H12851

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

DESCRIPTIVE REPORT

Type of Survey:	Navigable Area
Registry Number:	H12851

LOCALITY

State(s):	Alaska
General Locality:	North Coast of Kodiak
Sub-locality:	Uganik Bay

2016

CHIEF OF PARTY
Edward J. Van Den Ameele, CAPT/NOAA

LIBRARY & ARCHIVES

Date:

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

REGISTRY NUMBER:

HYDROGRAPHIC TITLE SHEET

H12851

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:	**North Coast of Kodiak**
Sub-Locality:	**Uganik Bay**
Scale:	**40000**
Dates of Survey:	**09/16/2016 to 10/14/2016**
Instructions Dated:	**05/16/2016**
Project Number:	**OPR-P136-RA-16**
Field Unit:	**NOAA Ship *Rainier***
Chief of Party:	**Edward J. Van Den Ameele, 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:

The purpose of this survey is to provide contemporary surveys to update National Ocean Service (NOS) nautical charts. All separates are filed with the hydrographic data. Any revisions to the Descriptive Report (DR) generated during office processing are shown in bold, red italic text. The processing branch maintains the DR as a field unit product, therefore, all information and recommendations within the body of the DR are considered preliminary unless otherwise noted. The final disposition of surveyed features is represented in the OCS nautical chart update products. All pertinent records for this survey, including the DR, are archived at the National Centers for Environmental Information (NCEI) and can be retrieved via http://www.ncei.noaa.gov/.

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Descriptive Report to Accompany Survey H12851

Project: OPR-P136-RA-16

Locality: North Coast of Kodiak

Sublocality: Uganik Bay

Scale: 1:40000

September 2016 - October 2016

NOAA Ship *Rainier*

Chief of Party: Edward J. Van Den Ameele, CAPT/NOAA

A. Area Surveyed

The project area is referred to as Sheet 3: "Uganik Bay" within the Project Instructions. The area covers approximately 12.5 square nautical miles south of the "Entrance to Uganik Bay" on the north coast of Kodiak Island, Alaska (Figures 1 and 2).

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
57° 54' 0.37" N 153° 38' 36.96" W	57° 47' 30.17" N 153° 27' 43.11" W

