H13591

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

DESCRIPTIVE REPORT

Type of Survey:	Navigable Area
Registry Number:	H13591

LOCALITY

State(s):	Alaska
General Locality:	Bering Sea
Sub-locality:	Cape Mohican to Iloodak Point

2022

CHIEF OF PARTY
Andrew Orthmann

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Date:

U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	REGISTRY NUMBER:
HYDROGRAPHIC TITLE SHEET	**H13591**

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):	**Alaska**
General Locality:	**Bering Sea**
Sub-Locality:	**Cape Mohican to Iloodak Point**
Scale:	**80000**
Dates of Survey:	**06/16/2022 to 08/13/2022**
Instructions Dated:	**02/08/2022**
Project Number:	**OPR-R302-KR-22**
Field Unit:	**Terrasond**
Chief of Party:	**Andrew Orthmann**
Soundings by:	**Multibeam Echo Sounder**
Imagery by:	**Multibeam Echo Sounder Backscatter**
Verification by:	**Pacific 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 3N, 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 H13591

Project: OPR-R302-KR-22

Locality: Bering Sea

Sublocality: Cape Mohican to Iloodak Point

Scale: 1:80000

June 2022 - August 2022

Terrasond

Chief of Party: Andrew Orthmann

A. Area Surveyed

The survey area is located off of northwest Nunivak Island, Alaska, in the Bering Sea.

The remote region is located in the Arctic. The area experiences pack ice for a large portion of the year, from approximately November through April, normally opening to navigation in late May or early June.

The area experiences frequent inclement weather due to its location in the Bering Sea, and has high exposure in most directions. Inclement weather conditions were often experienced here during survey operations which hampered work that could be completed, especially with the small survey vessel.

Field work for hydrographic data collection was carried out from June through August of 2022 under project OPR-R302-KR-22, with final processing and reporting occurring from September through December, 2022. Work was completed concurrently with five other sheets in the Nunivak Island region in accordance with the Hydrographic Survey Project Instructions (dated February 8th, 2022), accompanying Scope of Work, and the NOAA Hydrographic Surveys Specifications and Deliverables (HSSD, 2022 edition).

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
60° 28' 34.08" N 167° 41' 31.83" W	60° 7' 26.24" N 167° 5' 4.3" W

Table 1: Survey Limits

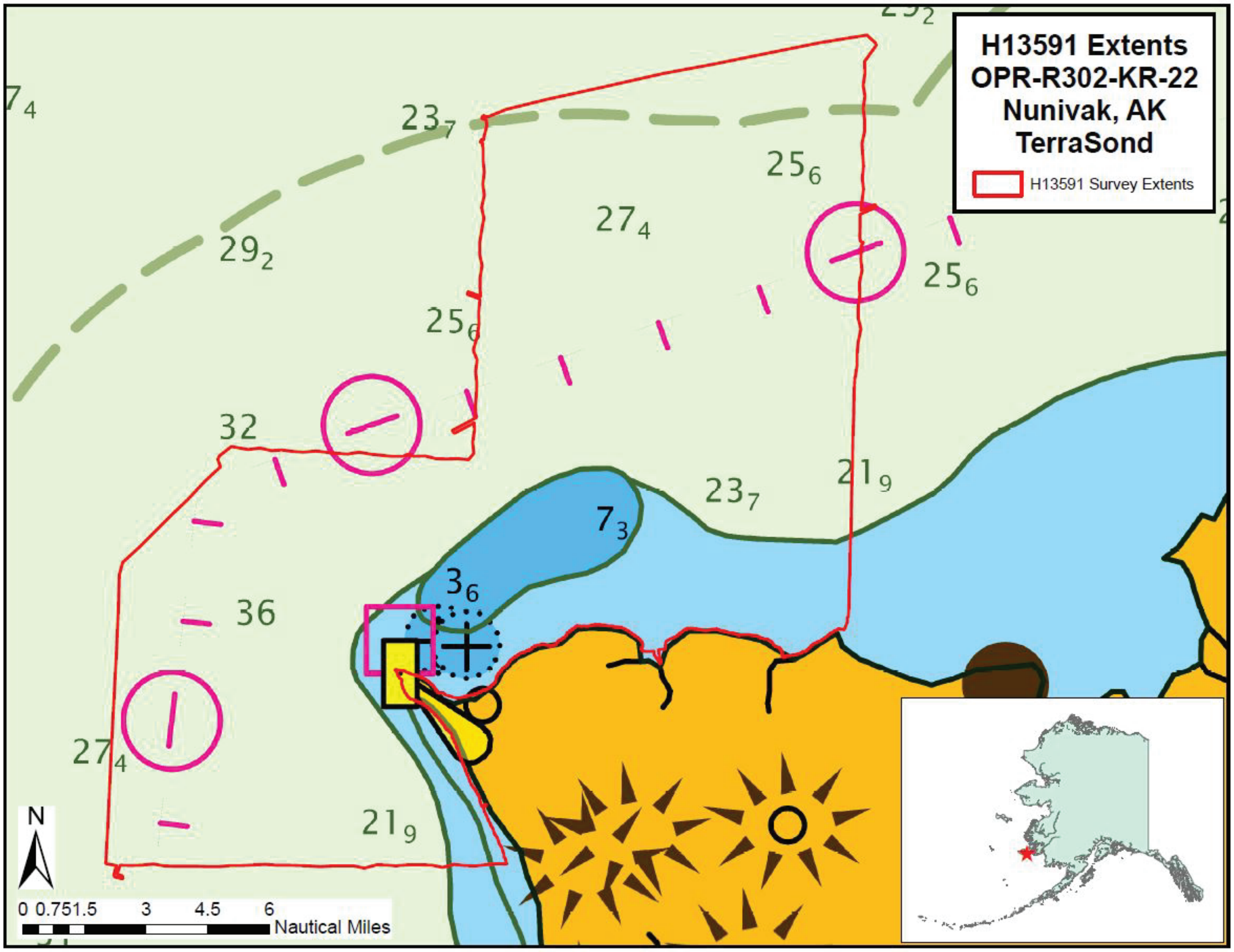

Figure 1: Image showing an overview of survey extents.

Survey limits were acquired in accordance with the requirements in the Project Instructions and the HSSD.

A.2 Survey Purpose

The purpose of this survey is described as follows in the Project Instructions:

The Nunivak project will provide contemporary surveys to update National Ocean Service (NOS) nautical charting products and services in waters that have not been surveyed since before Alaska was declared a state. The 1500 square nautical miles of targeted areas are important to the strategic maritime infrastructure of Alaska both on a local scale and on a regional scale.

Nunivak Island is strategically important to Alaska, as it can be used by regional traffic, supply tanks, and USCG PARS corridor to seek protection from weather. The survey vintage of these charts are 1902 and 1953. Old and sparse data elevate the potential risk for grounding. The survey will provide updated bathymetry and feature data that will be used to create larger scale charts for strategic waters in the area, reducing the risk to navigation for vessels transiting the area.

The project will support the remote coastal community Mekoryuk by providing the base data to update nautical products for nearby waters, including Nash Harbor. These products can improve the safety of subsistence fishing, marine transportation, and shipment of goods to the city. Shipments include the transportation of fuel, which need to be transported to smaller vessels in lightering areas. Survey areas have been prioritized to focus on vessel lightering areas identified by the Western Alaska Tanker Lightering Best Practices Committee, as part of the Alaska Maritime Prevention Response Network.

The lightering areas, traffic patterns, and regional requests were used to delineate and prioritize the Nunivak project. Data will supersede all prior survey data providing modern hydrographic survey data for this area and updating the local charting products.

