H13321

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

DESCRIPTIVE REPORT

Type of Survey:	Navigable Area
Registry Number:	H13321

LOCALITY

State(s):	Hawaii
General Locality:	Hawaiian Islands and Vicinity
Sub-locality:	Cape Kumukahi to Waipuku Point

2019

CHIEF OF PARTY
Benjamin K. Evans, CAPT/NOAA

LIBRARY & ARCHIVES

Date:

U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	REGISTRY NUMBER:
HYDROGRAPHIC TITLE SHEET	**H13321**

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):	**Hawaii**
General Locality:	**Hawaiian Islands and Vicinity**
Sub-Locality:	**Cape Kumukahi to Waipuku Point**
Scale:	**40000**
Dates of Survey:	**09/20/2019 to 09/22/2019**
Instructions Dated:	**08/01/2019**
Project Number:	**OPR-T383-RA-19**
Field Unit:	**NOAA Ship *Rainier***
Chief of Party:	**Benjamin K. Evans, CAPT/NOAA**
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 5N, 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 H13321

Project: OPR-T383-RA-19

Locality: Hawaiian Islands and Vicinity

Sublocality: Cape Kumukahi to Waipuku Point

Scale: 1:40000

September 2019 - September 2019

NOAA Ship *Rainier*

Chief of Party: Benjamin K. Evans, CAPT/NOAA

A. Area Surveyed

The survey area is referred to as H13321, "Cape Kumukahi to Waipuku Point" (sheet 11) within the Project Instructions. The area encompasses approximately 57 square nautical miles off the eastern side of the "Big Island" of Hawaii.

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
19° 33' 26" N 154° 56' 49" W	19° 19' 12" N 152° 42' 48" W

Table 1: Survey Limits

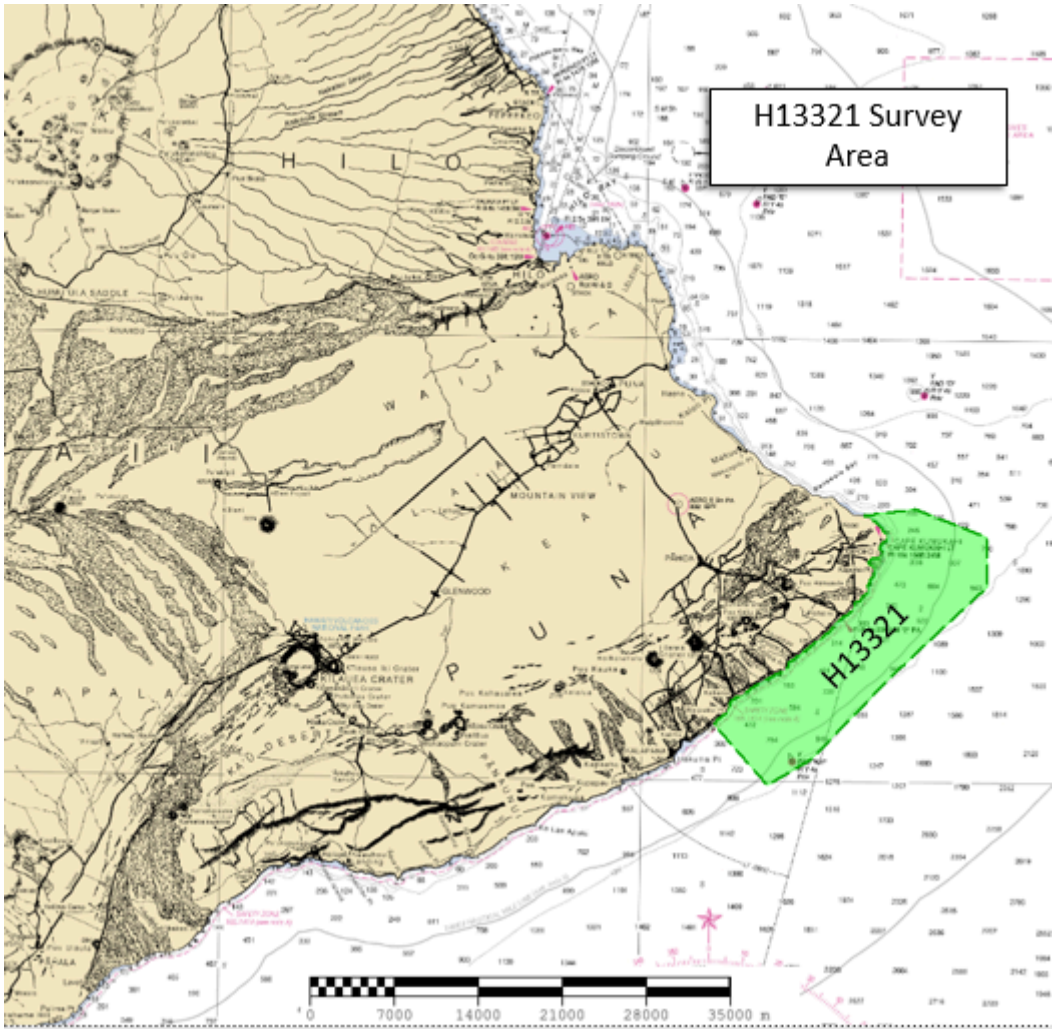


Figure 1: H13321 assigned survey area (Chart 19320).

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

A.2 Survey Purpose

The 2018 eruption of Kilauea deposited lava into the ocean, significantly changing the coastline and seafloor on the eastern side of the big island. Due to the volcanic eruption altering the seafloor, new bathymetric data are required to update nautical charts for safe navigation. Survey data from this project are intended to supersede all prior survey data in the common area.

A.3 Survey Quality

The entire survey is adequate to supersede previous data.

Pydro QC Tools was used to analyze H13321 multibeam echosounder (MBES) data density. The submitted H13321 variable-resolution (VR) surface met HSSD density requirements as shown in the histogram below.

