (±5° from nadir, Class 1) crossline data. The difference grid was created by subtracting the 1-meter H13517 mainscheme CUBE depths from the 1-meter H13517 crossline CUBE depths. Additional comparisons were conducted of each vessels mainscheme to crossline depth data. These results are summarized in Figure 5.

The SABER Frequency Distribution Tool was used to analyze the difference grid created from the mainscheme and crossline PFM grids and the results of the analysis were compiled into the following section.

Section 5.2.4.2 of the HSSD states that the depth difference values are to be within the maximum allowable Total Vertical Uncertainty [TVU]. For all the crossline to mainscheme analysis conducted for H13517, 100% of the comparisons were within TVU. Results for all crossing analysis are summarized in Figure 5.

As multiple vessels were used to survey H13517 repeatability analysis was performed between the data collected by both vessels where coincident. Of the vessel to vessel analysis, 99.99% of the comparisons were within TVU. Results are summarized in Figure 6. There were three comparisons which exceeded the maximum allowable TVU. In all instances, the differences were associated with features, all being associated with submerged snags and stumps.

Results for analysis conducted are presented in Figure 7 to Figure 14.

Crossing Analysis	Minimum and Maximum CUBE Depth (meters) of Crossline Grid	IHO Order 1A Maximum Allowable Uncertainty (meters) for the Range of Depths	Percentage of Depth Differences Within IHO Order 1A Maximum Allowable Uncertainty
R/V Sea Innovator I and R/V Oyster Bay II MBES 1m Crossline (Class 1) to R/V Sea Innovator I and R/V Oyster Bay II MBES 1m Mainscheme	2.303 -9.607	0.501 – 0.515	100.00%
R/V Sea Innovator I MBES 1m Crossline (Class 1) to R/V Sea Innovator I MBES 1m Mainscheme	5.978 – 9.621	0.506 – 0.515	100.00%
R/V Oyster Bay II MBES 1m Crossline (Class 1) to R/V Oyster Bay II MBES 1m Mainscheme	2.303 – 9.461	0.501-0.515	100.00%

Figure 5: Summary of Crossing Analysis

Repeatability Analysis	Minimum and Maximum CUBE Depth (meters) of Comparison	IHO Order 1A Maximum Allowable Uncertainty (meters) for the Range of Depths	Percentage of Depth Differences Within IHO Order 1A Maximum Allowable Uncertainty
R/V Sea Innovator I MBES 1m to R/V Oyster Bay II MBES 1m	1.092 - 11.898	0.500 – 0.523	99.99%

Figure 6: Summary of Vessel Comparison Repeatability Analysis

Depth Difference Range (m)	All		Positive		Negative		Zero	
	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent
0-0.01	6957	16.65	3463	8.29	3198	7.65	296	0.71
>0.01-0.02	6237	31.58	3264	16.10	2973	14.77		
>0.02-0.03	6418	46.94	3048	23.40	3370	22.84		
>0.03-0.04	5444	59.97	2259	28.80	3185	30.46		
>0.04-0.05	4522	70.80	1763	33.02	2759	37.06		
>0.05-0.06	2963	77.89	1119	35.70	1844	41.48		
>0.06-0.07	2343	83.50	888	37.83	1455	44.96		
>0.07-0.08	1757	87.70	758	39.64	999	47.35		
>0.08-0.09	1144	90.44	486	40.81	658	48.93		
>0.09-0.1	953	92.72	403	41.77	550	50.24		
>0.1-0.11	951	95.00	366	42.65	585	51.64		
>0.11-0.12	745	96.78	255	43.26	490	52.82		
>0.12-0.13	544	98.08	173	43.67	371	53.70		
>0.13-0.14	416	99.08	102	43.91	314	54.46		
>0.14-0.15	212	99.59	50	44.03	162	54.84		
>0.15-0.16	107	99.84	4	44.04	103	55.09		
>0.16-0.17	47	99.95	0	44.04	47	55.20		
>0.17-0.18	14	99.99	0	44.04	14	55.24		
>0.18-0.19	4	99.99	0	44.04	4	55.25		
>0.19-0.26	0	99.99	0	44.04	0	55.25		
>0.27-0.273	1	100.00	0	44.04	1	55.25		
Total	41779	**100.00%**	18401	**44.04%**	**23082**	**55.25%**	**296**	**0.71%**
Reference Grid: H13517_OB_SI_MB_1m_cross_5deg_CUBE_pfm_H13517_OB_SI_MB_1m_main_CUBE_pfm.dif								