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	Complete a minimum of 7,300 LNM. Transit mileage, system calibration mileage and data which do not meet HSSD specifications shall not count towards the completion of the LNM requirement. 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.
All waters in survey area	Set Line Spacing system of MBES with concurrent backscatter (Refer to HSSD Section 5.2.2.4 Option A).
H13591	Sounding lines shall be acquired with spacing adequate to collect data at an interval of at least 480 meters.
All Sheets - SDB Checklines	Within each shoreline sheet, acquire four geographically dispersed sounding lines that extend to the inshore limit of safe navigation. The field unit will choose the location. Prioritize areas outside cell margin. See Cell_OPR-R302-KR-22_Nunivak.shp for overlap margins.

Table 2: Survey Coverage

Coverage requirements were met. Additional clarification on specific requirements are provided below.

LNM Requirements:

The project required 7,797 LNM of multibeam data to be collected project-wide. This consisted of the originally assigned 7,300 and an additional 497 tasked by the Government on August 16, 2022. Correspondence is included with the project deliverables.

8,050 LNM was actually acquired project-wide, exceeding requirements by 253 LNM. The excess of approximately 3.2% was collected to compensate for inefficiencies incidental to data collection such as crossline mileage that exceeded requirements, data acquired on run-ins or run-outs (including in shallow water in order to scout depths between lines), and excess overlap (if any). LNM quantities do not include transit or calibration data, or data that does not meet HSSD specifications.

Inshore Limit:

The inshore limit was defined in the Project Instructions as the NALL, with its minimum depth contour definition at 9.5 m. This depth limit was achieved.

Note that soundings were intentionally collected in depths less than 9.5 m over a shoal located northeast of Cape Mohican. The shoal is detached from shore and therefore mainscheme lines were extended over the top of the feature near high tide to obtain its least depth. The shoal is discussed in more detail later in this report.

SDB Checklines:

SDB (Satellite Derived Bathymetry) checklines, to be used for SDB calibrations, were acquired at locations chosen by the field crew. Areas outside the provided cell margins were prioritized, but personnel and vessel safety took precedence in location decisions. For the checklines, the ASV-CW5 vessel collected data as shallow as possible, until it was deemed unsafe to continue closer to shore. These checklines were normally acquired at mid- to high- tide in order to achieve as shoal of a tide-corrected depth as possible. All SDB checkline data is included in the final surface submitted with the survey deliverables. The image below shows their relative location and minimum depths achieved.

Note that due to the rugged and steep nature of the coastline in this area, and the frequent inclement weather conditions, it was only safe to acquire two SDB checklines with the vessel running directly towards shore. These are the 3.3 and 4.5 m sounding checklines shown in the figure below. The others were acquired as outer beam data while the vessel was running parallel to shore during nearshore contour traces. Additionally, some soundings shoaler than the checkline data was incidentally collected during mainscheme collection and is available in the final surface as well.

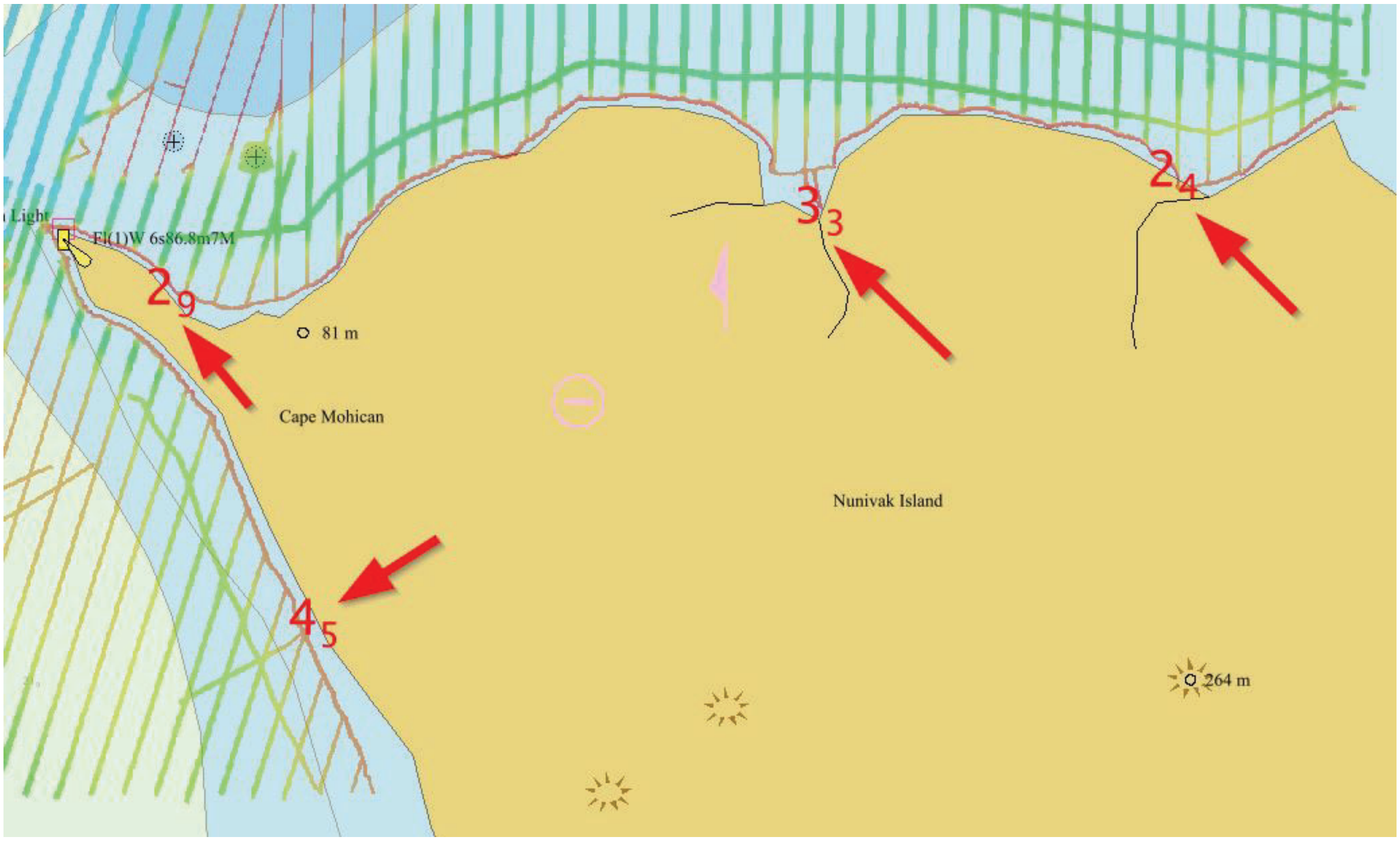

Figure 2: Image showing an overview of SDB checkline locations. Red arrows indicate the location of least depths obtained on SDB checklines. Soundings (red) show least depth achieved, in meters.