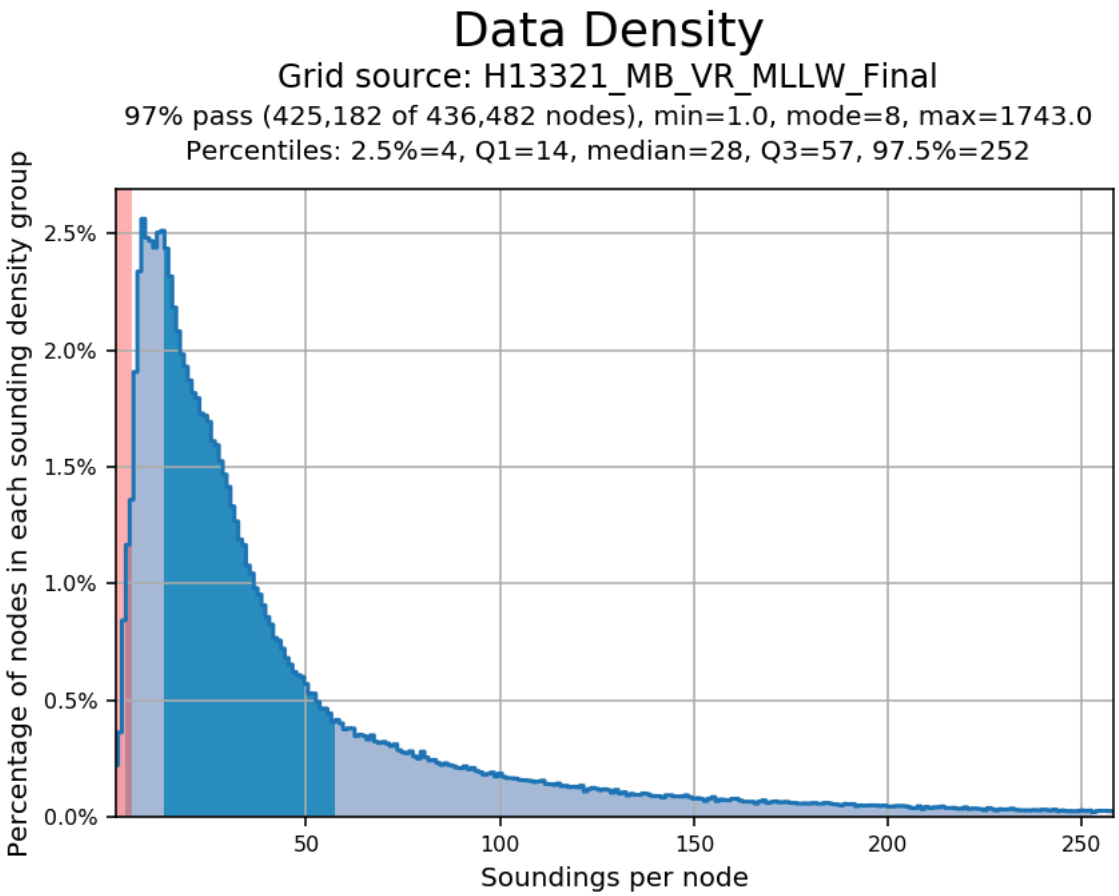


Figure 2: Pydro derived plot showing HSSD density compliance of H13321 finalized complete coverage variable-resolution MBES data.

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 within survey area	Complete Coverage (Refer to HSSD Section 5.2.2.3)

Table 2: Survey Coverage

Multibeam echosounder (MBES) coverage was acquired to the Navigable Area Limit Line (NALL) in most places. The Project Instructions defined the NALL for this survey as 10-meter water depth. The survey vessels were operated as close to the new lava flow created shoreline as navigationally possible. Areas

where survey coverage did not reach 10-meters depths nor the assigned sheet limits were due to reaching the extent of safe navigation.

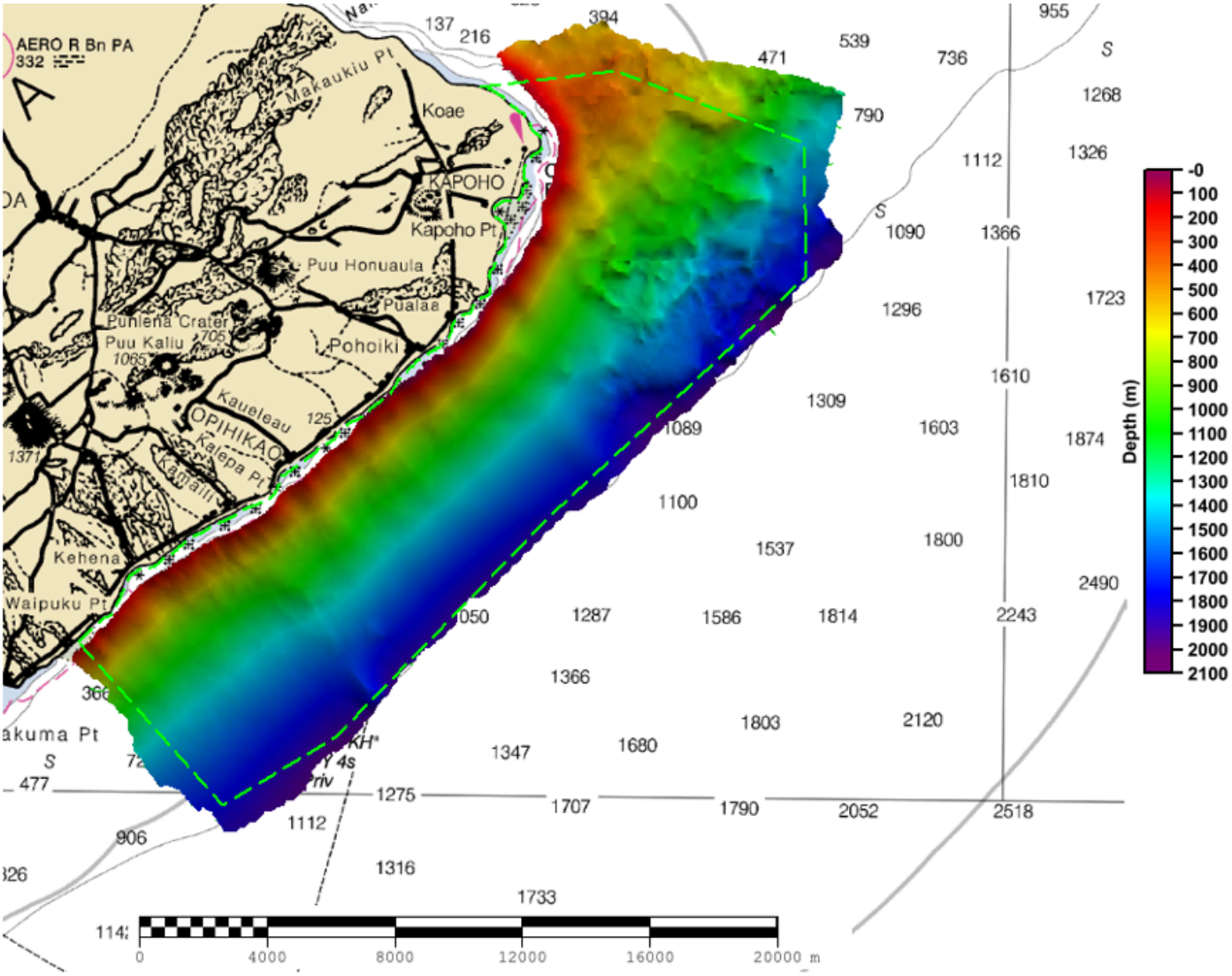


Figure 3: H13321 MBES coverage and assigned survey limits (Chart 19320).