Figure 7: Tabular Results Crossing Analysis, Crosslines vs. Mainscheme Lines

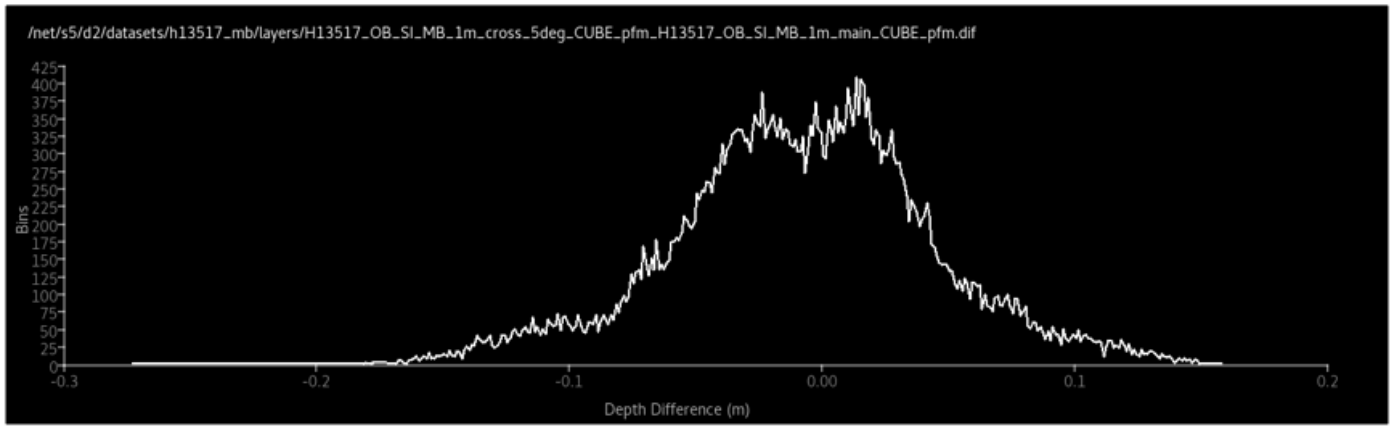

Figure 8: Plot of Crossing Analysis Crosslines vs. Mainscheme Lines

Depth Difference Range (m)	All		Positive		Negative		Zero	
	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent
0-0.01	4443	20.02	2264	10.20	1974	8.90	205	0.92
>0.01-0.02	3857	37.40	2201	20.12	1656	16.36		
>0.02-0.03	3733	54.22	1928	28.81	1805	24.49		
>0.03-0.04	2759	66.65	1265	34.51	1494	31.22		
>0.04-0.05	1981	75.58	774	38.00	1207	36.66		
>0.05-0.06	1454	82.13	571	40.57	883	40.64		
>0.06-0.07	1058	86.90	449	42.59	609	43.39		
>0.07-0.08	702	90.06	334	44.10	368	45.04		
>0.08-0.09	491	92.28	166	44.84	325	46.51		
>0.09-0.1	462	94.36	140	45.48	322	47.96		
>0.1-0.11	485	96.54	143	46.12	342	49.50		
>0.11-0.12	264	97.73	28	46.25	236	50.56		
>0.12-0.13	214	98.70	5	46.27	209	51.51		
>0.13-0.14	196	99.58	1	46.27	195	52.38		
>0.14-0.15	66	99.88	0	46.27	66	52.68		
>0.15-0.16	24	99.99	1	46.28	23	52.78		
>0.16-0.163	3	100.00	0	46.28	3	52.80		
Total	**22192**	**100.00%**	**10270**	**46.28%**	**11717**	**52.80%**	**205**	**0.92%**
Reference Grid: H13517_SI_MB_1m_cross_5deg_pfm_CUBE_pfm_H13517_SI_MB_1m_main_pfm_CUBE_pfm.dif								

Figure 9: Tabular Results Crossing Analysis, R/V Sea Innovator I Crosslines vs. Mainscheme Lines

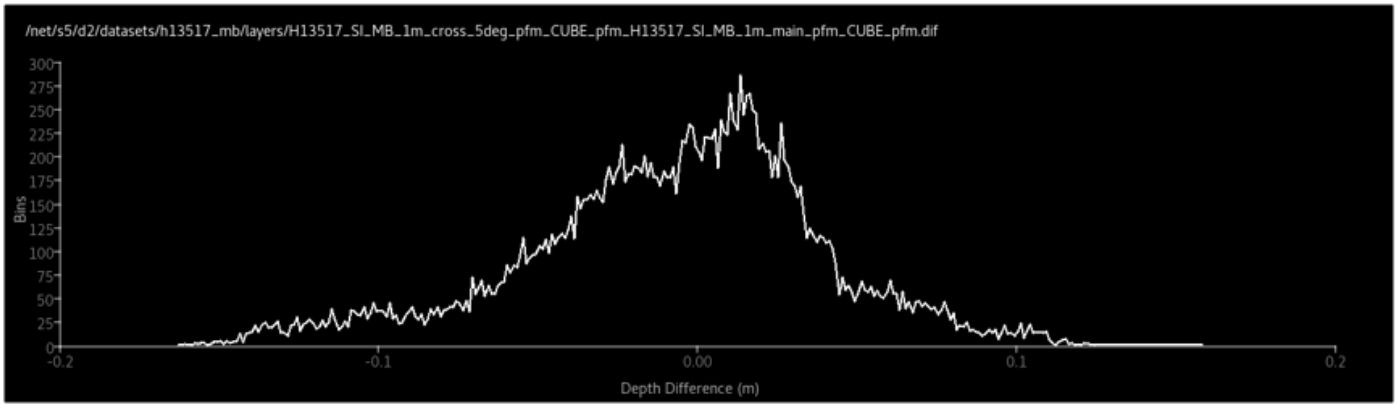

Figure 10: Plot of Crossing Analysis R/V Sea Innovator I Crosslines vs. Mainscheme Lines

Depth Difference Range (m)	All		Positive		Negative		Zero	
	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent
0-0.01	2853	18.55	1300	8.45	1448	9.41	105	0.68
>0.01-0.02	2552	35.14	1068	15.39	1484	19.06		
>0.02-0.03	2518	51.51	933	21.46	1585	29.37		
>0.03-0.04	2202	65.82	712	26.09	1490	39.05		
>0.04-0.05	1831	77.73	519	29.46	1312	47.58		
>0.05-0.06	1068	84.67	232	30.97	836	53.02		
>0.06-0.07	830	90.07	171	32.08	659	57.30		
>0.07-0.08	607	94.01	107	32.78	500	60.55		
>0.08-0.09	387	96.53	85	33.33	302	62.51		
>0.09-0.1	180	97.70	51	33.66	129	63.35		
>0.1-0.11	110	98.41	15	33.76	95	63.97		
>0.11-0.12	88	98.99	5	33.79	83	64.51		
>0.12-0.13	51	99.32	1	33.80	50	64.84		
>0.13-0.14	39	99.57	0	33.80	39	65.09		
>0.14-0.15	26	99.74	0	33.80	26	65.26		
>0.15-0.16	17	99.85	0	33.80	17	65.37		
>0.16-0.17	7	99.90	0	33.80	7	65.41		
>0.17-0.18	11	99.97	0	33.80	11	65.49		
>0.18-0.19	4	99.99	0	33.80	4	65.51		
>0.19-0.27	4	99.99	0	33.80	4	65.51		
>0.19-0.273	1	100.00	0	33.80	1	65.52		
Total	**15382**	**100.00%**	**5199**	**33.80%**	**10078**	**65.52%**	**105**	**0.68%**
Reference Grid: H13517_OB_MB_1m_cross_5degree_pfm_CUBE_pfm H13517_OB_MB_1m_main_pfm_CUBE_pfm.dif								