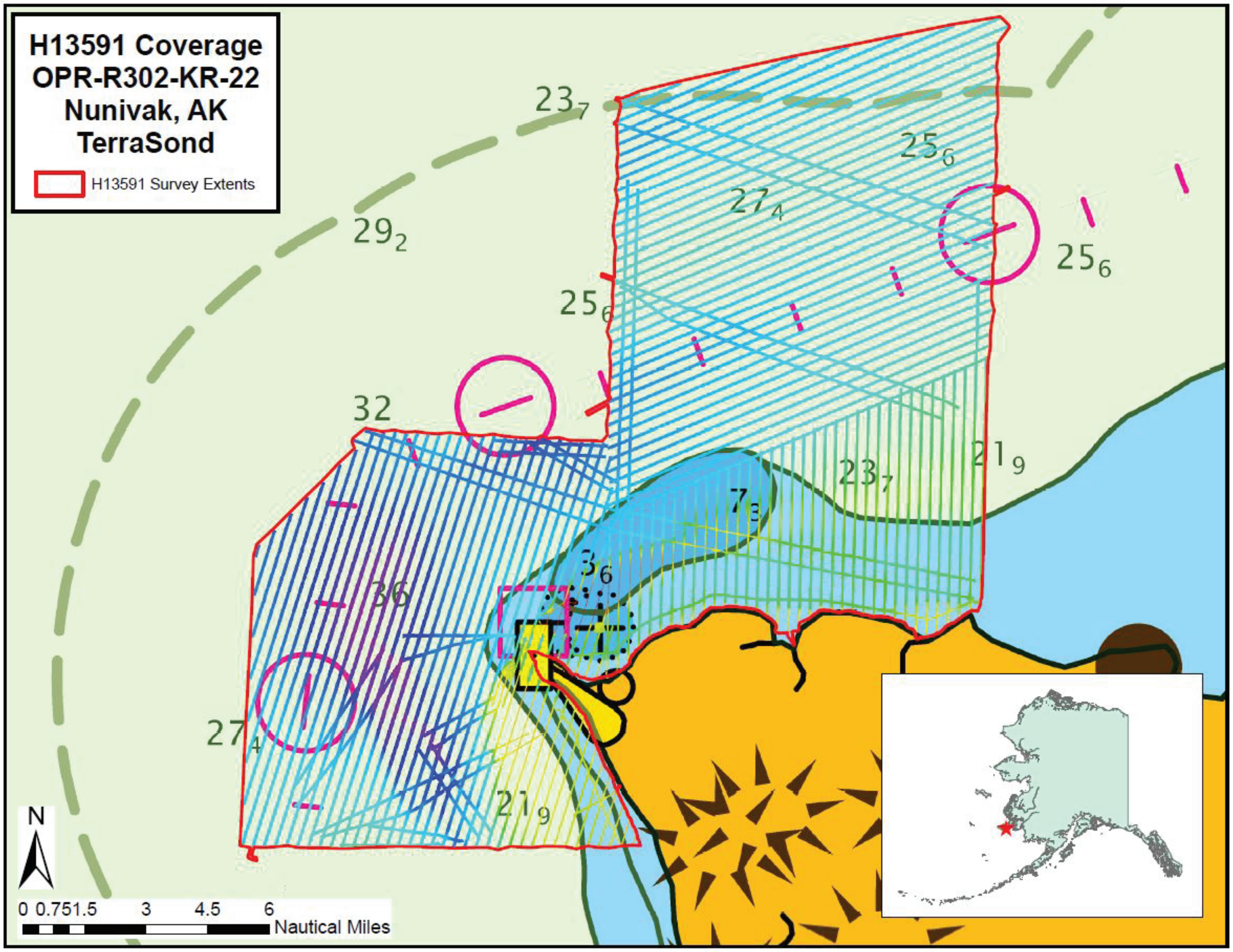

Figure 3: Image showing an overview of survey coverage.

A.6 Survey Statistics

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

	HULL ID	*Qualifier 105*	*ASV-CW5*	*Total*
LNM	**SBES Mainscheme**	0.0	0.0	0.0
	MBES Mainscheme	486.9	425.5	912.4
	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	0.0	0.0	0.0
	SBES/MBES Crosslines	73.2	58.3	131.4
	Lidar Crosslines	0.0	0.0	0.0
Number of Bottom Samples				11
Number Maritime Boundary Points Investigated				0
Number of DPs				0
Number of Items Investigated by Dive Ops				0
Total SNM				211.0

Table 3: Hydrographic Survey Statistics

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

Survey Dates	Day of the Year
06/16/2022	167

Survey Dates	Day of the Year
06/17/2022	168
06/20/2022	171
06/21/2022	172
06/23/2022	174
06/24/2022	175
06/25/2022	176
06/26/2022	177
07/02/2022	183
07/17/2022	198
07/22/2022	203
07/23/2022	204
07/29/2022	210
07/30/2022	211
08/03/2022	215
08/04/2022	216
08/05/2022	217
08/11/2022	223
08/12/2022	224
08/13/2022	225

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	*Qualifier 105*	*ASV-CW5*
LOA	32.0 meters	5.5 meters
Draft	1.8 meters	0.6 meters

Table 5: Vessels Used

Figure 4: ASV-CW5 (foreground) and Qualifier 105 (background).

The Qualifier 105 (Q105) is a 32 m aluminum-hull vessel owned and operated by Support Vessels of Alaska. The Q105 acquired multibeam data and provided housing and facilities for on-site data processing. The vessel was also used to collect bottom samples, deploy/recover tide buoys, conduct sound speed casts, and deploy/recover the ASV-CW5 vessel.

The ASV-CW5 (ASV) is a 5.5 m aluminum-hull Autonomous Surface Vessel (ASV), C-Worker 5 model, owned and operated by L3-Harris ASV. The ASV was operated in an uncrewed but monitored mode, collecting multibeam data in close proximity to the Q105, as well as in areas too shallow for the Q105.

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
Teledyne RESON	SeaBat T50-R	MBES Backscatter
Applanix	POS MV 320 v5	Positioning and Attitude System
Teledyne Oceanscience	rapidCAST	Sound Speed System
Valeport	SWiFT SVP	Sound Speed System
AML Oceanographic	SV-Xchange	Sound Speed System

Table 6: Major Systems Used

The survey vessels were configured for MBES data collection with nearly identical survey equipment and software. Both vessels utilized Reson Seabat T50-R MBES systems, with surface sound speed measurements provided by AML Oceanographic Micro-X sensors. Both vessels used Applanix POSMVs (integrated into the T50-R MBES systems) with submersible IP-68 rated IMUs for attitude and position measurements. Sound speed profiles were collected using a Valeport SWiFT sensor, deployed while underway using a Teledyne Oceanscience RapidCast system, on the Q105. QPS QINSy software, running on Microsoft Windows 10-based PCs, was used for multibeam data logging and vessel navigation.

B.2 Quality Control

B.2.1 Crosslines

Effort was made to ensure crosslines (XLs) had good temporal and geographic distribution, were angled to enable nadir-to-nadir comparisons, and that the required minimum percent of mainscheme LNM was achieved.

Crosslines were conducted with both vessels to ensure there was ample overlap for inter-vessel comparisons, with each vessel crossing the other's mainscheme lines. Since the two vessels worked in close proximity and normally ran parallel lines, crosslines were collected in sets whenever both vessels were in simultaneous operation. The collection of crosslines in sets, while spreading sets out across the survey area for good distribution, led to incidental collection of additional crossline LNM beyond the required 8% of mainscheme.

Crosslines were often collected while transiting across the survey area to reach a different survey priority such as bottom sample locations or infills, leading to crosslines that were diagonal to the direction of mainscheme lines.

The crossline analysis was conducted using CARIS HIPS “Line QC Report” process. Each crossline (with all associated file segments) was selected and run separately through the process, which calculated the depth difference between each accepted crossline sounding and a "QC" BASE (CUBE-type) surface’s depth layer created from the mainscheme data. The QC surface was created with the same parameters and resolution used for the final surface, with the important distinction that the QC surface did not include crosslines so as to not bias the results. Differences in depth were grouped by beam number and statistics were computed, including the percentage of soundings with differences from the QC surface falling within IHO Order 1a.

When at least 95% of the sounding differences exceed IHO Order 1a, the crossline was considered to “pass,” but when less than 95% of the soundings compare within IHO Order 1, the crossline was considered to “fail.” A 5% (or less) failure rate was considered acceptable since this approach compares soundings to a surface (instead of a surface to a surface), allowing for the possibility that noisy crossline soundings that don't adversely affect the final surface could be counted as a QC failure in this process.

Lines selected as crosslines and their percentage (%) of soundings passing IHO Order 1a, sorted from highest passing to lowest, are listed below.