Table 1: Survey Limits

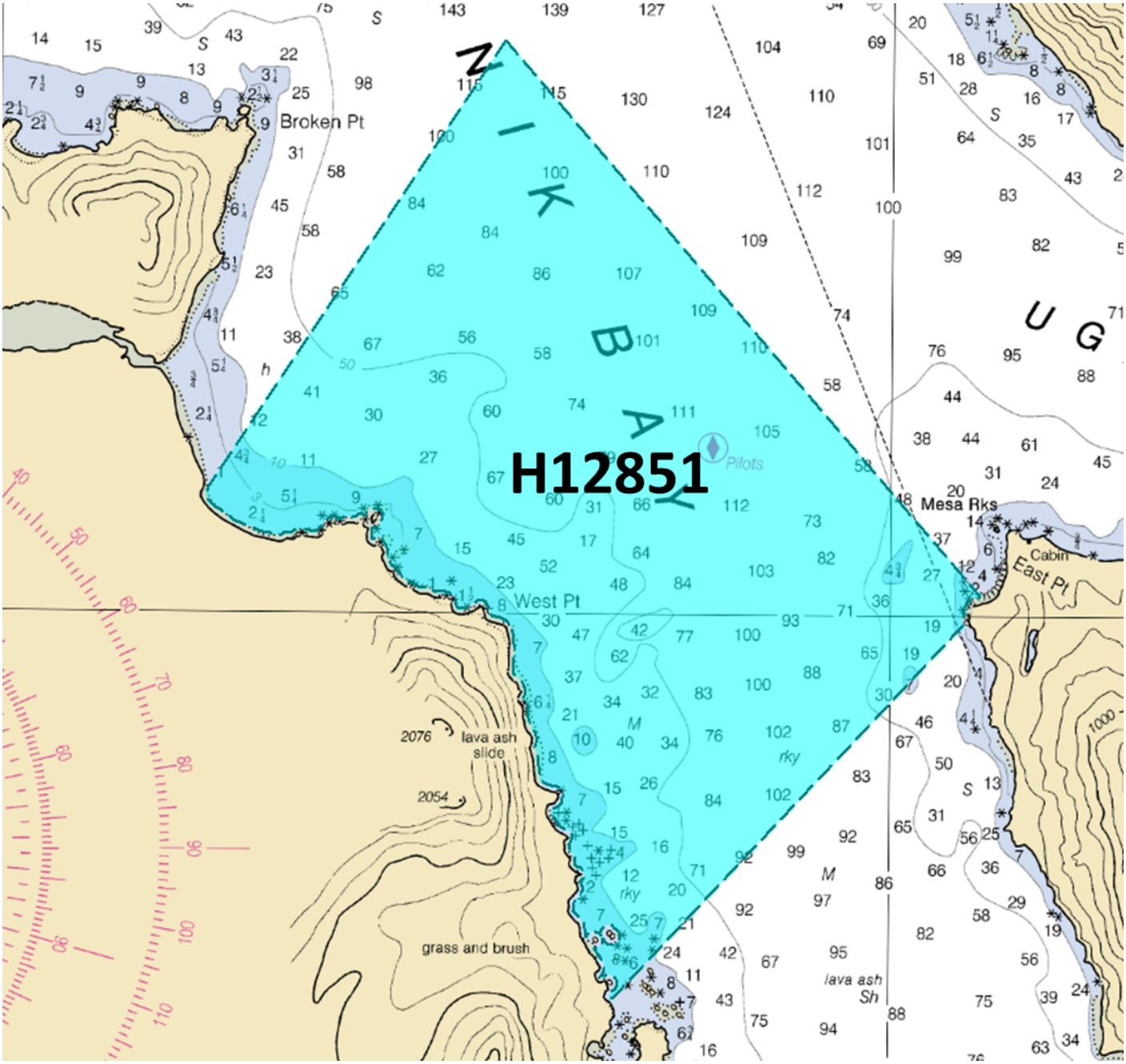

Figure 1: H12851 survey area as assigned in Project Instructions (Chart 16597).