Figure 11: Tabular Results Crossing Analysis, R/V Oyster Bay II Crosslines vs. Mainscheme Lines

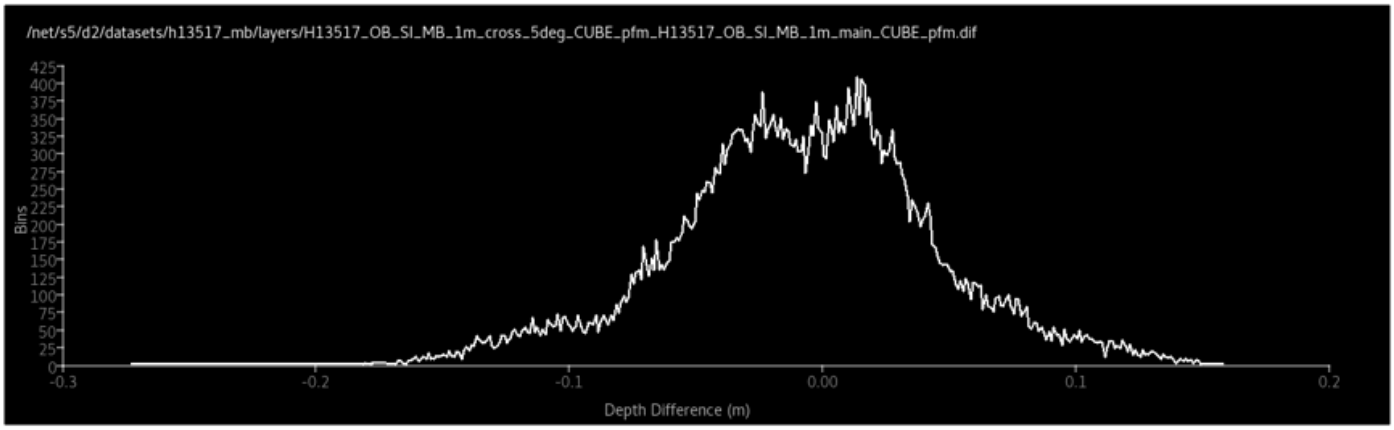

Figure 12: Plot of Crossing Analysis R/V Oyster Bay II Crosslines vs. Mainscheme Lines

Depth Difference Range (m)	All		Positive		Negative		Zero	
	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent
0-0.1	420932	68.01	26923	4.35	393071	63.51	938	0.15
>0.1-0.2	194801	99.49	5	4.35	194796	94.98		
>0.2-0.3	3180	99.99	1	4.35	3179	95.5		
>0.3-0.4	3	99.99	1	4.35	2	95.5		
>0.4-0.5	1	99.99	0	4.35	1	95.5		
>0.5-1.5	1	99.99	1	4.35	0	95.5		
>1.5-2.5	1	99.99	0	4.35	1	95.5		
>2.5-2.91	1	100.00	0	4.35	1	95.5		
Total	**618920**	**100.00%**	**26931**	**4.35%**	**519051**	**95.50%**	**938**	**0.15%**
Reference Grid: H13517 OB MB 1m all pfm CUBE pfm H13517 SI MB 1m all pfm CUBE pfm.dif								

Figure 13: Tabular Results Vessel Comparison Analysis, R/V Sea Innovator I vs. R/V Oyster Bay II

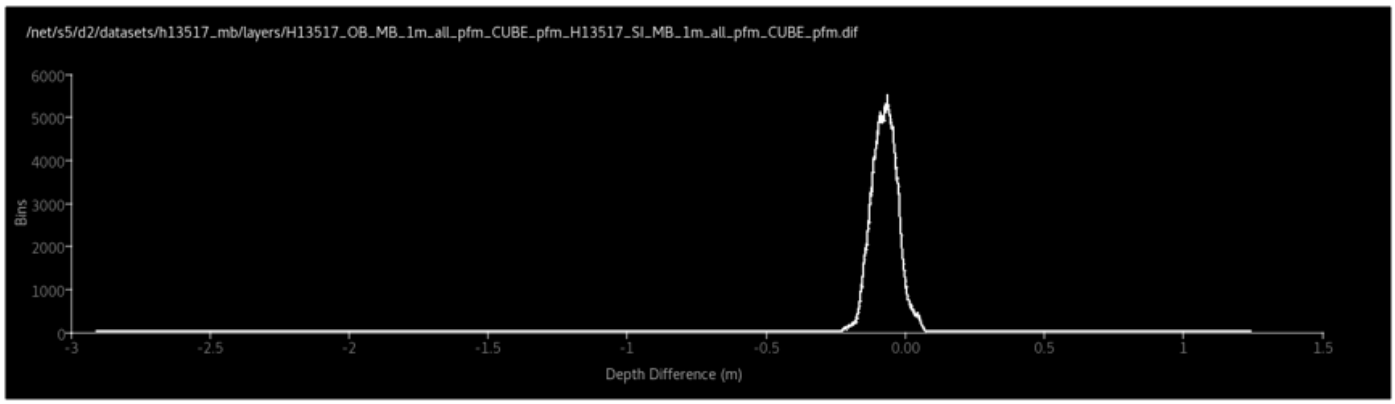

Figure 14: Plot of Vessel Comparison Analysis R/V Sea Innovator I vs. R/V Oyster Bay II

B.2.2 Uncertainty

The following survey specific parameters were used for this survey:

Method	Measured	Zoning
ERS via VDATUM	0.092 meters	0.2 meters

Table 7: Survey Specific Tide TPU Values.