0671-210-Q105-C2_Nearshore_XL_-_0001-0003 -- 100.0% pass
0599-204-Q105-C_XL0001_-_0001-0004 -- 100.0% pass
0886-224-Q105-Sheet_C_XL_8_-_0001-0004 -- 100.0% pass
0846-204-ASV-C_XL0002_-_0001-0004 -- 100.0% pass
0104-172-Q105-C2_S_XL2_-_0001-0002 -- 100.0% pass
1444-223-ASV-C2-XL_0006_-_0001-0002 -- 100.0% pass
0028-168-ASV-C2-XL-0002_-_0001 -- 100.0% pass
0022-168-Q105-C2-XL_-_0001-0002 -- 100.0% pass
1492-224-ASV-C-XL-0020_-_0001-0002 -- 100.0% pass
0862-223-Q105-C2-XL_0005_-_0001-0002 -- 100.0% pass
0814-215-Q105-C1_XL01_-_0001-0004 -- 100.0% pass
0892-224-Q105-C-XL-0010_-_0001-0002 -- 100.0% pass
0187-172-ASV-C2_S_XL1_-_0001 -- 100.0% pass
1402-215-ASV-C1_XL02_-_0001-0004 -- 100.0% pass
0178-171-ASV-C2-XL-0003_-_0001 -- 100.0% pass
0029-168-ASV-C2-XL-0002_-_0001 -- 100.0% pass
1445-223-ASV-C1-XL_0002_-_0001-0004 -- 100.0% pass
0094-171-Q105-C2-XL-0004_-_0001 -- 100.0% pass
1493-224-ASV-C-XL-002_-_0001 -- 100.0% pass
0864-223-Q105-C-C1-XL_0001_-_0001-0004 -- 100.0% pass
0893-224-Q105-C-XL-0011_-_0001 -- 100.0% pass
0155-174-Q105-C2_XL_-_0001 -- 100.0% pass
0176-176-Q105-C1_13440-XL_-_0001-0006 -- 100.0% pass
0895-224-Q105-C-XL-0012_-_0001-0003 -- 100.0% pass
1496-224-ASV-C-XL-0022_-_0001-0003 -- 100.0% pass
0252-174-ASV-C2_XL_ASV_-_0001 -- 99.9% pass
0253-174-ASV-C2_XL_ASV_-_0001 -- 99.9% pass
0154-174-Q105-C2_XL_-_0001-0002 -- 99.9% pass
1484-224-ASV-Sheet_CXL_9_-_0001-0004 -- 99.7% pass

Results: Agreement between them mainscheme surface and crossline soundings is excellent. Of 29 crosslines, all pass QC. At least 95% of all crossline soundings compare to the mainscheme surface within IHO Order 1a for all crosslines. Refer to Separate II: Digital Data for the detailed Crossline QC reports.

B.2.2 Uncertainty

The following survey specific parameters were used for this survey:

Method	Measured	Zoning
ERS via ERTDM	0.13 meters	0.0 meters

Table 7: Survey Specific Tide TPU Values.

Hull ID	Measured - CTD	Measured - MVP	Measured - XBT	Surface
Qualifier 105	0 meters/second	2.1 meters/second	0 meters/second	0.025 meters/second
ASV-CW5	0 meters/second	2.1 meters/second	0 meters/second	0.025 meters/second

Table 8: Survey Specific Sound Speed TPU Values.

The uncertainty layer of the final surface was examined in CARIS HIPS, as well as analyzed in Pydro QC Tools V3.7.0 Grid QA v6.

Uncertainty of the final grid cells range from 0.336 to 1.339 m. Greater than 99.5% of grid cells have TVU falling within the allowable range by depth. The larger values were observed to be in areas of highly variable and rocky seafloor, primarily on near-shore traces, where many soundings of different depths contribute to the value a grid cell, resulting in a overall higher standard deviation for the grid cell. Despite the higher uncertainty computed for some grid cells, depths for all final grid cells are within specifications.

B.2.3 Junctions

During field operations, effort was made to ensure sufficient overlap was achieved between lines run in adjacent survey sheets in order to complete junction analysis. This included extending survey lines into overlapping sheets, and in some cases running survey lines along junction boundaries.

The "Gridded Surface Comparison V19.4" utility within Pydro was used to compare survey junctions. The utility differences the surfaces from the two surveys and generates statistics that include the percentage of grid cells that compare to within allowable TVU for the depth. 4 m resolution surfaces were used for all comparisons.

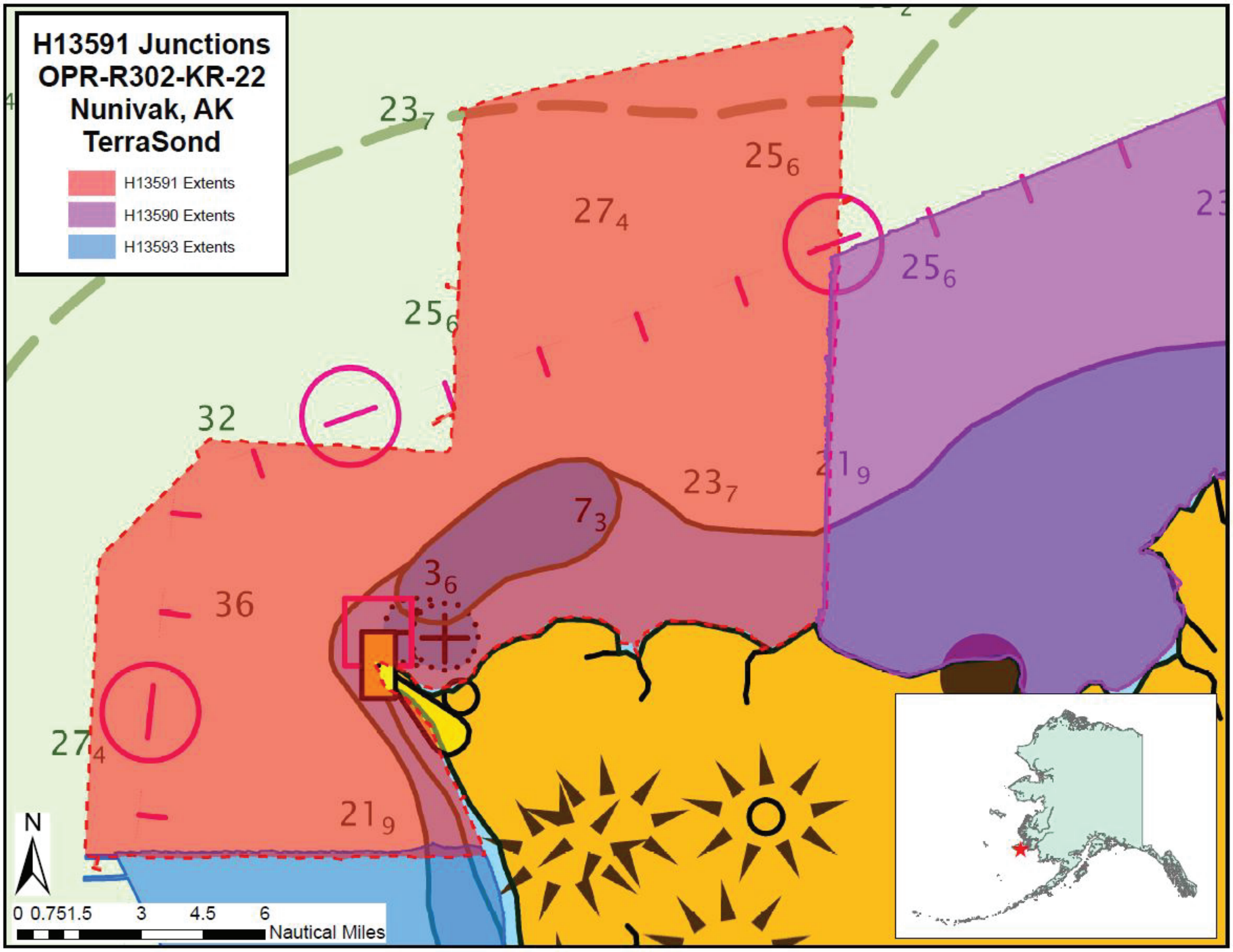

Figure 5: Overview of junctions with this survey.