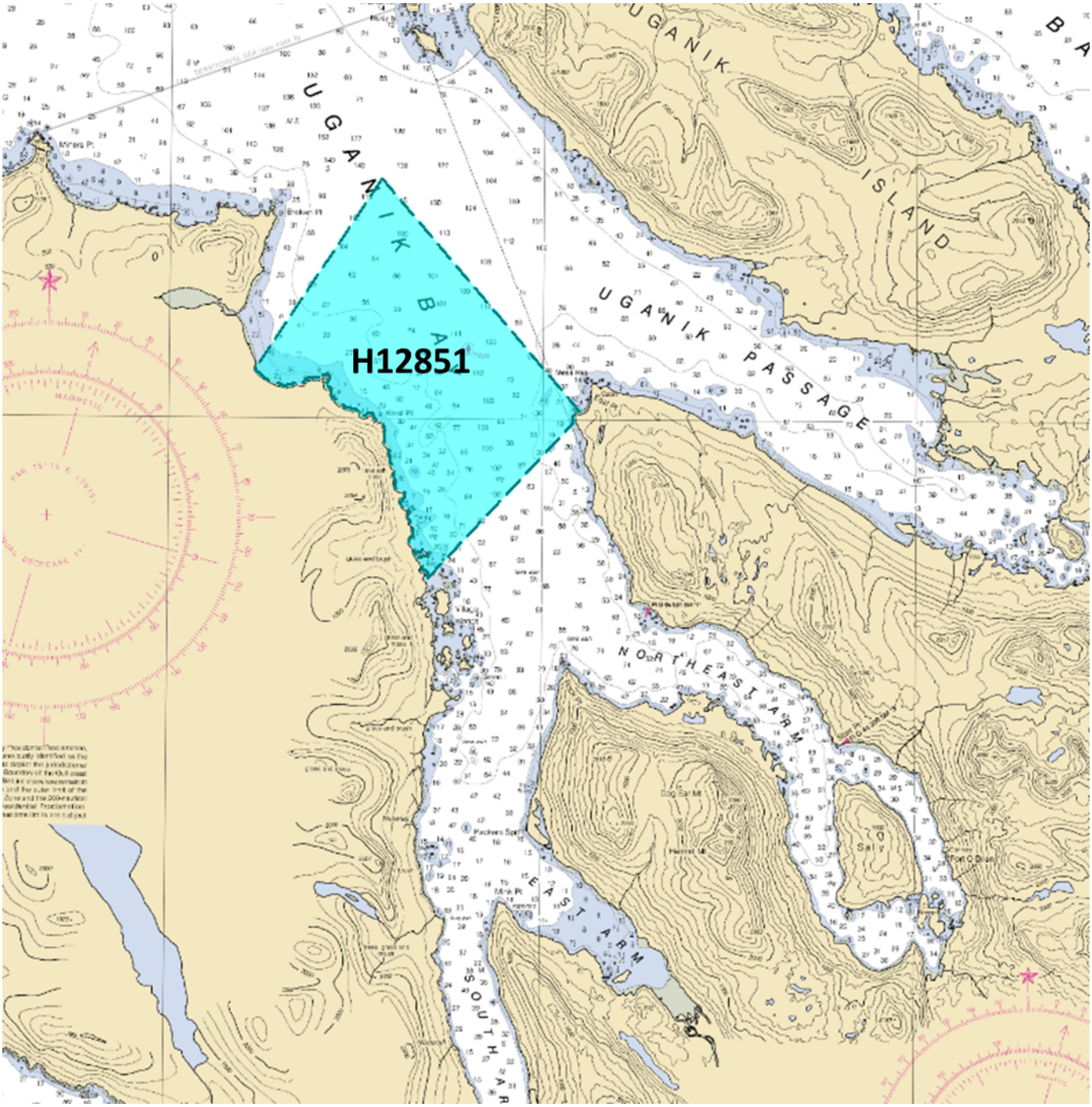

Figure 2: H12851 survey area overview.

Survey data were acquired within survey limits in accordance with the requirements in the Project Instructions and the Hydrographic Surveys Specifications and Deliverables (HSSD) unless noted otherwise in this report.

A.2 Survey Purpose

The purpose of this project is to provide contemporary surveys to update National Ocean Service (NOS) nautical charting products, which will support Kodiak's large fishing fleet and increasing levels of passenger vessel traffic. This survey is within an area identified as Emerging Critical and Navigationally Significant according to the 2012 NOAA Hydrographic Survey Priorities (NHSP).

A.3 Survey Quality

The entire survey is adequate to supersede previous data.

The QC Tools - Grid QA tool within Pydro Explorer was used to analyze multibeam echosounder (MBES) data density. All finalized surfaces meet the HSSD data density requirement (Figures 3-7).