Hull ID	Measured - CTD	Measured - MVP	Measured - XBT	Surface
R/V Sea Innovator I	1.0 meters/second	1.0 meters/second	1.0 meters/second	1.0 meters/second
R/V Oyster Bay II	1.0 meters/second	1.0 meters/second	1.0 meters/second	1.0 meters/second

Table 8: Survey Specific Sound Speed TPU Values.

For specific details on the use and application of the SABER Total Propagated Uncertainty (TPU) model, refer to the DAPR. Once the TPU model was applied to the GSF bathymetry data, each beam was attributed with the horizontal uncertainty and the vertical uncertainty at the 95% confidence level. The vertical and horizontal uncertainty values, estimated by the TPU model for individual multibeam soundings, varied little across the dataset, tending to be most affected by beam angle. Individual soundings that had vertical and horizontal uncertainty values above IHO S-44 6th Edition, Order 1a were flagged as invalid during the uncertainty attribution.

As discussed in the DAPR, SABER generates two vertical uncertainty surfaces; the Hypothesis Standard Deviation (Hyp. StdDev) and the Hypothesis Average Total Propagated Uncertainty (Hyp. AvgTPU). A third vertical uncertainty surface is generated from the larger value of these two uncertainties at each node and is referred to as the Hypothesis Final Uncertainty (Hyp. Final Uncertainty).

The final H13517 1-meter PFM CUBE surface contained final vertical uncertainties that ranged from 0.200 meters to 0.800 meters. The IHO Order 1a maximum allowable vertical uncertainty was calculated to range between 0.500 to 0.523 meters, based on the minimum CUBE depth (1.092 meters) and maximum CUBE depth (11.898 meters). Results from the SABER Check PFM Uncertainty function identified that there were seven nodes in the final H13517 1-meter PFM CUBE surface with final vertical uncertainties that exceeded IHO Order 1a allowable vertical uncertainty. These nodes were associated with objects within the charted fish haven, and the steep slopes associated with the edge of Swan Point Channel and with the scour surrounding an USCG ATON buoy anchor. The SABER Frequency Distribution Tool was also used to review the Hyp. Final Uncertainty surface within the final H13517 1-meter CUBE PFM grid. Results showed that 98.73% of all nodes had final uncertainties less than or equal to 0.210 meters.

B.2.3 Junctions

Per the PI, junction analysis was performed between H13517 and the surveys listed in the table below and illustrated in Figure 15; results are discussed below. Analysis of H13517 to H13685 will be provided within the H13685 Descriptive Report as final analysis and processing efforts for H13685 remain on-going.