The following junctions were made with this survey:

Registry Number	Scale	Year	Field Unit	Relative Location
H13590	1:40000	2022	TerraSond	E
H13593	1:80000	2022	TerraSond	S

Table 9: Junctioning Surveys

H13590

Agreement between the two surveys is excellent. The mean difference is 0.03 m with a standard deviation of 0.06 m. Greater than 99.5% of grid cells agree to within allowable TVU for the depth.

H13593

Agreement between the two surveys is excellent. The mean difference is 0.03 m with a standard deviation of 0.08 m. 100% of grid cells agree to within allowable TVU for the depth.

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

Data Blowouts

During rough weather conditions air bubbles would occasionally be forced under the multibeam sonar head and result in temporary loss of bottom tracking or "blowouts", sometimes resulting in along-track gaps.

In addition, near the end of the project, a failing MBES cable on the Q105 caused intermittent data loss resulting in occassional blowouts similar in appearance to air bubble-caused blowouts.

These were examined and normally only rerun when the along-track gap exceeded three nodes (12 m horizontal distance) for mainscheme lines. These were not rerun where they occurred on crosslines since there was ample crossline LNM for QC purposes. Final data is within specifications.

B.2.6 Factors Affecting Soundings

Sound Speed Error

Sound speed error, which is characterized by a general upward or downward across-track cupping of sounding data that increases in magnitude towards the outer beams, is evident sporadically in the dataset. This was most evident on the west side of the survey area, on lines run earlier in the project, and is more prevalent in this sheet (as well as junctioning survey H13593 to the south) than the other surveys run under OPR-R302-KR-22.

Profiles were taken frequently, at least every two hours, and whenever changing areas, but some residual error remains. In processing, beam filters were applied to reject outer beams greater than 65 degrees from nadir in order to reject soundings most subject to sound speed error. In addition, some survey lines showing higher sound speed error received additional filtering to 55 degrees.

The effect on the final surfaces is relatively minor, usually to 0.25 m or less on grid cells furthest from nadir. Final data is within specifications.

Bottom Change

The seafloor in this area, especially in the vicinity of Cape Mohican, appears to be very dynamic. Evidence of sediment transport is prevalent. Sandwaves are widespread both northeast and southwest of the Cape.

On the shoal northeast of Cape Mohican, bottom change from sandwave movement was obvious on lines run days to weeks apart, resulting in relatively large vertical shifts or "busts" in overlapping data, with some observed to be as great as 1.5 meters. An example is shown in the image below.

Note that no effort was made to edit or "choose" a seafloor in these areas.

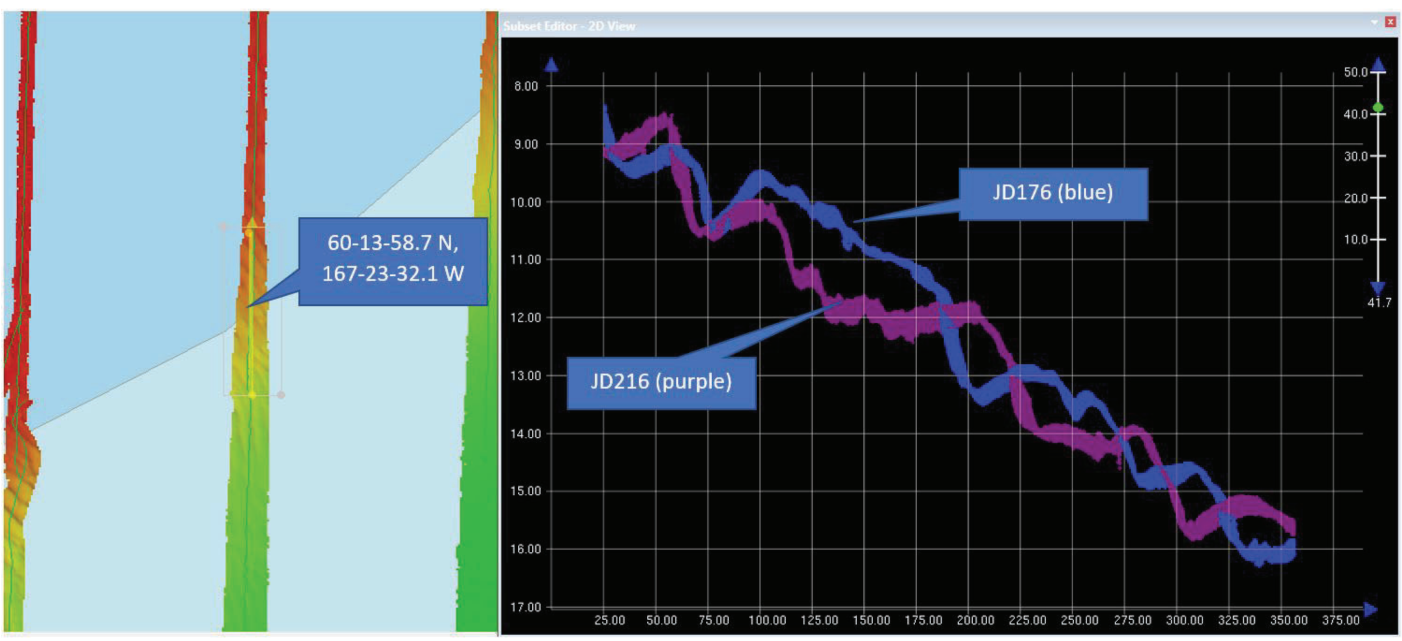

Figure 6: An example from CARIS subset mode northeast of Cape Mohican of bottom change from sandwave movement resulting in vertical busts of up to 1.5 meters. The data was collected 40 days apart.

B.2.7 Sound Speed Methods

Sound Speed Cast Frequency: 2 hours

Sound speed profiles or "casts" were acquired aboard the Q105 while underway with a Teledyne Oceanscience RapidCAST system, which utilized a Valeport SWiFT sound speed profiler. Note that the ASV-CW5 was not equipped to collect sound speed profiles -- Q105 sound speed profiles were used to correct all ASV sounding data, which was possible because the vessels always worked in close proximity to each other (usually within 2 kilometers).

Surface sound speed at the sonar head was monitored continuously and a new cast was collected when the surface speed varied from the previous profile's speed at the same depth by greater than 2 m/s, leading to a cast interval of approximately 2 hours.

Casts were taken as deep as possible. On survey lines with significant differences in depth, the deeper portion of the line was normally favored to ensure that changes across the full water column were measured. The cast data was used to correct the sounding data using the "nearest in distance within time" (set to 2 hours) within CARIS HIPS.

B.2.8 Coverage Equipment and Methods

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

B.2.9 GPS Vertical Busts

Although vertical agreement between overlapping lines is generally very good, normally within 0.10 m or better, vertical busts attributable to GPS positioning error are apparent sporadically in the data set. On rare occasions these reach approximately 0.20 m in this area. Any that approached or exceeded IHO Order 1a for their depth were investigated and addressed in processing. All crosslines pass within IHO Order 1a, and final surfaces are within allowable TVU for the depth.

B.3 Echo Sounding Corrections

B.3.1 Corrections to Echo Soundings

The following exceptions to standard methodology described in the DAPR were completed in processing. All final data is within specifications.

SVP Exceptions:

1. Line file 0107-172-Q105-C2_05760_-_0004 used "nearest in distance" within three hours
2. Line files 0153-174-Q105-C2_12480 (segment 1 and 2) used "previous in time" to improve SVP error

B.3.2 Calibrations

All sounding systems were calibrated as detailed in the DAPR.

B.4 Backscatter

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

B.5 Data Processing

B.5.1 Primary Data Processing Software

The following Feature Object Catalog was used: NOAA Extended Attribute Files V2022_1.

The most current version of NOAA's Extended Attribute Files available at the start of survey operations was utilized for this project.