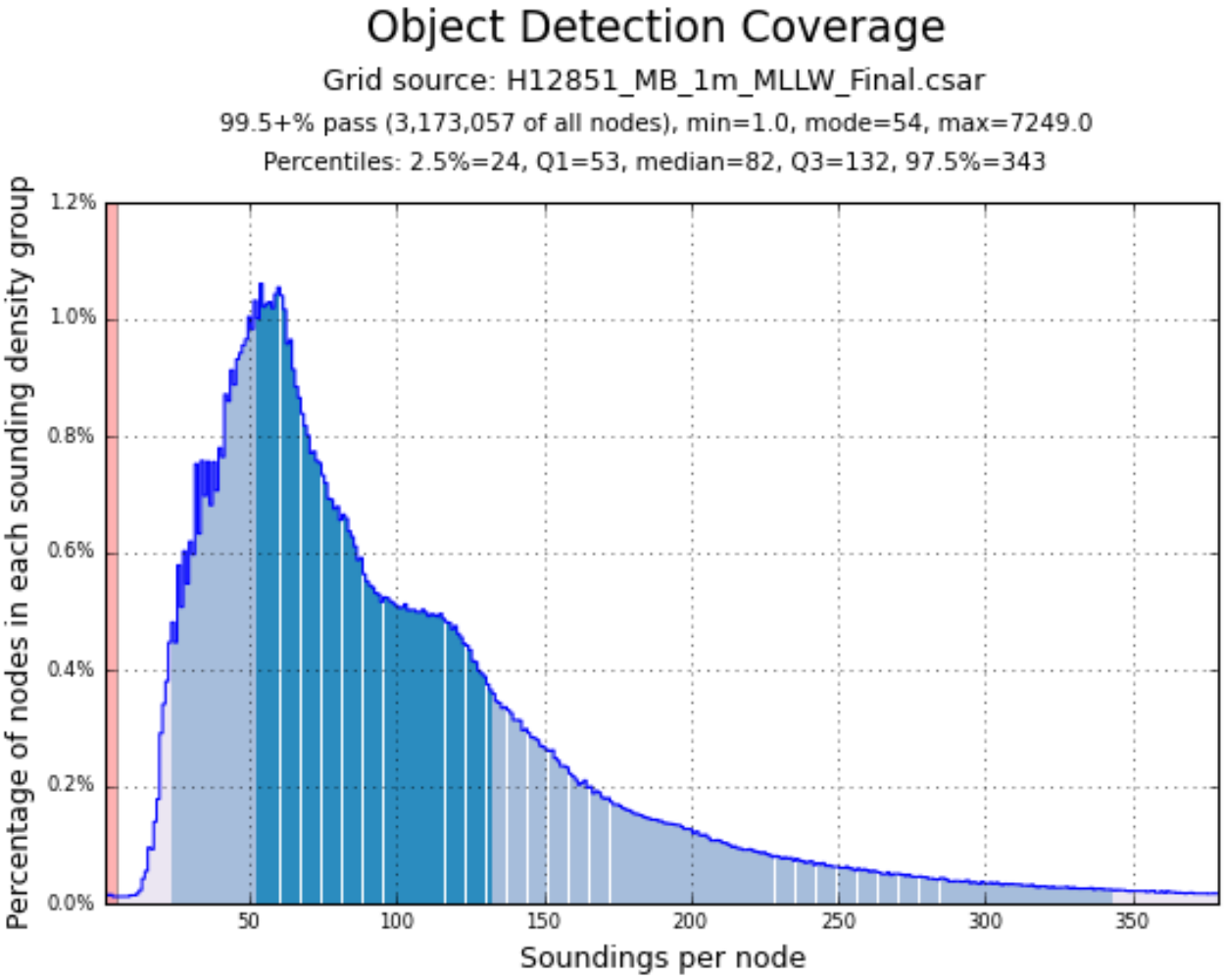

Figure 3: Pydro derived histogram plot showing HSSD compliance of H12851 MBES data within the 1-meter finalized CUBE surface.