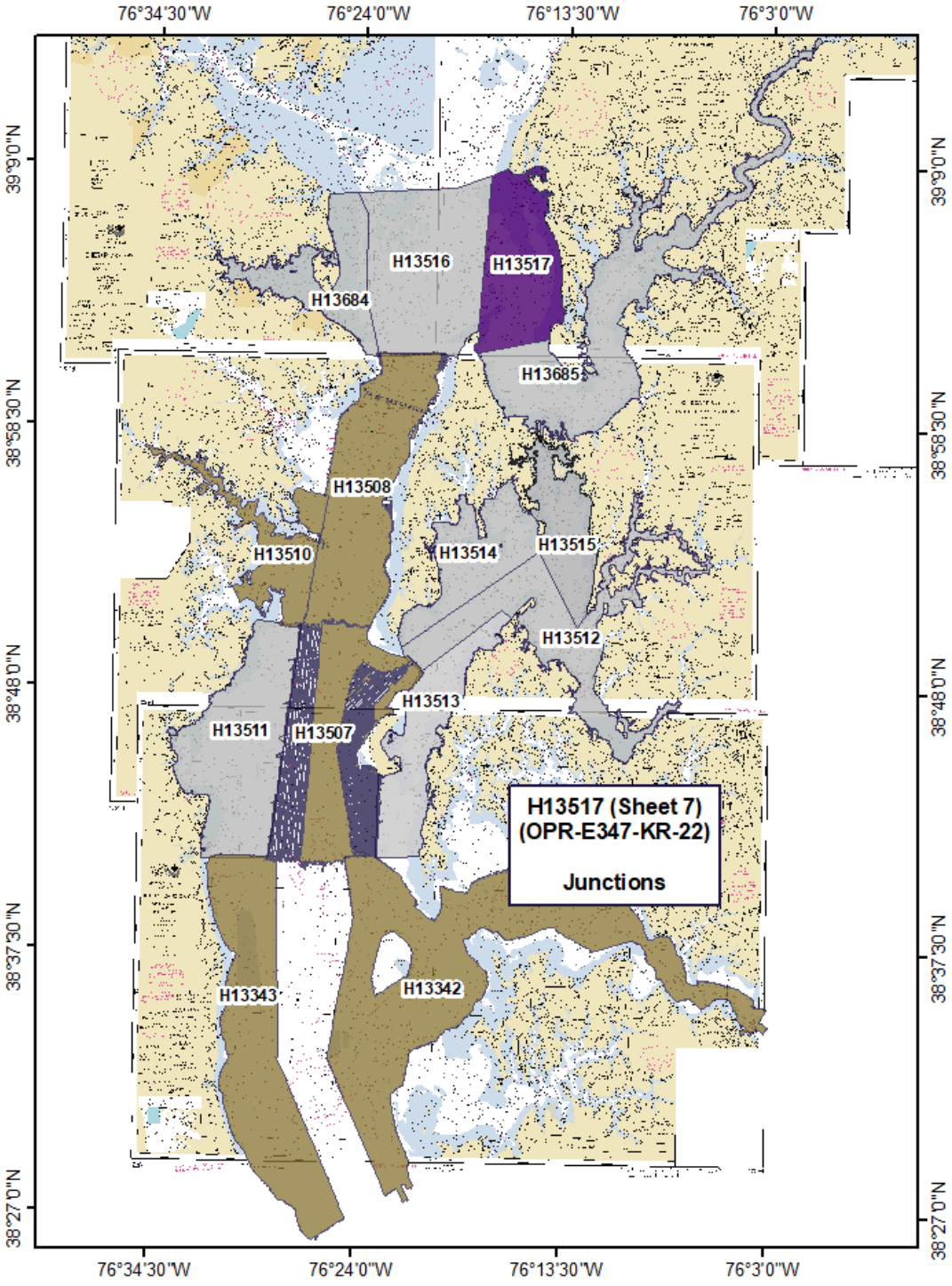

Figure 15: General Locality of H13517 with Junctioning Surveys

The following junctions were made with this survey:

Registry Number	Scale	Year	Field Unit	Relative Location
H13516	1:10000	2023	Leidos	W

Table 9: Junctioning Surveys

H13516

Junctioning survey H13516 was conducted in 2022-2023 and junctions to the west of H13517. For this analysis the H13516 50-cemtimeter CUBE surface was compared to the H13517 1-meter CUBE depth surface. Junction analysis was conducted on the common area of these two sheets, with an overlapping area approximately 11,300 by 300 meters along the western edge of H13517. Observed depths within the common area were 2.280 to 14.535 meters which resulted in a calculated allowable TVU range of 0.501 to 0.523 meters.

The difference grid was generated by subtracting the H13516 data from the H13517 data. Positive values indicate that H13517 depth data were deeper than H13516 depth data. Throughout the common area, H13517 CUBE depths were deeper 64.47% of the time and were shoaler 34.66% of the time (Figure 16) with 99.99% of the comparisons within 0.500. The distribution is skewed negative of zero as presented in Figure 17 due to the overlap area covering a feature and an ATON with deep scour.

99.99% of the comparisons were 0.250 meters or less, within the calculated allowable TVU range.

Depth Difference Range (m)	All		Positive		Negative		Zero	
	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent
0-0.010	154809	18.01	76964	8.95	70351	8.18	7494	0.87
>0.01-0.02	127346	32.82	72727	17.41	54619	14.53		
>0.02-0.03	131279	48.09	78449	26.53	52830	20.68		
>0.03-0.04	106405	60.46	65588	34.16	40817	25.43		
>0.04-0.05	92147	71.18	61556	41.32	30591	28.98		
>0.05-0.06	63374	78.55	45368	46.60	18006	31.08		
>0.06-0.07	50441	84.42	39545	51.20	10896	32.35		
>0.07-0.08	38781	88.93	32068	54.93	6713	33.13		
>0.08-0.09	32365	92.69	26926	58.06	5439	33.76		
>0.09-0.10	22829	95.35	19132	60.28	3697	34.19		
>0.10-0.11	15388	97.14	13293	61.83	2095	34.43		
>0.11-0.12	9449	98.23	8543	62.82	906	34.54		
>0.12-0.13	6189	98.95	5771	63.50	418	34.59		
>0.13-0.14	3694	99.38	3395	63.89	299	34.62		
>0.14-0.15	2389	99.66	2195	64.15	194	34.64		
>0.15-0.20	2710	99.98	2630	64.45	80	34.65		
>0.20-0.25	104	99.99	94	64.46	10	34.66		
>0.25-0.30	26	99.99	21	64.46	5	34.66		
>0.30-0.35	11	99.99	4	64.46	7	34.66		
>0.35-0.40	9	99.99	6	64.46	3	34.66		
>0.40-0.45	8	99.99	3	64.46	5	34.66		
>0.45-0.50	5	99.99	1	64.46	4	34.66		
>0.50-1.00	0	99.99	0	64.46	0	34.66		
>1.00-2.00	0	99.99	0	64.46	0	34.66		
>2.00-2.934	1	100.00	0	64.47	1	34.66		
Total	**859789**	**100.00%**	**554287**	**64.47%**	**298008**	**34.66%**	**7494**	**0.87%**
Reference Grid: H13517_MB_1m_MLLW_Final_pfm_H13516_MB_50cm_MLLW_20230525.dif								