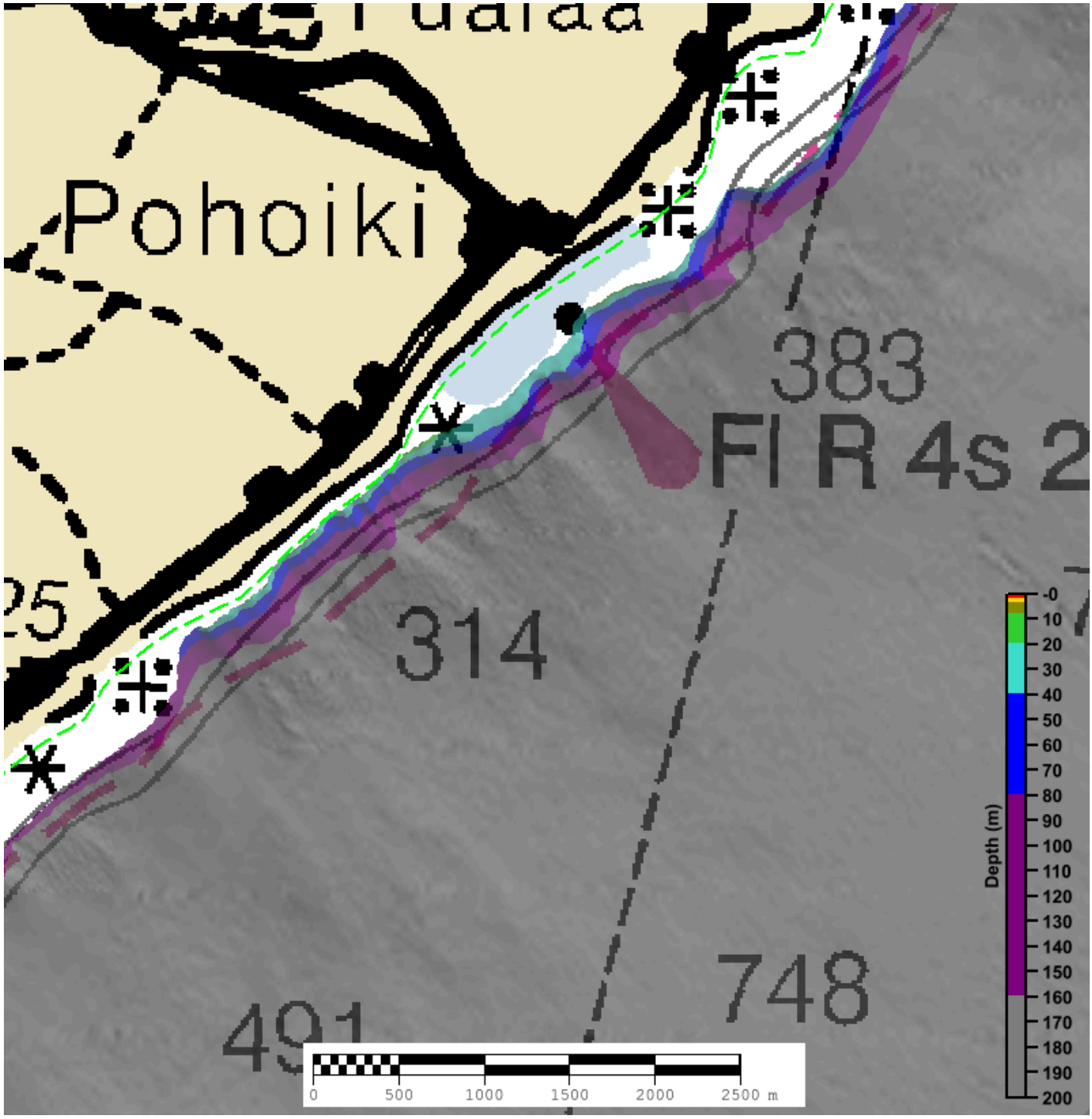


Figure 4: Example of Navigable Area Limit Line (NALL) determination; the dashed line indicates assigned sheet limits. Safety and time constraints prevented full coverage of the NALL.

A.6 Survey Statistics

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

	HULL ID	*S221*	*2804*	*Total*
LNM	**SBES Mainscheme**	0	0	0
	MBES Mainscheme	223.94	9.87	233.81
	Lidar Mainscheme	0	0	0
	SSS Mainscheme	0	0	0
	SBES/SSS Mainscheme	0	0	0
	MBES/SSS Mainscheme	0	0	0
	SBES/MBES Crosslines	40.25	0	40.25
	Lidar Crosslines	0	0	0
Number of Bottom Samples				0
Number Maritime Boundary Points Investigated				0
Number of DPs				0
Number of Items Investigated by Dive Ops				0
Total SNM				65.74

Table 3: Hydrographic Survey Statistics

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

Survey Dates	Day of the Year
09/20/2019	263
09/22/2019	265

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	***S221***	***2804***
LOA	70.4 meters	8.8 meters
Draft	5.7 meters	1.1 meters

Table 5: Vessels Used

Figure 5: NOAA Ship RAINIER.

Figure 6: Example of NOAA ship RAINIER survey launch.

All H13321 data were acquired by NOAA Ship RAINIER and survey launch 2804 (RA-6). These vessels acquired depth soundings, backscatter imagery and sound speed profiles. Water column data were logged by RAINIER concurrently with multibeam as .WCD files on days 263 and 265. Limited shoreline verification was conducted from NOAA Ship RAINIER and launch 2804 (RA-6).

B.1.2 Equipment

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

Manufacturer	Model	Type
Applanix	POS MV 320 v5	Positioning and Attitude System
Kongsberg Maritime	EM 710	MBES
Kongsberg Maritime	EM 2040	MBES
AML Oceanographic	Micro-CTD	Conductivity, Temperature, and Depth Sensor
Sea-Bird Scientific	SBE 19plus	Conductivity, Temperature, and Depth Sensor
ODIM Brooke Ocean	MVP200	Sound Speed System
Teledyne RESON	SVP 70	Sound Speed System

Table 6: Major Systems Used

Refer to the Data Acquisition and Processing Report (DAPR) for a comprehensive description of data acquisition and processing systems, survey vessels, quality control and processing methods. Additional information to supplement soundings and other survey data and any deviations from the DAPR are discussed in this report.

B.2 Quality Control

B.2.1 Crosslines

NOAA Ship RAINIER acquired 40.25 nautical miles of multibeam crosslines. H13321 crossline data is adequate for verifying and evaluating the internal consistency of survey data. The Compare Grids function in Pydro Explorer analyzed finalized VR surfaces of H13321 crossline-only and mainscheme-only data. In the different surface, 99.5% of nodes met IHO allowable Total Vertical Uncertainty (TVU) standards. Figures 7-9 provide additional results.