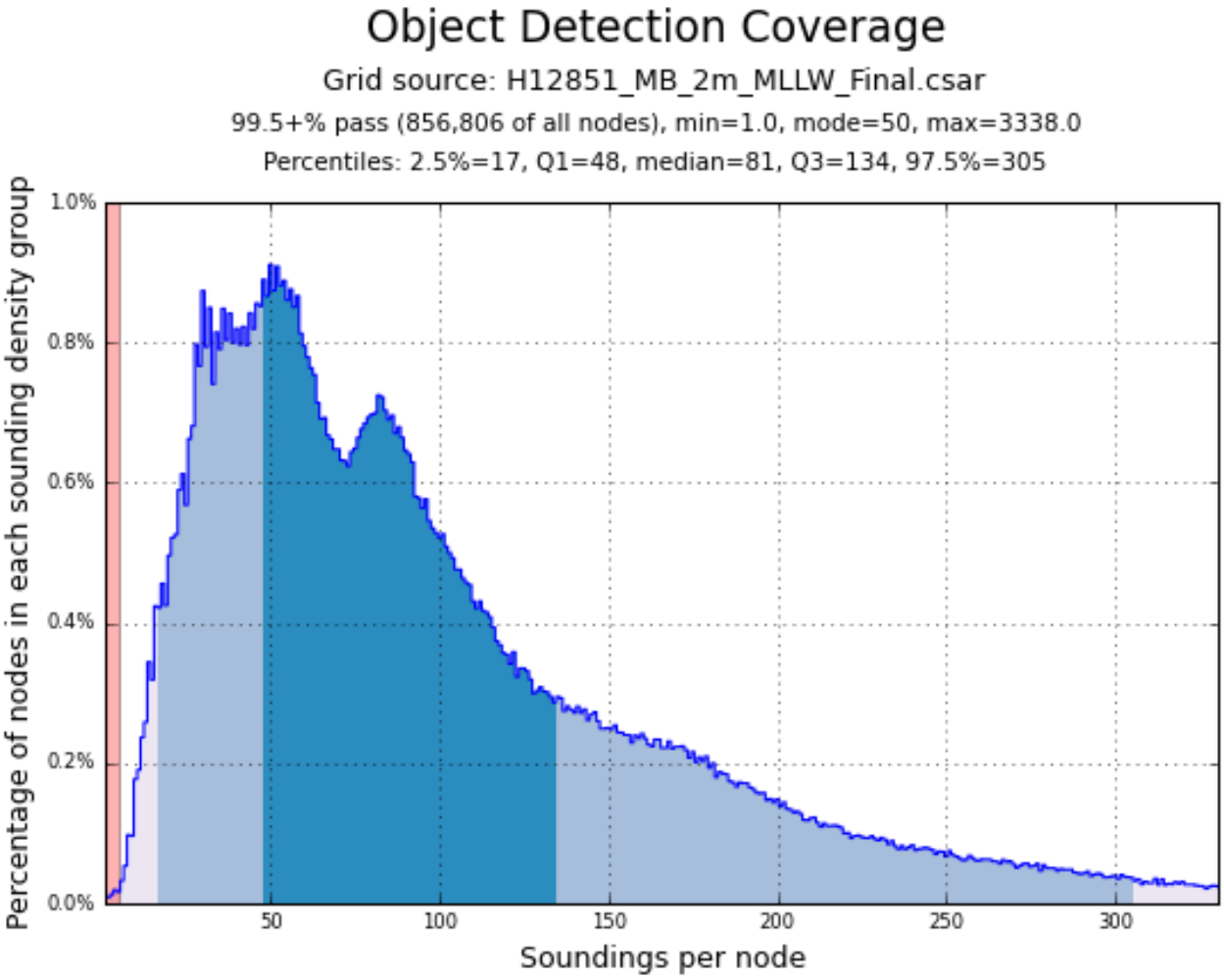

Figure 4: Pydro derived histogram plot showing HSSD compliance of H12851 MBES data within the 2-meter finalized CUBE surface.