Figure 16: Tabular Results Junction Analysis H13517 vs. H13516

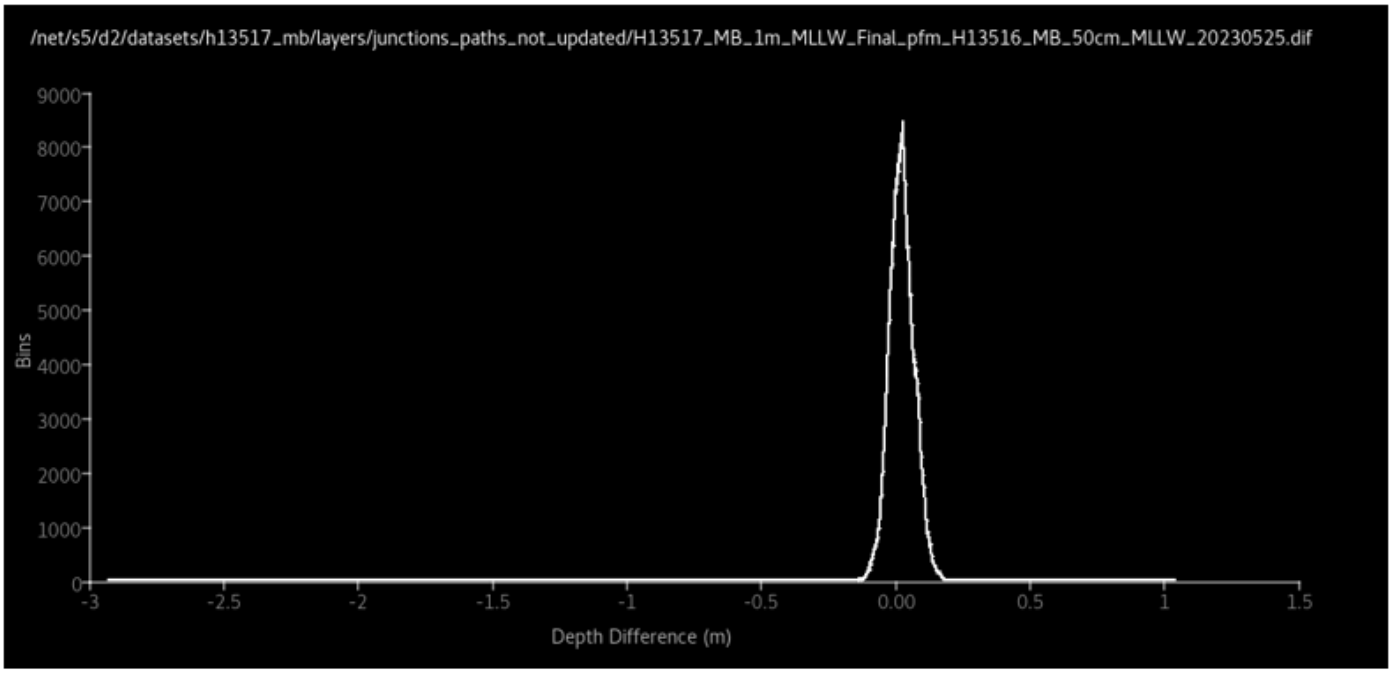

Figure 17: Plot of Junction Analysis H13517 vs. H13516

B.2.4 Sonar QC Checks

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

B.2.5 Equipment Effectiveness

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

B.2.6 Factors Affecting Soundings

Factors Affecting Soundings

Dense biological interference were observed during discrete areas and during various days of survey which required numerous holiday reruns. Additionally, throughout survey acquisition both commercial and

recreational fishing activity was heavy causing deviations in the survey acquisition lines requiring numerous holiday reruns. The end result was that there were no significant impacts to the final sounding data.

B.2.7 Sound Speed Methods

Sound Speed Cast Frequency: On the R/V Sea Innovator I, the MVP30 was the primary system used to collect sound speed profile (SSP) data, and on the R/V Oyster Bay II, the AML BaseX2 was the primary system used to collect SSP data, refer to the DAPR for additional details. SSP data were obtained at intervals frequent enough to meet depth accuracy requirements.

All sound speed profiles applied for online bathymetry data collection were acquired within 500 meters of the bounds of the survey area as specified in Section 5.2.3.3 of the HSSD.

Confidence checks of the sound speed profile casts were routinely conducted by comparing at least two consecutive casts taken with different SSP sensors.

All individual SSP files are delivered with the H13517 data and are broken out into sub-folders, which correspond to the purpose of each cast. Also, all individual SSP files for H13517 have been concatenated into two separate files based on the purpose of the cast, provided in CARIS format files (.svp), and delivered under (H13517/Processed/SVP/CARIS_SSP) on the delivery drive. In accordance with HSSD Section 8.3.6, SSP files were also converted to NCEI format, as detailed in the DAPR, and provided as a separate delivery to NCEI. Refer to the DAPR for additional details.

B.2.8 Coverage Equipment and Methods

All equipment and survey methods are detailed in the DAPR.

B.2.9 Multibeam Coverage Analysis

Leidos chose to achieve the coverage requirement using 100% SSS coverage with concurrent MBES. To achieve this coverage, the SSS was set to 50-meter range scale, and main scheme survey lines were collected at 70-meters to ensure 100% SSS coverage was achieved.

The SABER Gapchecker program was used to flag MBES data gaps within the CUBE surface. Additionally, the entire surface was visually scanned for holidays at various points during the data processing effort. Additional survey lines were run to fill any holidays that were detected as defined for complete coverage surveys in Section 5.2.2.3 of the HSSD and email correspondence dated 02/22/2023 (refer to Project Correspondence for additional details). Bathymetric data and side scan sonar imagery were reviewed and bathymetric splits were acquired if deemed necessary per Hydrographer’s discretion, as noted in Section 5.2.2.1 of the HSSD.

A final review of the CUBE Depth surface for H13517 showed that there were no holidays as defined for complete coverage surveys in Section 5.2.2.3 of the HSSD or NOAA provided guidance (02/22/2023). Any three by three node gaps were along the outer swath data beyond side scan nadir coverage

The final CUBE PFM grids were examined for the number of soundings contributing to the chosen CUBE hypotheses for each node by running SABER's Frequency Distribution Tool on the Hypothesis Number of Soundings (Hyp. # Soundings) surface. The Hyp. # Soundings surface reports the number of soundings that were used to compute the chosen hypothesis. Analysis was conducted on the Hyp. # Soundings surface of the PFM grid to ensure that the requirements for Complete Coverage surveys (HSSD Section 5.2.2.3) were met. Within the final 1-meter CUBE PFM grid 99.48% of all nodes contained five or more soundings.

As noted in Section A.4, the assigned survey bounds were achieved across H13517 except where the inshore limit of the NALL was reached or the shoreline bathymetry made it unsafe of equipment and crew to continue into shoaler depths.