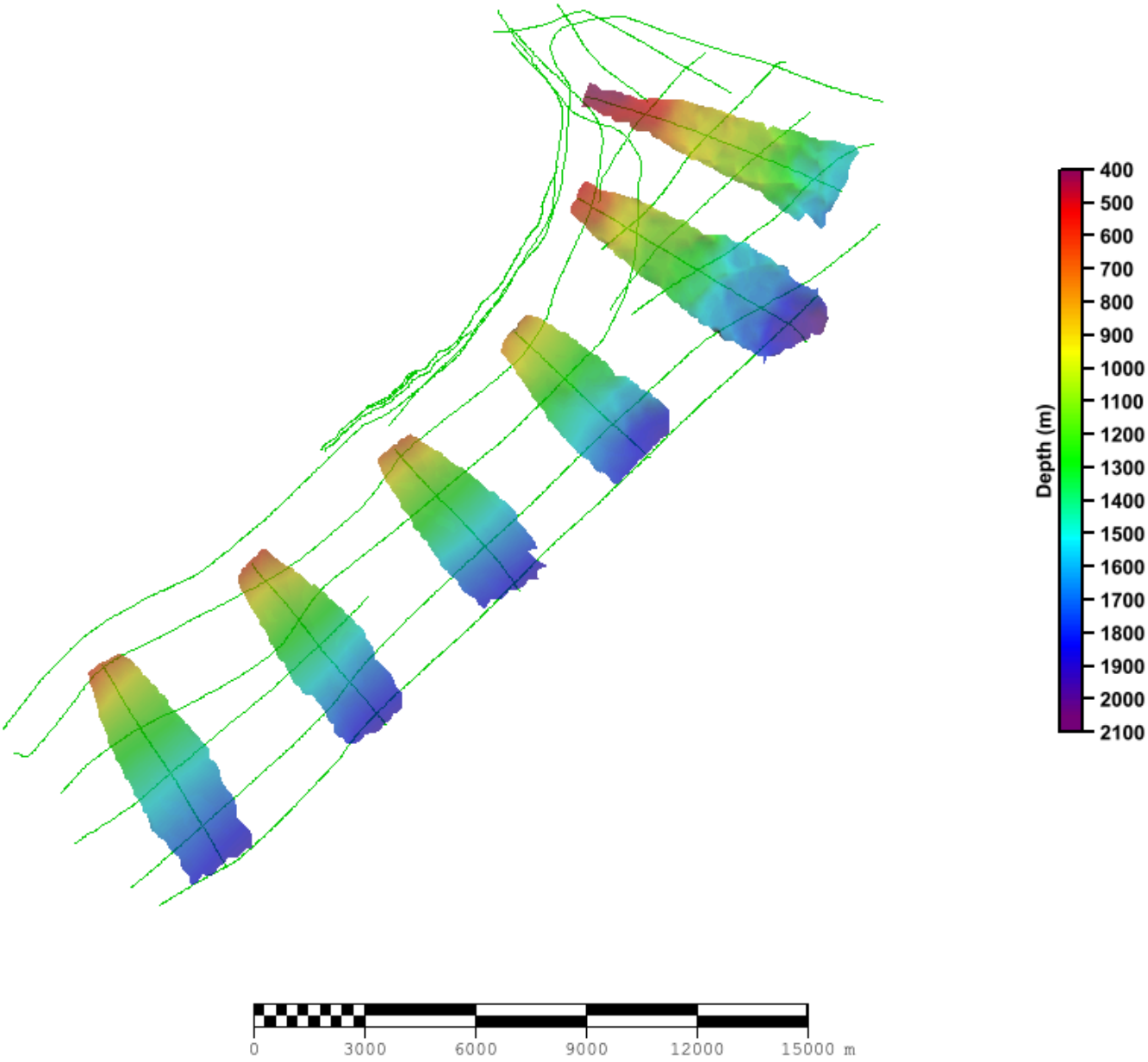


Figure 7: H13321 crossline surface overlaid on mainscheme tracklines.