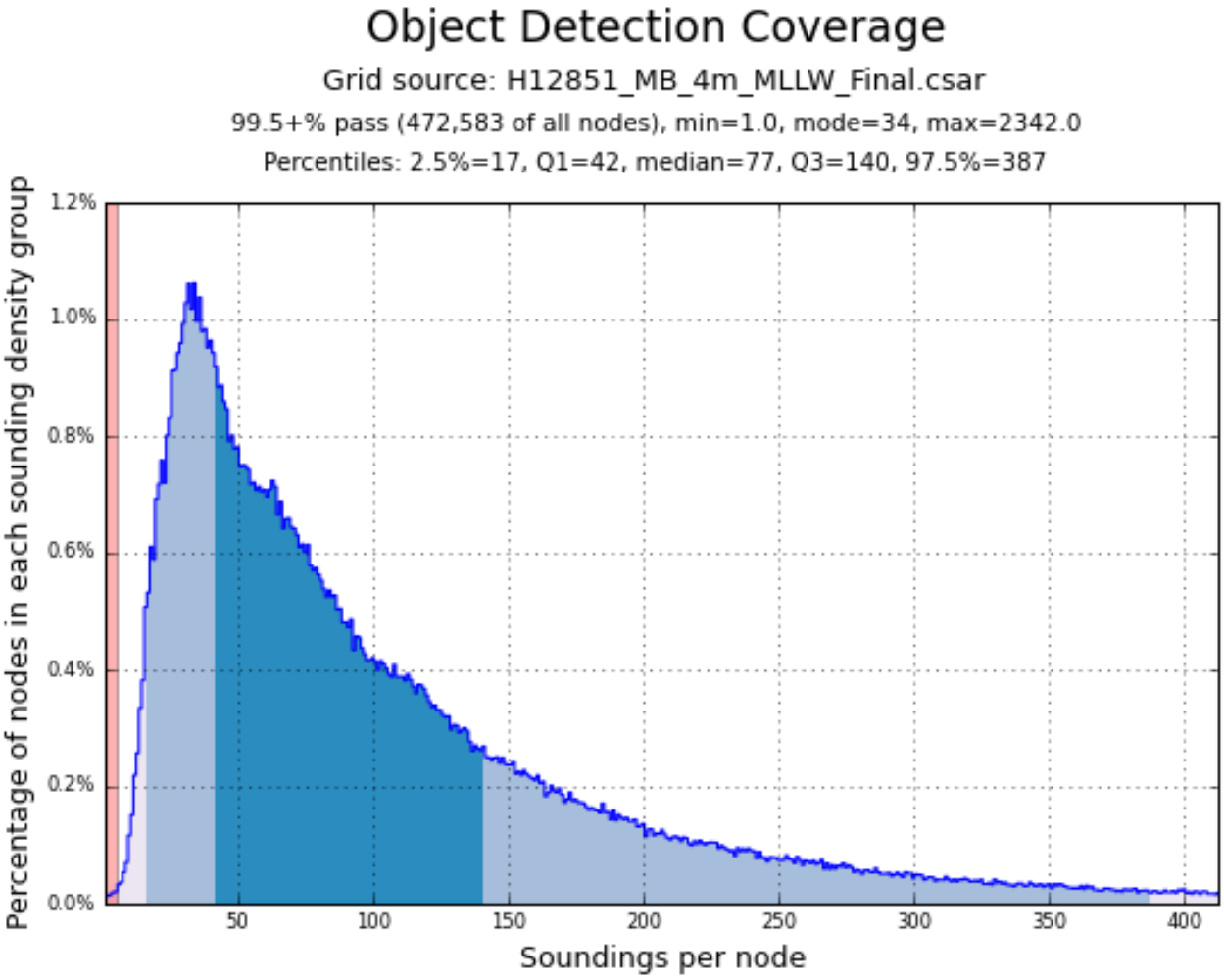

Figure 5: Pydro derived histogram plot showing HSSD compliance of H12851 MBES data within the 4-meter finalized CUBE surface.