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
H13591_MB_4m_MLLW_Final	CARIS Raster Surface (CUBE)	4 meters	1.648 meters - 41.19 meters	NOAA_4m	MBES Set Line Spacing
H13591_MB_1m_MLLW_Final	CARIS Raster Surface (CUBE)	1 meters	13.6 meters - 20.0 meters	NOAA_1m	Complete MBES

Surface Name	Surface Type	Resolution	Depth Range	Surface Parameter	Purpose
H13591_MBAB_2m_400kHz_1of1	MB Backscatter Mosaic	2 meters	0.0 meters - 80.0 meters	N/A	MBES Set Line Spacing

Table 10: Submitted Surfaces

The final depth information for this survey was submitted as a single 4 m resolution CARIS BASE surface (CSAR format) which best represents the seafloor at the time of the 2022 survey. The surface was created from fully processed data with all final corrections applied.

A 1 m resolution surface was also provided. This was submitted to demonstrate that Complete MBES coverage was achieved at an assigned feature location. The extents of this surface was limited to include only the feature investigation area.

Surfaces were created using NOAA CUBE parameters and resolutions in conformance with the 2022 HSSD. Surfaces were finalized, and designated soundings applied where applicable.

Horizontal projection was selected as UTM Zone 3 North, NAD83(2011).

Non-finalized versions of the CSAR surfaces are also included with the survey deliverables for reference. These do not have the "_Final" designation in the filename.

Multibeam Acoustic Backscatter (MBAB) surface(s), produced with QPS Fledermaus Geocoder Toolbox (FMGT), is also provided. MBAB data for both vessels, acquired using 400 kHz, is combined in the mosaic.

A Final Feature File (FFF) in S-57 format is included with the survey deliverables. The FFF includes bottom samples, and the results of feature investigations where applicable.

C. Vertical and Horizontal Control

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

C.1 Vertical Control

The vertical datum for this project is 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 ERTDM	OPR-R302-KR-22_Sheets08232022_ERTDM2021_NAD83(2011)-MLLW

Table 11: ERS method and SEP file

All soundings were reduced to MLLW using the ERTDM NAD83 to MLLW separation model grid file provided by NOAA using ERS methodology. The uncertainty stated for the model in the Project Instructions is 0.13 m.

H13591 was conducted in 2022. At the time, the field was provided a preliminary ERTDM SEP Model for the field party to reduce their sounding elevations from ellipsoidal heights to depths referenced to MLLW. As part of their survey operations, the field party set up a series of tide buoys to help improve ellipsoidal-to MLLW datum reduction modeling in the area. In early 2023, HSTB provided updated SEP models to the hydrographic branches, based on the tide data collected by the buoys. The hydrographic branch used two vertical shifts to transform submitted data depths. The first shift used the original 2022 SEP Model to return gridded depths to the ellipsoidally referenced elevations. The second shift used the improved 2023 SEP to reduce grid depths back to MLLW. The hydrographic branch did not re-process the individual soundings that generate the grids. All HDCS data remains referenced to MLLW, based on the original SEP model. Sounding depths of original HDCS sounding data vary from the grids approved for charting anywhere between +/- 0.11m.

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 3.

The following PPK methods were used for horizontal control:

- RTX

PPP

Post-processing of all navigation data for final positions was done in Applanix POSPac MMS (v8.7) software. Trimble PP-RTX was used as the processing methodology within POSPac, with exceptions (if any) noted previously in this report.

RTK

Real-time positions were primarily RTK. Hemisphere SmartLink antennas on each vessel were set to receive the subscription-based Atlas H-10 service, which output WGS84-based RTCM corrections to each vessel's POSMV, allowing them to operate in RTK mode. This assisted with real-time positioning, especially helping to ensure depth requirements relative to chart datum were met. However, all real-time positions were replaced in post-processing with NAD83(2011)-based PPK positions.

WAAS

The Wide Area Augmentation System (WAAS) was used incidentally for real-time positions as a backup when there were issues receiving RTK corrections. However, all real-time positions were replaced in post-processing with PPK positions, as described previously.

D. Results and Recommendations

D.1 Chart Comparison

The chart comparison was performed by examining the best-scale Electronic Navigational Charts (ENCs) that intersect the survey area. The latest edition(s) available at the time of report compilation were used.

The chart comparison was accomplished by overlaying the finalized BASE surface(s) with shoal-biased soundings and the final feature file (FFF) on the charts in CARIS HIPS. The general agreement between charted soundings and survey soundings was then examined and a more detailed comparison was undertaken for any shoals or other dangerous features.

In areas where a large scale chart overlapped with a small scale chart, only the larger scale chart was examined. When comparing to survey data, chart scale was taken into account so that 1 mm at chart scale was considered to be the valid radius for charted soundings and features. Results are shown in the following sections. It is recommended that in all cases of disagreement this survey should supersede charted data.

ENC metadata and non-specific geographic area objects on the ENCs that overlap the survey area were not investigated.

Charted soundings that overlap this survey are sparse. Where charted soundings do overlap, agreement is generally within 1 to 2 meters.

The following images show general sounding agreement with the chart.

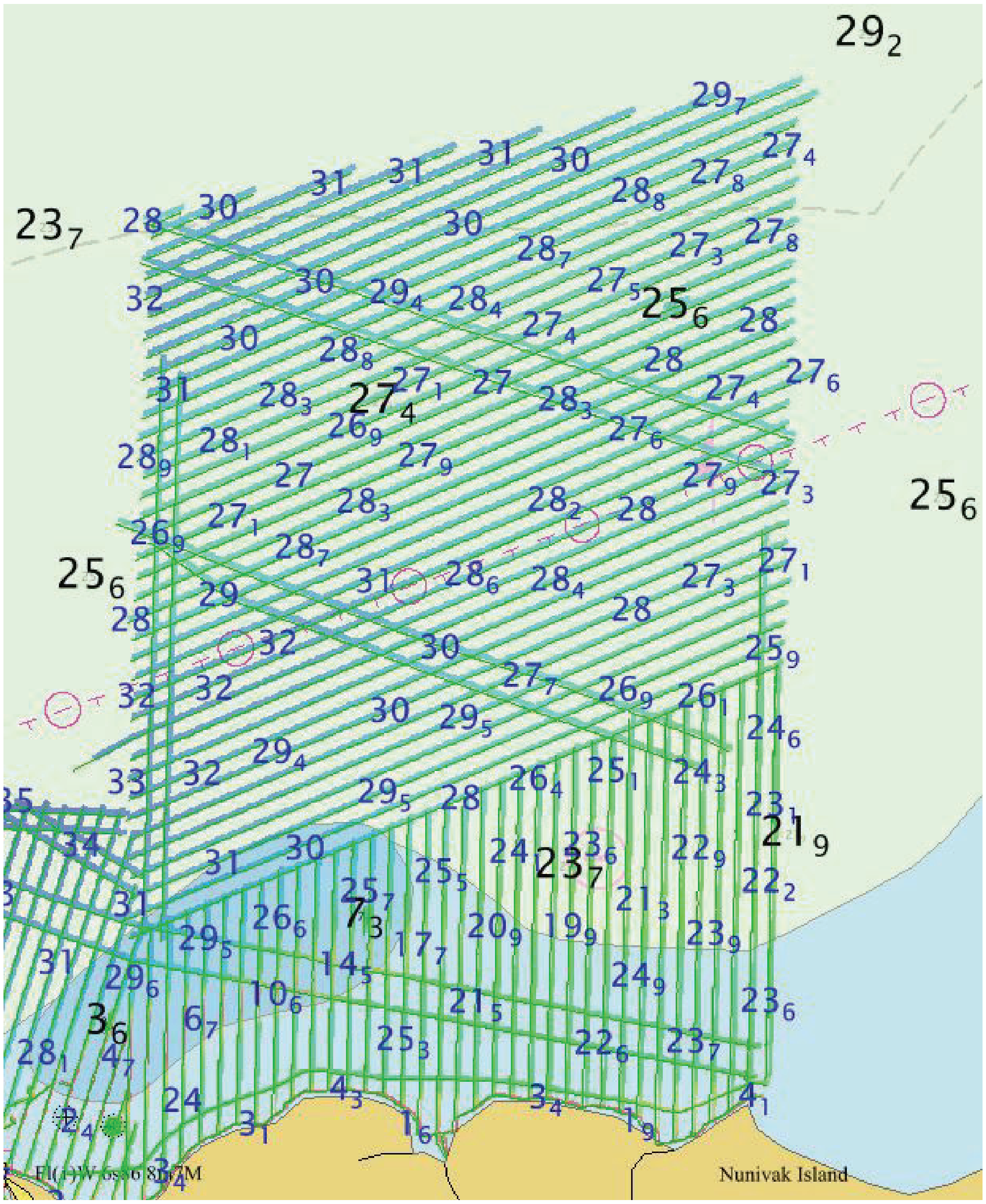

Figure 7: Northeast part of the survey area: Soundings from this survey (blue) overlaid with existing charted soundings (black). Soundings in meters.