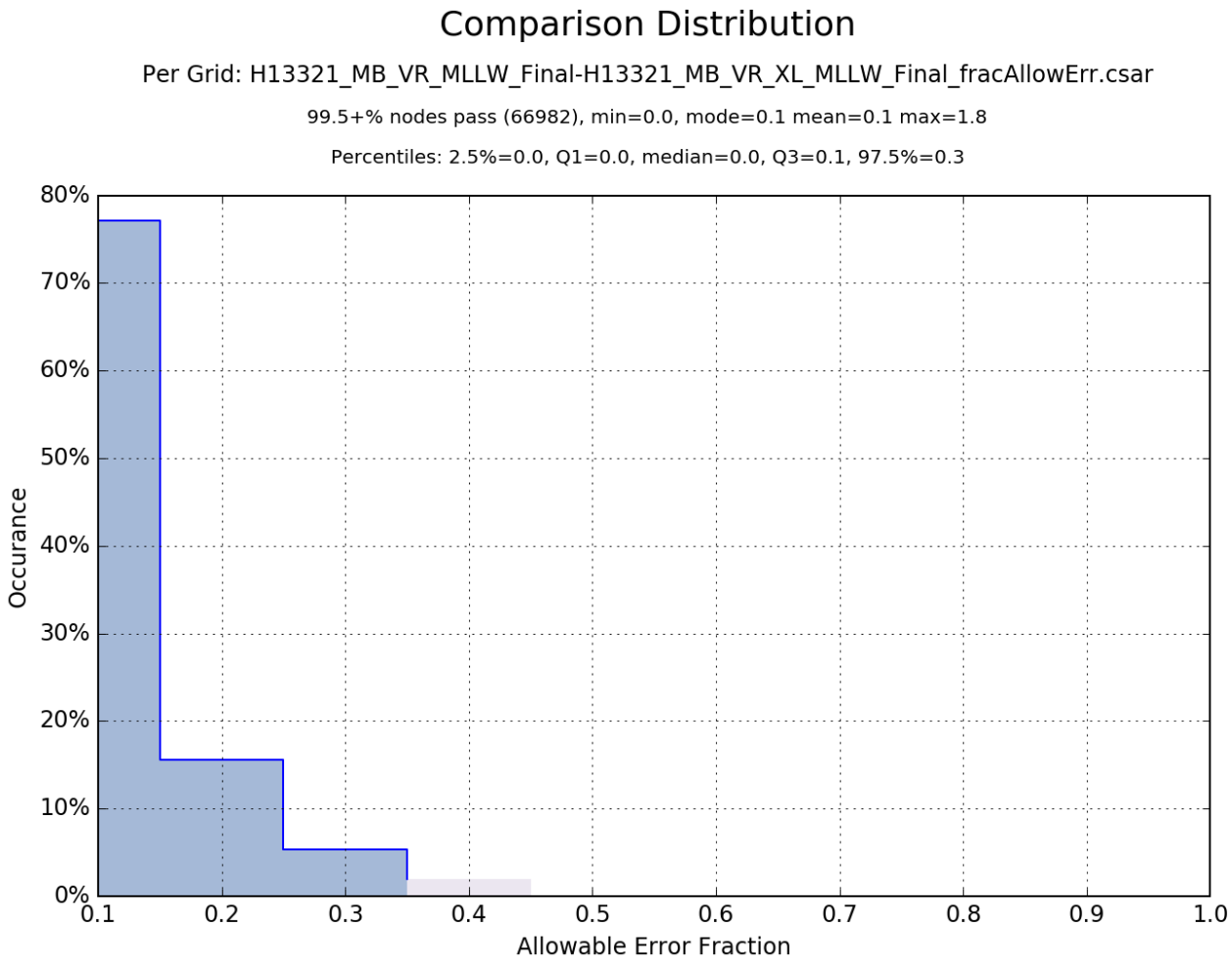
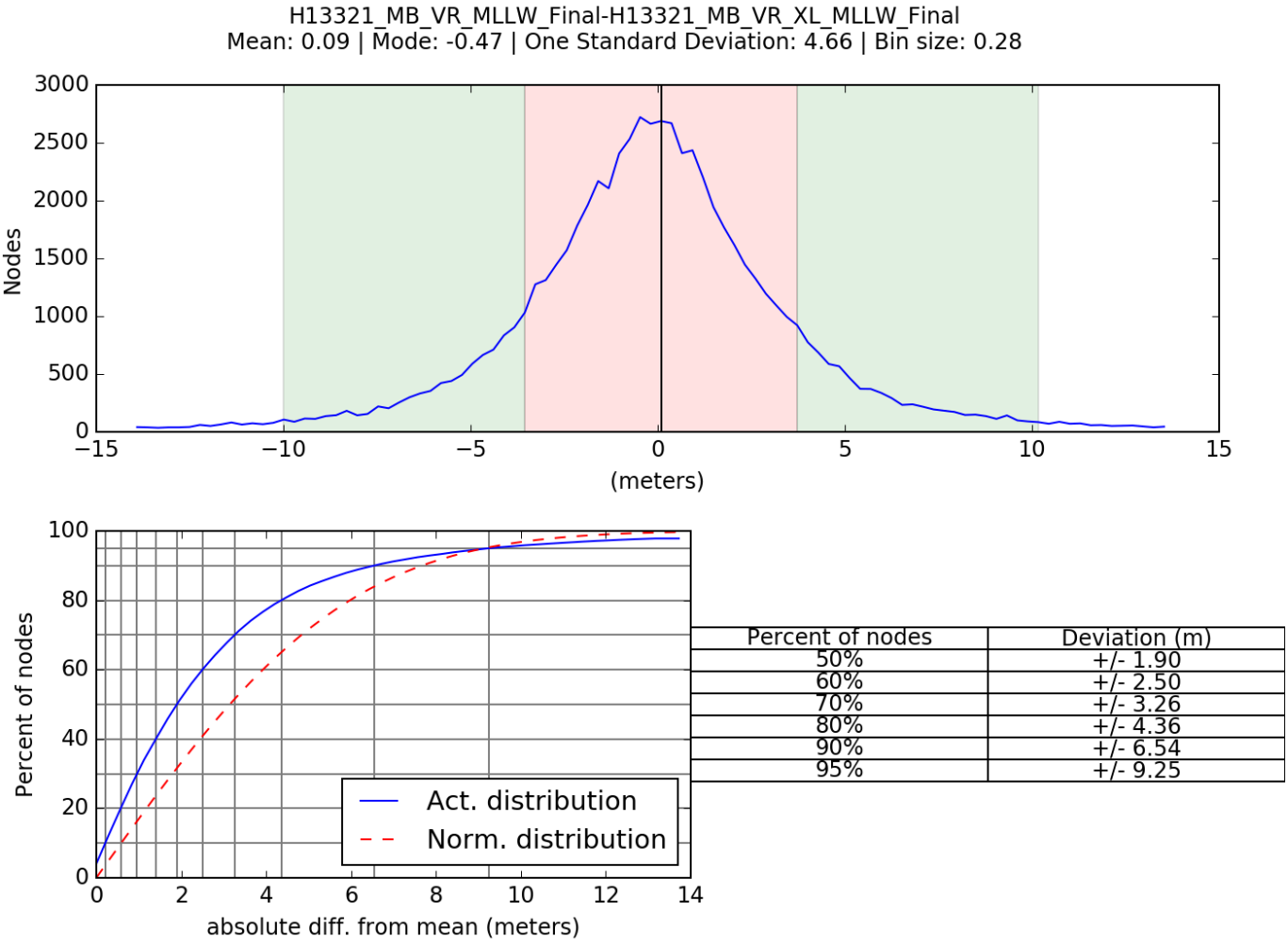


Figure 8: Pydro derived plot showing node difference statistics of H13321 mainscheme to crossline data.



Percent of nodes	Deviation (m)
50%	+/- 1.90
60%	+/- 2.50
70%	+/- 3.26
80%	+/- 4.36
90%	+/- 6.54
95%	+/- 9.25

Figure 9: Pydro derived plot showing absolute percentage pass value of H13321 mainscheme to crossline data.

B.2.2 Uncertainty

The following survey specific parameters were used for this survey:

Method	Measured	Zoning
ERS via ERTDM	0 meters	0.1 meters

Table 7: Survey Specific Tide TPU Values.

Hull ID	Measured - CTD	Measured - MVP	Measured - XBT	Surface
S221	N/A meters/second	1 meters/second	N/A meters/second	0.05 meters/second
2804	3 meters/second	N/A meters/second	N/A meters/second	0.05 meters/second

Table 8: Survey Specific Sound Speed TPU Values.

We derived Total Propagated Uncertainty (TPU) values for H13321 based on a combination of equipment specifications and capabilities, and vessel characteristics. The tidal uncertainty used for this survey was provided in the project instructions for the NOAA Ellipsoidal Referenced Tidal Datum Model (ERTDM).

In addition, we incorporated real-time and post-processed uncertainty sources into the depth estimates of this survey. The real-time uncertainties for position, navigation, attitude, and vessel motion data were applied during acquisition and initially in post-processing. Then, we used POSPac MMS software to generate SBET and RMS files with attitude, GPS height, and position uncertainties, which supersede real-time POS MV data when applied in CARIS HIPS.

Uncertainty values of the submitted finalized grid were calculated in CARIS using "Greater of the Two" of uncertainty and standard deviation (scaled to 95%). Grid QA v5 within Pydro QC Tools was used to analyze H13321 TVU compliance. H13321 met HSSD requirements in over 99.5 percent of grid nodes, which is shown in the histogram plot below."