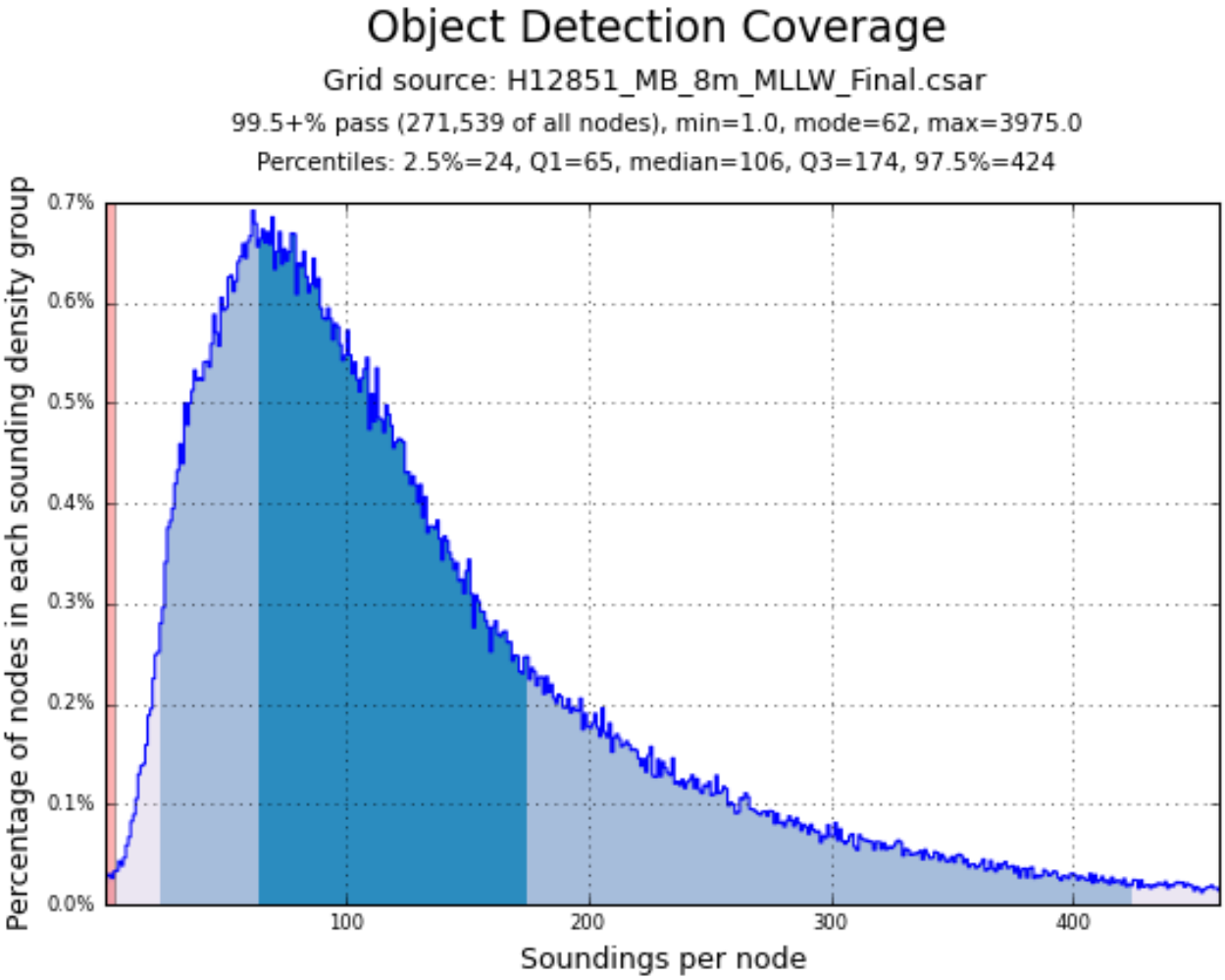

Figure 6: Pydro derived histogram plot showing HSSD compliance of H12851 MBES data within the 8-meter finalized CUBE surface.