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

Side Scan Sonar (SSS) Coverage Analysis: For all details regarding SSS data processing, see the DAPR. Leidos chose to adhere to the coverage requirements in the PI using Complete Coverage, Option B (100% side scan sonar coverage with concurrent multibeam). Leidos generated two separate coverage mosaics at 1-meter cell size resolution as specified in Section 8.2.1 of the HSSD (See section B.2.9 for additional information). The first 100% and second 100% coverage mosaics were independently reviewed using tools in SABER to verify data quality and swath coverage. The SABER Gapchecker routine was used to flag data gaps within each of the 100% SSS coverage mosaics. Additionally, the entirety of each SSS surface was visually scanned for holidays at various points during the data processing effort. Additional survey lines were run to fill any holidays that were detected. All coverage mosaics are determined to be complete and sufficient to meet the requirements contained within the PI and HSSD. Each 100 percent coverage mosaic

is delivered as a single georeferenced raster file (datum of NAD-83) in floating point GeoTIFF format, as specified in Sections 8.2.1 and 8.3.3 in the HSSD.

Multibeam Echo Sounder Seafloor Backscatter: For all details regarding MBES backscatter acquisition and processing see the DAPR. Leidos generated a MBES backscatter at 2-meter cell resolution; per HSSD. The MBES backscatter mosaic was reviewed for data quality and coverage. The MBES backscatter data acquired were written to the GSF in real-time by ISS-2000 and are delivered in the final GSF files for this sheet under the Processed/Sonar_Data/H13515_MB directory. The MBES backscatter mosaics were determined to be complete and sufficient to meet the requirements contained within the PI and HSSD. The coverage mosaics are delivered as a single georeferenced raster file (datum of NAD-83) in floating point GeoTIFF format, as specified in Section 6.2.4.2 in the HSSD.

B.5 Data Processing

B.5.1 Primary Data Processing Software

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

Manufacturer	Name	Version
Leidos	SABER	5.4.1.6.1

Table 10: Primary bathymetric data processing software

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

Manufacturer	Name	Version
Leidos	SABER	5.4.1.6.1
QPS	FMGT	7.10.3

Table 11: Primary imagery data processing software

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

The primary data processing software used for both bathymetry and imagery was SABER.

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
H13517_MB_1m_MLLW_Final	BAG	1 meters	1.092 meters - 11.898 meters	N/A	Complete Coverage, Option B
H13517_SSSAB_1m_400kHz_900kHz_1of1	SSS Mosaic	1 meters	-	N/A	100% SSS
H13517_SSSAB_1m_400kHz_900kHz_2of2	SSS Mosaic	1 meters	-	N/A	200% SSS
H13517_MBAB_2m_SeaInnovatorI_400kHz_1of3	MB Backscatter Mosaic	2 meters	-	N/A	Multibeam Backscatter Coverage
H13517_MBAB_2m_OysterBayII_300kHz_2of3	MB Backscatter Mosaic	2 meters	-	N/A	Multibeam Backscatter Coverage
H13517_MBAB_2m_OysterBayII_400kHz_3of3	MB Backscatter Mosaic	2 meters	-	N/A	Multibeam Backscatter Coverage

Table 12: Submitted Surfaces

Complete Coverage Section 5.2.2.3 of the HSSD requires 1-meter grid resolution for depths ranging from 0 meters to 20 meters. Leidos generated a CUBE PFM grid for H13517 at 1-meter resolution.

The final gridded bathymetry data are delivered in Bathymetric Attributed Grid (BAG) format. The BAG files were exported from the CUBE PFM grid as detailed in the DAPR.

C. Vertical and Horizontal Control

In accordance with HSSD Section 2.2, the horizontal datum for this project is NAD83. HSSD Section 2.2 states that the “only exception for the NAD83 datum requirement is that the S-57 Final Feature File (Section 7.3) will be in the WGS84 datum to comply with international S-57 specifications”. As discussed in the DAPR Section C.7, for every feature flag in a MBES GSF file, SABER converts the position from the NAD83 datum to the WGS84 datum to generate the S-57 file and comply with HSSD and IHO requirements. Feature positions meet the precision stated in HSSD Section 7.4 for each respective datum. Depending on

geographic reference there may be approximately a 1-meter difference comparing positions between NAD83 and WGS84 datums. Therefore, if the feature overrides from the BAG surface (NAD83) are compared to the Final Feature File S-57 positions (WGS84) it is anticipated that there could be positional differences exceeding those listed in Section 7.4 of the HSSD. Additional information discussing the vertical and horizontal control for this survey can be found in the DAPR.

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-E347-KR-22 _NAD83_VDatum_MLLW.cov

Table 13: ERS method and SEP file

Refer to the DAPR for details regarding the application of VDatum to the MBES data files. No final tide note was provided nor was it required from NOAA Center for Operational Oceanographic Products and Services (CO-OPS).

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 18.

PPP

The vessel kinematic data (POS/MV files) were post-processed in Applanix POSPac software using the Applanix PP-RTX solution to generate the Smoothed Best Estimate of Trajectory (SBET) solutions which were applied through SABER to the multibeam data. Refer to the DAPR for additional information and for details regarding all antenna and transducer offsets. Any soundings with total horizontal uncertainties exceeding the maximum allowable IHO S-44 6th Edition Order 1a specifications were flagged as invalid and therefore were not used in the CUBE depth calculations.

D. Results and Recommendations

D.1 Chart Comparison

Chart comparisons were conducted using a combination of SABER and CARIS' HIPS and SIPS. H13517 data met data accuracy standards and bottom coverage requirements. Leidos recommends updating the common areas of all charts using data from this survey. Review showed that the H13517 CUBE data were varied in agreement with charted depths compared to the ENCs listed in Section D.1.1. While CUBE depths generally agreed with the charted depths greater than 6-meters (±0.4m), depths less than 6-meters varied from charted depths by approximately 0.5 to 1.0 meter with CUBE depths generally found to be deeper than charted.