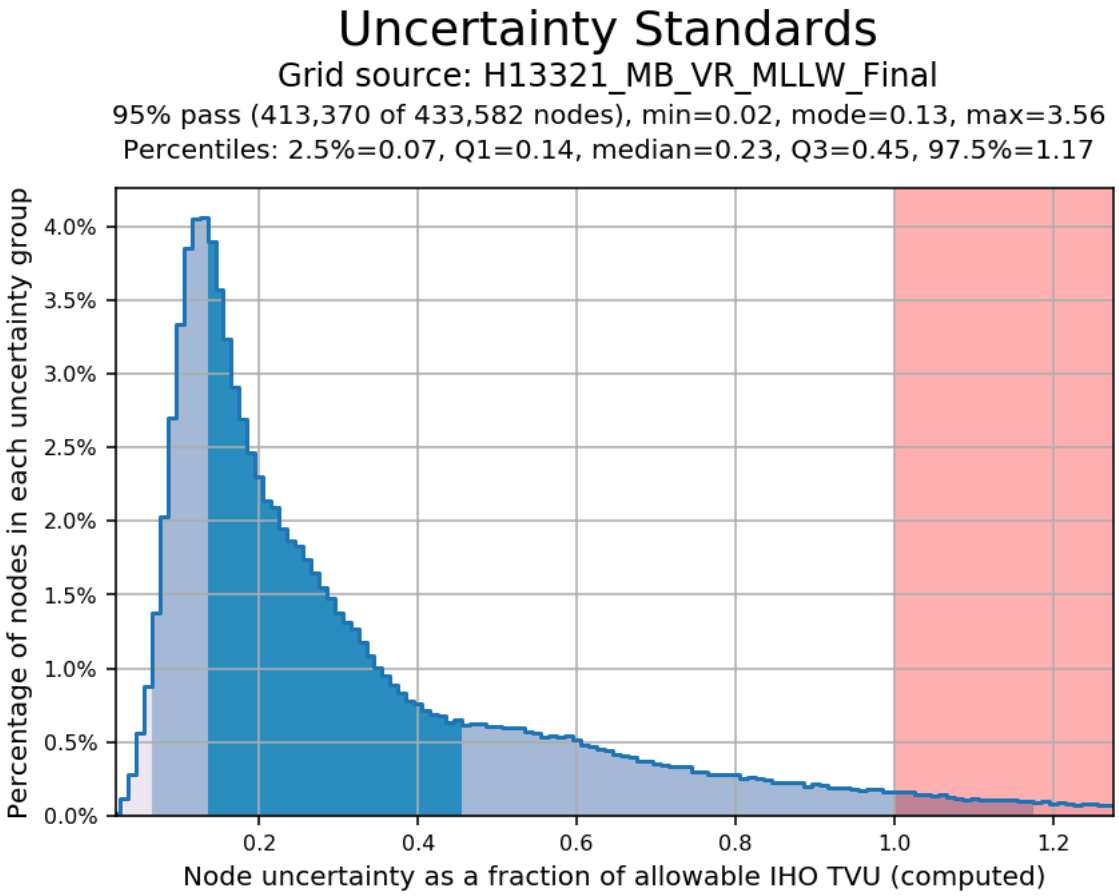


Figure 10: Pydro derived plot showing TVU compliance of H13321 complete coverage finalized variable resolution MBES data.

B.2.3 Junctions

There are no contemporary surveys that junction with this survey.

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: A total of 18 sound speed profiles were acquired for this survey at discrete locations within the survey area at least once every four hours. S221 sound speed profiles were acquired using ODIM Brooke Ocean MVP200. Launch sound speed profiles were acquired using Sea-Bird Scientific SBE 19 plus profilers. All casts were concatenated into a master file and applied using the "Nearest in distance within time (4 hours)" profile selection method within CARIS.

Three casts were extended in the concatenated master file by selecting sections of a nearby cast that had been extended in Sound Speed Manager and adding the data to supplement sound speed profiles in deeper water.

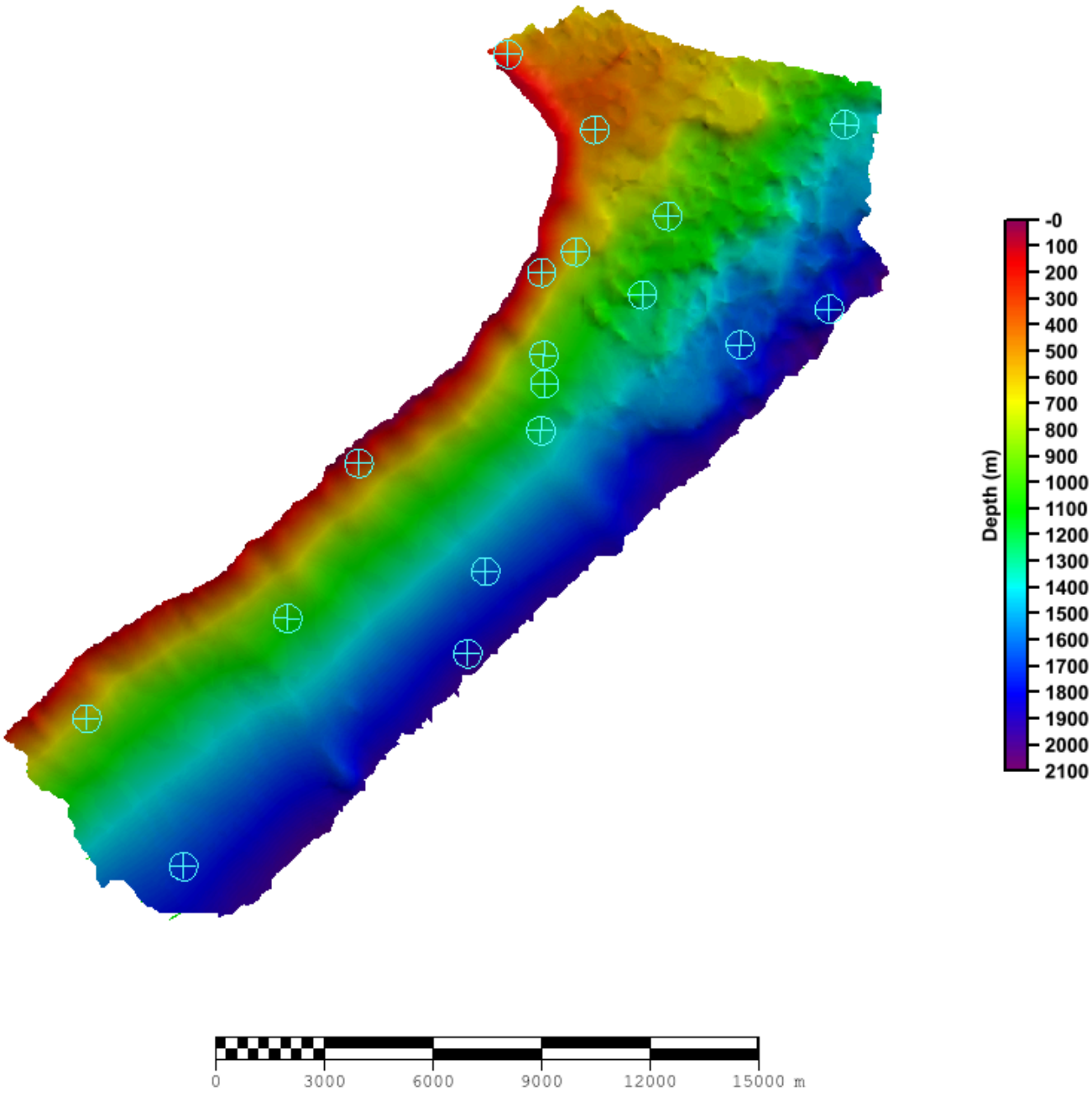


Figure 11: H13321 sound speed cast locations.