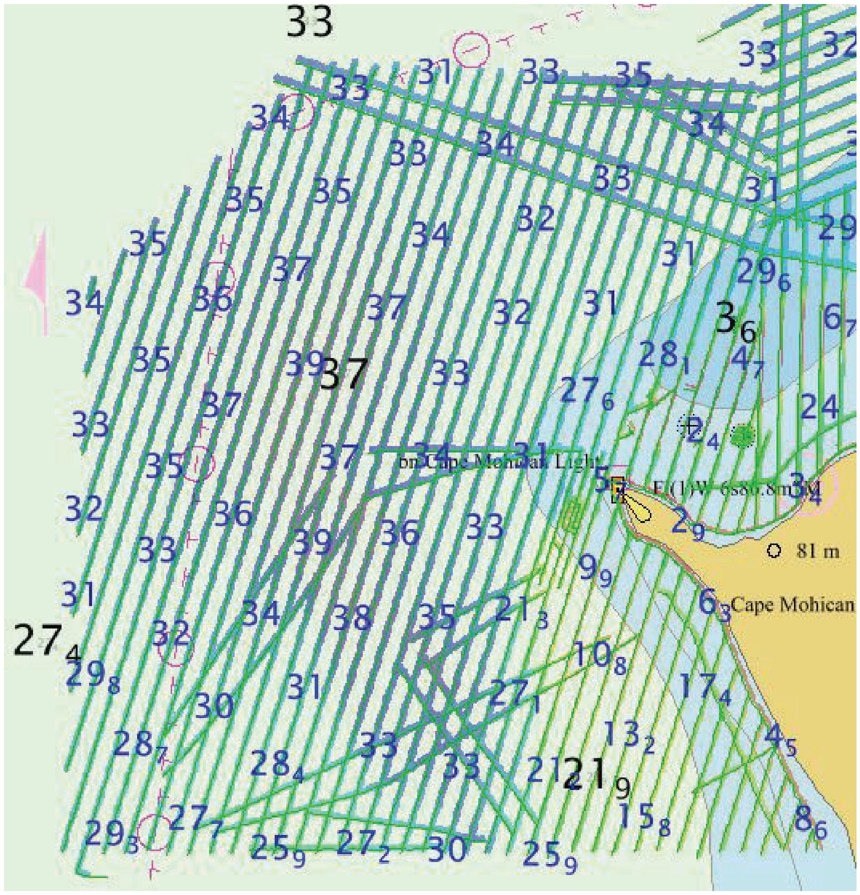

Figure 8: Southwest part of the survey area: Soundings from this survey (blue) overlaid with existing charted soundings (black). Soundings in meters.

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
US2AK95M	1:1534076	11	02/07/2022	02/07/2022

Table 12: Largest Scale ENCs

D.1.2 Shoal and Hazardous Features

There are two potentially hazardous shoals in this area:

1. The shoal on US2AK95M northeast of Cape Mohican with a charted least depth of 3.6 meters is potentially hazardous. It was found to be closer to shore than charted, and to have a shoaler least depth.

The charted 5 fathom / 9.1 m contour designating the general location of the shoal is up to 2 NM closer to shore than charted. A least depth of 2.351 m was found at 60-13-26.81 N, 167-25-25.536 W. The area is shown in the image below.

2. A least depth of 7.384 m was acquired at 60-12-24.209 N, 167-28-41.046 W about 0.65 NM SW of Cape Mohican in an uncharted area. The sounding was acquired on the top of a large sandwave, with other large sandwave features evident on the area. Splits were acquired at 120 m spacing in its vicinity to further define the sandwave extents, but additional development was not possible here due to weather. Note that the sandwave features here are abnormally large, standing greater than 10 m proud of the seafloor.

Given the extent of bottom change observed during this survey (described earlier this report), and since the potentially hazardous shoals appear to be ephemeral in nature and/or mobile, it is recommended a warning be included in affected charts that mariners should exercise caution when navigating in the vicinity of Cape Mohican due to the possibility of shoal migration.

No DTONs were submitted for this survey.