Charting recommendations for new features and updates to charted features, are documented in the H13517 S-57 FFF. Additional charted objects are discussed in later sections. Of note, the base and ruins of the old Love Point Light (Feature 55) are not charted on ENC US5MD12M, Leidos recommends ENC US5MD12M be updated, refer to the H13517 S-57 FFF.

United States Coast Guard (USCG) District 5 LNM publications were reviewed for changes subsequent to the date of the PI and before the end of survey. The LNM reviewed were from week 35/22 (30 August 2022) until week 24/23 (13 June 2023).

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
US5MD12M	1:40000	50	11/24/2021	06/27/2023
US5MD18M	1:40000	17	01/28/2022	04/07/2023

Table 14: Largest Scale ENCs

D.1.2 Shoal and Hazardous Features

Refer to Section D.1.4 for significant shoals or hazardous features within the area covered by this survey. Leidos submitted the following DTON reports to the Atlantic Hydrographic Branch (AHB) in S-57 format per HSSD:
-H13517_ DTON_01.000, submitted to AHB 2023-07-04, NDB registration DD-38530
-H13517_DTON_02.000, submitted to AHB 2023-07-12, NDB registration DD-38530
-H13517_DTON_03.000, submitted to AHB 2023-07-13, NDB registration DD-37412
-H13517_DTON_04.000, submitted to AHB 2023-07-13, NDB registration DD-38567

-H13517_DTON_05_06.000, submitted to AHB 2023-07-18, NDB registration DD-38581

D.1.3 Charted Features

There were numerous assigned charted features in the final CSF (CSF.000) within the SOW of H13517. Per HSSD Section 8.1.4, these charted features are not addressed in this section, refer to the H13517 S-57 FFF (H13517_FFF.000) for all the details and recommendations regarding these features.

D.1.4 Uncharted Features

See the H13517 S-57 FFF for all the details and recommendations regarding new uncharted features investigated. During the course of H13517 survey operations, fishing gear and temporary floats were observed throughout the survey area. When a temporary fishing surface float was identified and correlated to objects in the MBES data, as these data were not true seafloor the MBES data were invalidated to no longer contributed to a CUBE surface. In many cases, where it was not possible to confirm the fishing gear were not derelict or tied to a surface float, the object was retained in the MBES data. See Section B.2.5 for more information. Per the HSSD Section 7.3.6, temporary uncharted buoys associated with fishing activity were not provided in the FFF. Associated contacts are provided within the SSS Contacts S-57.

D.1.5 Channels

There were five assigned channels within the H13517 SOW from the final CSF. All assigned dredge areas fell inshore of NALL and were not surveyed. However, the survey area was coincident to Swan Point Channel leading to the Tolchester Channel (ENC US5MD12M). H13517 CUBE depths were in agreement with the charted depths.

D.2 Additional Results

D.2.1 Aids to Navigation

While there were no assigned Aids to Navigation (ATON) within the SOW of H13517 from the final CSF; there were numerous USCG and privately maintained fixed and floating ATONs within H13517. Per HSSD Section 7.3.6 and the CSF, ATONs found on-station and serving their purpose, are not provided within the FFF. Associated contacts are provided within the SSS Contacts S-57. Leidos submitted a DTON per HSSD Section 1.6.2.2, for charted ATON which was not present through the Marine Chart Division’s ASSIST customer service chart reporting system on 10 July 2023; refer to Project Correspondence.

D.2.2 Maritime Boundary Points

No Maritime Boundary Points were assigned for this survey.

D.2.3 Bottom Samples

In accordance with both the PI and Section 7.2.3 of the HSSD, bottom characteristics were obtained for H13517. Bottom characteristics were acquired at the three locations assigned in the final PRF (OPR-E347-KR-22_PRF.000). Leidos did not modify the bottom sample locations from the location proposed by NOAA in the PRF. Bottom characteristics are included in the S-57 FFF. In addition, images of the sediment obtained for each bottom sample are referenced in the S-57 FFF and are included on the delivery drive under the folder H13517/Processed/Multimedia.

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

Refer to the H13517 FFF for recommendations regarding assigned platforms within H13517.

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 other abnormal seafloor or environmental conditions, as defined in Section 8.1.4 of the HSSD, exist within this survey area other than those discussed in Section B.2.5 and D.1.2.

D.2.9 Construction and Dredging

No construction or dredging exists within the assigned H13517 area.

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.

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 Hydrographic Survey Specifications and Deliverables, Project Instructions, and Statement of Work. These data are adequate to supersede charted data in their common areas. This survey is complete and no additional work is required. Previously, or previously, submitted deliverables for OPR-E347-KR-22 are provided in the table below.

Report Name	Report Date Sent
OPR-E347-KR-22 Final Project Summary Report.pdf	2023-05-31
OPR-E347-KR-22_ Marine_Species_Awareness_Training_Record.pdf	2023-06-21
OPR-E347-KR-22_Coast Pilot Review Report.pdf	2023-06-22
OPR-E347-KR-22_DAPR.pdf	2023-07-17
H13511_DR.pdf	2023-07-17
H13515_DR.pdf	2023-07-18
OPR-E347-KR-22_20230719.zip (NCEI Sound Speed Data)	2023-07-19
H13514_DR.pdf	2023-07-19

Approver Name	Approver Title	Approval Date	Signature
Dorena S. Vogel	Lead Hydrographer	07/20/2023	Dorena S. Vogel Digitally signed by: Dorena S. Vogel DN: CN = Dorena S. Vogel email = vogelds@leidos.com C = US O = Leidos Date: 2023.07.20 13:24:30 -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