B.2.8 Coverage Equipment and Methods

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

B.2.9 Detect Fliers

Pydro QC Tools Flier Finder v8 was used to find fliers in the finalized variable resolution surface. Flier Finder settings: Checks included #2: Gaussian Curvature, #3: Adjacent Cells, #4: Edge Slivers, and #5: Isolated Nodes; Filters were defined as Distance <= 1.0 nodes and Delta Z <= 0.01 meters. "Features from S57 File" and "Designated (SR BAG only)" were not used. Flier height was not restricted. Obvious noise was rejected by the hydrographer in CARIS subset editor. After data cleaning, Flier Finder was run again and found 86 fliers in the surface. These fliers are a result of low data density at extreme depths and steep slopes in changing bathymetry.

B.3 Echo Sounding Corrections

B.3.1 Corrections to Echo Soundings

All data reduction procedures conform to those detailed in the DAPR.

B.3.2 Calibrations

All sounding systems were calibrated as detailed in the DAPR.

B.4 Backscatter

Raw backscatter data were acquired as .all files logged during MBES operations and processed by RAINIER personnel. Multiple gaps are present in the backscatter data are due to 20 minute automated line breaks during MBES acquisition. The .GSF files created during processing and one backscatter mosaic per vessel per frequency has been delivered with this report. Backscatter processing procedures are described in the DAPR. Line 0022_20190921_015329_Rainier_Deep_263_merged.gsf was not processed in a mosaic due to an internal error and does not impact the quality of the mosaic.

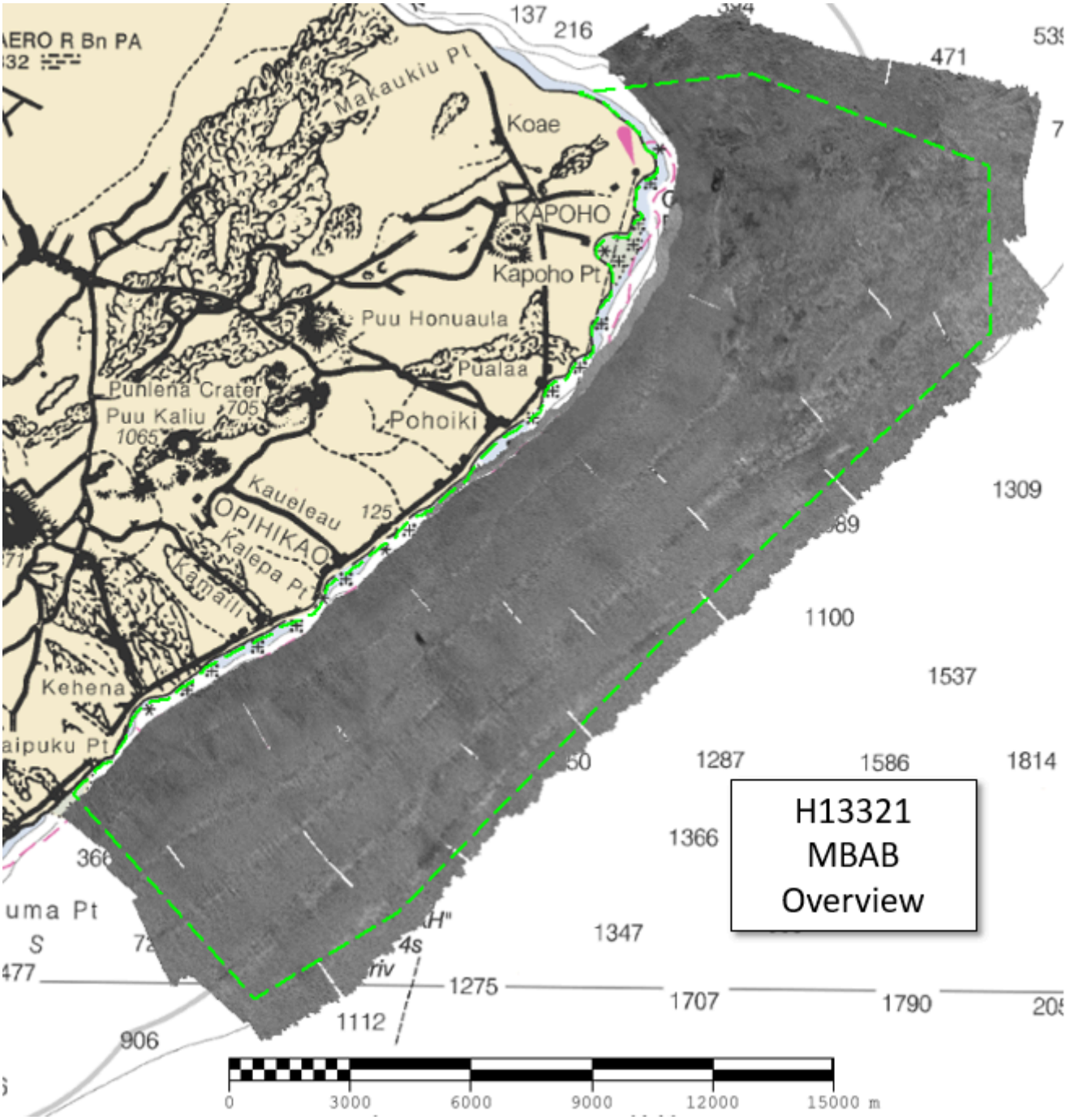


Figure 12: Overview of H13321 multibeam acoustic backscatter coverage (assigned sheet limits shown in green).

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
CARIS	HIPS and SIPS	11.1.03

Table 9: Primary bathymetric data processing software

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

Manufacturer	Name	Version
QPS	Fledermaus Geocoder Toolkit (FMGT)	7.8.1

Table 10: Primary imagery data processing software

The following Feature Object Catalog was used: NOAA Profile Version 2019.

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
H13321_MB_VR_MLLW	CARIS VR Surface (CUBE)	Variable Resolution	9.52 meters - 2084.51 meters	NOAA_VR	Complete MBES
H13321_MB_VR_MLLW_Final	CARIS VR Surface (CUBE)	Variable Resolution	9.52 meters - 2084.51 meters	NOAA_VR	Complete MBES

Table 11: Submitted Surfaces

Submitted Surfaces were generated using the NOAA recommended parameters for depth-based (Ranges) CARIS variable-resolution bathymetric grids as specified in 2019 HSSD.

Due to the extreme range of survey data, the surface did not meet resolution requirements for variable resolution surfaces in the shallower portions of this survey, per HSSD 5.2.2.3. Upon review it does not appear to impact the integrity or the feature detection ability of this survey and does not pose a danger to surface navigation.

C. Vertical and Horizontal Control

Additional information discussing the vertical and horizontal control for this survey can be found in the accompanying 2019 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 ERTDM	OPR-T383-RA-19_ERTDM_NAD83(2011)_MLLW_Extended2.csar

Table 12: ERS method and SEP file

C.2 Horizontal Control

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

The projection used for this project is Universal Transverse Mercator (UTM) Zone 5.

The following PPK methods were used for horizontal control:

- RTX

WAAS

The Wide Area Augmentation System (WAAS) was used for real-time horizontal control during data acquisition. Post Processed-Real-Time Extended (PP-RTX) processing methods were used in Applanix POSPac MMS 8.3 software to produce SBETs for post-processed horizontal and vertical corrections.