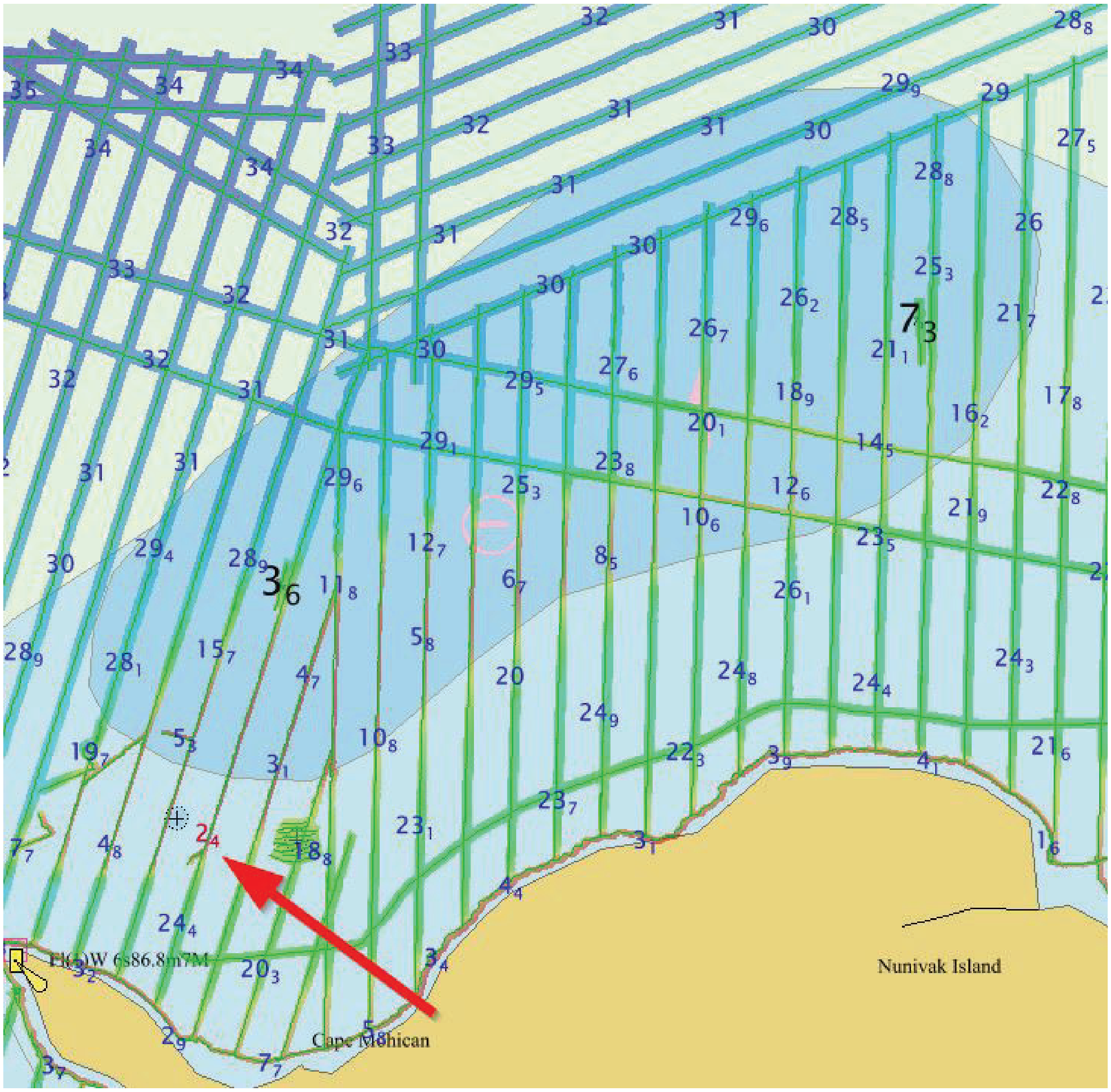

Figure 9: Charted shoal NE of Cape Mohican was found to be closer to shore and to have a shoaler least depth than charted. The shoalest depth found on the shoal is indicated with a red arrow. Soundings from this survey (blue) overlaid with existing charted soundings (black). Soundings in meters.

D.1.3 Charted Features

An assigned feature (depth unknown UWTROC) at 60-13-32.362 N, 167-25-47.312 W was not investigated due to very shallow water and weather conditions while the survey vessel was on site for the investigation. However, the charted location is in the vicinity of the shallowest area identified on the shoal northeast of Cape Mohican; it is likely that the UWTROC was charted to be representative of the shoalest portion of the area. It is recommended to be retained.

Note that it was possible to safely investigate (and disprove) a second assigned feature about 0.65 NM ESE due to deeper water there.

The the area is shown in the image below. Results are available in the FFF.

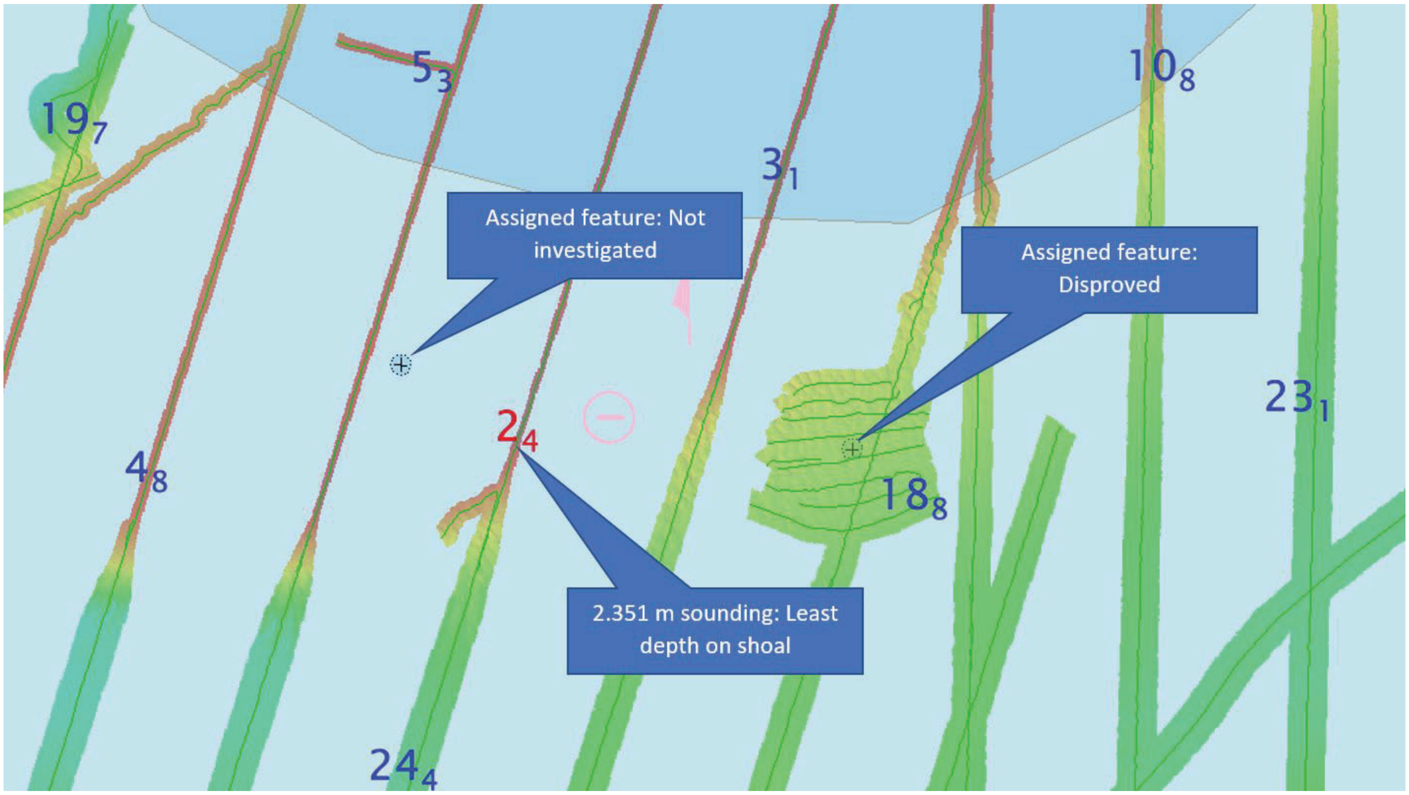

Figure 10: Assigned UWTROC features NE of Cape Mohican. The west feature could not be investigated, while the east feature was disproved. The least depth obtained on the shoal is also shown. All soundings in meters.

D.1.4 Uncharted Features

No uncharted features exist for this survey.

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

The general charted position of Cape Mohican Light is correct. The daymark and tower were visible from the survey vessel. However, the light appeared to be extinguished since it was not observed at night when conducting operations nearby. An ATON Discrepancy Report was submitted to the USCG on August 12, 2022. The ATON is included in the FFF per the 2022 HSSD since the light was not functional. Refer to the survey correspondence for the ATON Discrepancy Report. A photo of the ATON is included below.

Figure 11: Photo taken August 3rd, 2022, of Cape Mohican.
The Cape Mohican ATON is visible atop the Cape.

D.2.2 Maritime Boundary Points

No Maritime Boundary Points were assigned for this survey.

D.2.3 Bottom Samples

11 bottom samples were obtained during this survey.

The location of one sample was assigned in the PRF. A sample was successfully obtained near the assigned location.

Remaining samples (10) were acquired at locations chosen by the field crew to be relatively geographically dispersed, and representative of areas of seafloor backscatter intensity.

Fine brown sand was the predominant constituent in most samples. Samples were photographed but not retained. Refer to the FFF for additional details. Photos are included in the Multimedia directory.

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

Note that abnormally large sandwave features and bottom change associated with sandwave movement in the vicinity of Cape Mohican was discussed earlier in this report.

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, Hydrographic Survey 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 with the exception of deficiencies,if any, noted in the Descriptive Report.

Report Name	Report Date Sent
GNSS Tide Buoy Reports	2022-11-30
Coast Pilot Review Report	2022-11-26
MMO Logsheets and Training Observer Logs	2022-11-26
NCEI Sound Speed Data Submittal	2022-10-07
Final Progress Report	2022-09-27
Survey Outline Submittal	2022-09-15

Approver Name	Approver Title	Approval Date	Signature
Andrew Orthmann	Charting Program Manager	12/30/2022	Andrew Orthmann Digitally signed by Andrew Orthmann Date: 2022.12.30 11:08:31 -09'00'

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