D. Results and Recommendations

D.1 Chart Comparison

A comparison was made between H13321 survey data and Electronic Navigational Chart (ENC) US US3HA10M using a CUBE surface, selected soundings and contours created in CARIS.

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
US3HA10M	1:250000	17	07/20/2018	08/30/2019

Table 13: Largest Scale ENCs

D.1.2 Shoal and Hazardous Features

No shoals or potentially hazardous features exist for this survey.

D.1.3 Charted Features

No charted features exist for this survey.

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

Along the Puna Coast there is a privately maintained buoy; its position and status appear to be properly depicted on the chart. There is also a charted daymarker along the shoreline that was not observed. Further information regarding ATONs within the survey area is included in the H13321 Final Feature Files submitted with this report.

D.2.2 Maritime Boundary Points

No Maritime Boundary Points were assigned for this survey.

D.2.3 Bottom Samples

No bottom samples were required for this survey.

D.2.4 Overhead Features

No overhead features exist for this survey.

D.2.5 Submarine Features

No submarine features exist for this survey.

D.2.6 Platforms

No platforms exist for this survey.

D.2.7 Ferry Routes and Terminals

No ferry routes or terminals exist for this survey.

D.2.8 Abnormal Seafloor or Environmental Conditions

Nearly the entire seafloor within H13321 exhibits evidence of volcanic activity thus creating a dynamic seafloor with features of potential interest to researchers in the fields of marine geology, volcanology, benthic ecology and more.

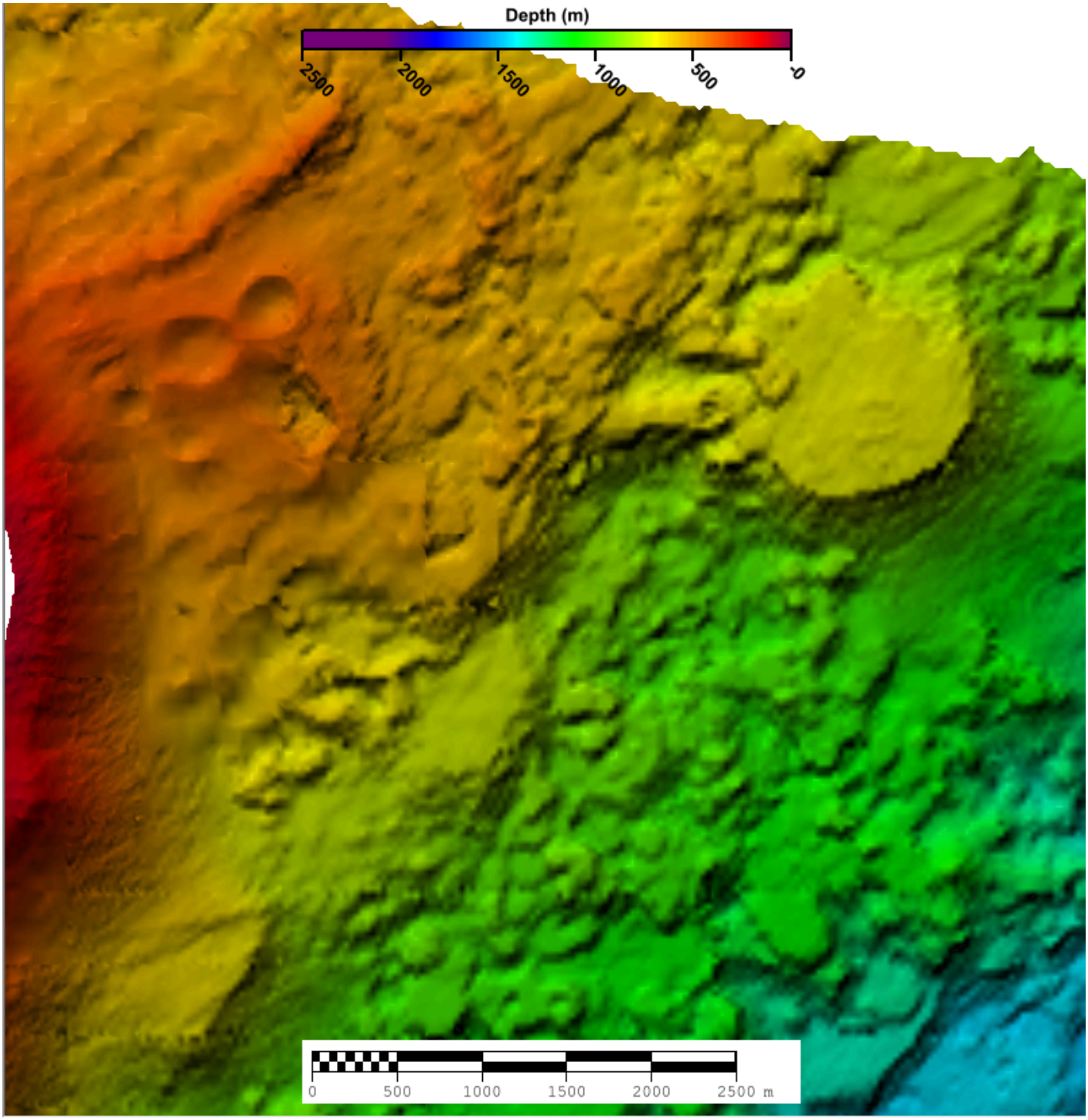


Figure 13: Example of abnormal seafloor in survey area H13321.

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 insets are recommended for this area.

E. Approval Sheet

As Chief of Party, field operations for this hydrographic survey were conducted under my direct supervision, with frequent personal checks of progress and adequacy. I have reviewed the attached survey data and reports.

All field sheets, this Descriptive Report, and all accompanying records and data are approved. All records are forwarded for final review and processing to the Processing Branch.

The survey data meets or exceeds requirements as set forth in the NOS Hydrographic Surveys Specifications and Deliverables, Field Procedures Manual, Letter Instructions, and all HSD Technical Directives. These data are adequate to supersede charted data in their common areas. This survey is complete and no additional work is required with the exception of deficiencies noted in the Descriptive Report.

Approver Name	Approver Title	Approval Date	Signature
Samuel F. Greenaway CDR/NOAA	Commanding Officer	02/24/2020	Digitally signed by GREENAWAY.SAMUEL.F.1275635347 Date: 2020.02.24 12:12:11 -08'00'
Hadley A. Owen LT/NOAA	Field Operations Officer	02/24/2020	Digitally signed by OWEN.HADLEY.ANNE.1410967070 Date: 2020.02.24 11:42:17 -08'00'
James B. Jacobson	Chief Survey Technician	02/24/2020	JACOBSON.JAMES.BRYAN.1269664017 I have reviewed this document 2020.02.24 12:10:21 -08'00'
Christina L. Brooks	Assistant Survey Technician	02/24/2020	BROOKS.CHRISTINA.LORRAINE.1553513177 2020.02.24 11:23:37 -08'00'

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