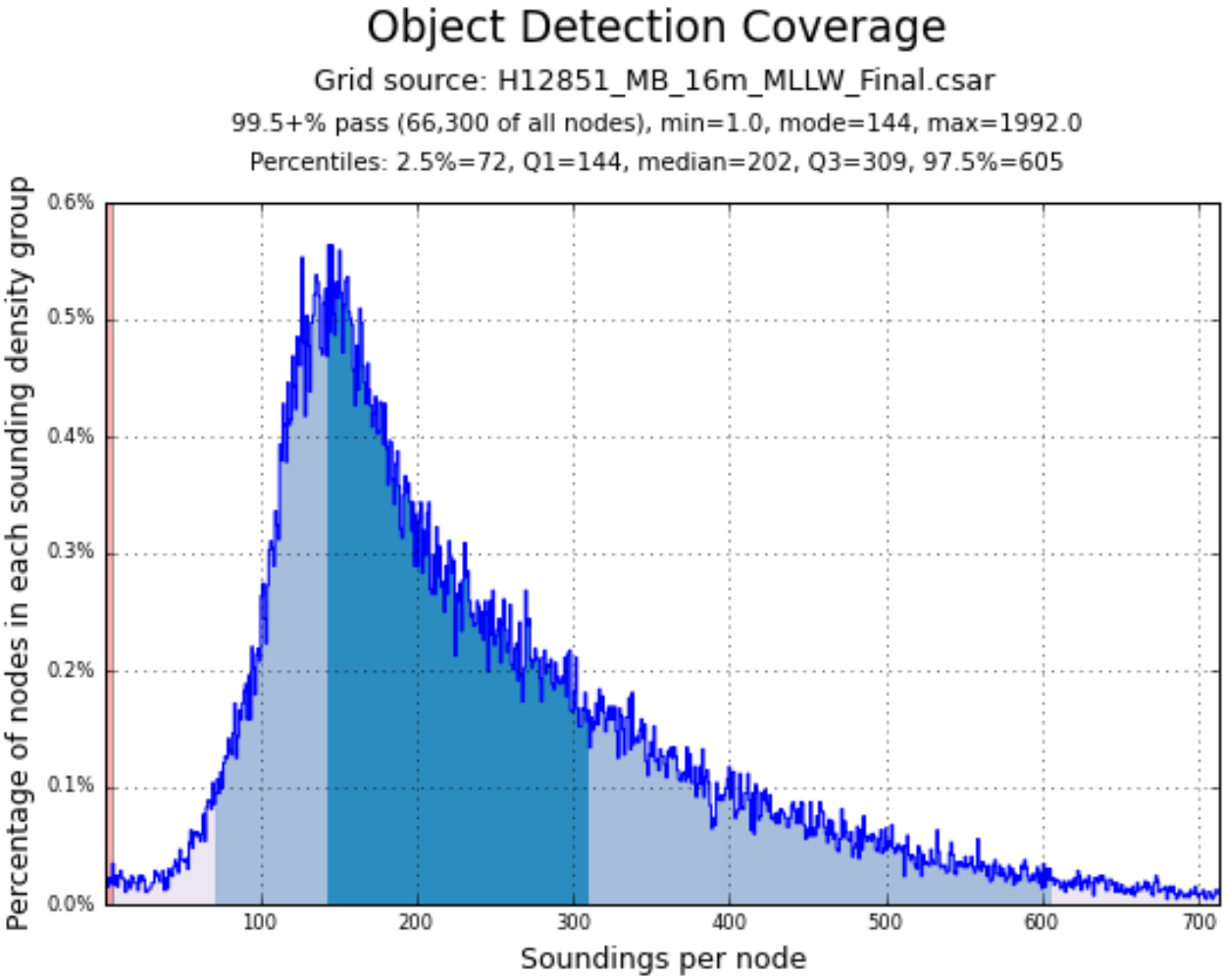

Figure 7: Pydro derived histogram plot showing HSSD compliance of H12851 MBES data within the 16-meter finalized CUBE surface.

A.4 Survey Coverage

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

Water Depth	Coverage Required
Inshore limit to 8 meters water depth	Complete coverage MB with backscatter (Section 5.2.2.3) or Set Line Spacing MBES or SBES at 100m (HSSD Section 5.2.2.4).
Greater than 8 meters water depth	Complete Coverage MBES (HSSD Section 5.2.2.3 Option A).

Complete MBES coverage was achieved within the limits of hydrography as specified in the Project Instructions except where it was unsafe to continue survey operations further inshore. The following areas do not meet coverage requirements:

Near shore survey coverage to the south of Broken Point did not extend to the sheet limits in multiple areas due to rocks and shoal areas (Figure 8).

Survey coverage near shore to the west of East Point did not extend to the sheet limits due to rocks and shoal areas (Figure 9).

Survey coverage north of Village Islands did not extend to the sheet limits due to rocks and safety concerns of launch personnel. Missing coverage in this area is fully covered by sheet H12917 (Figure 10).

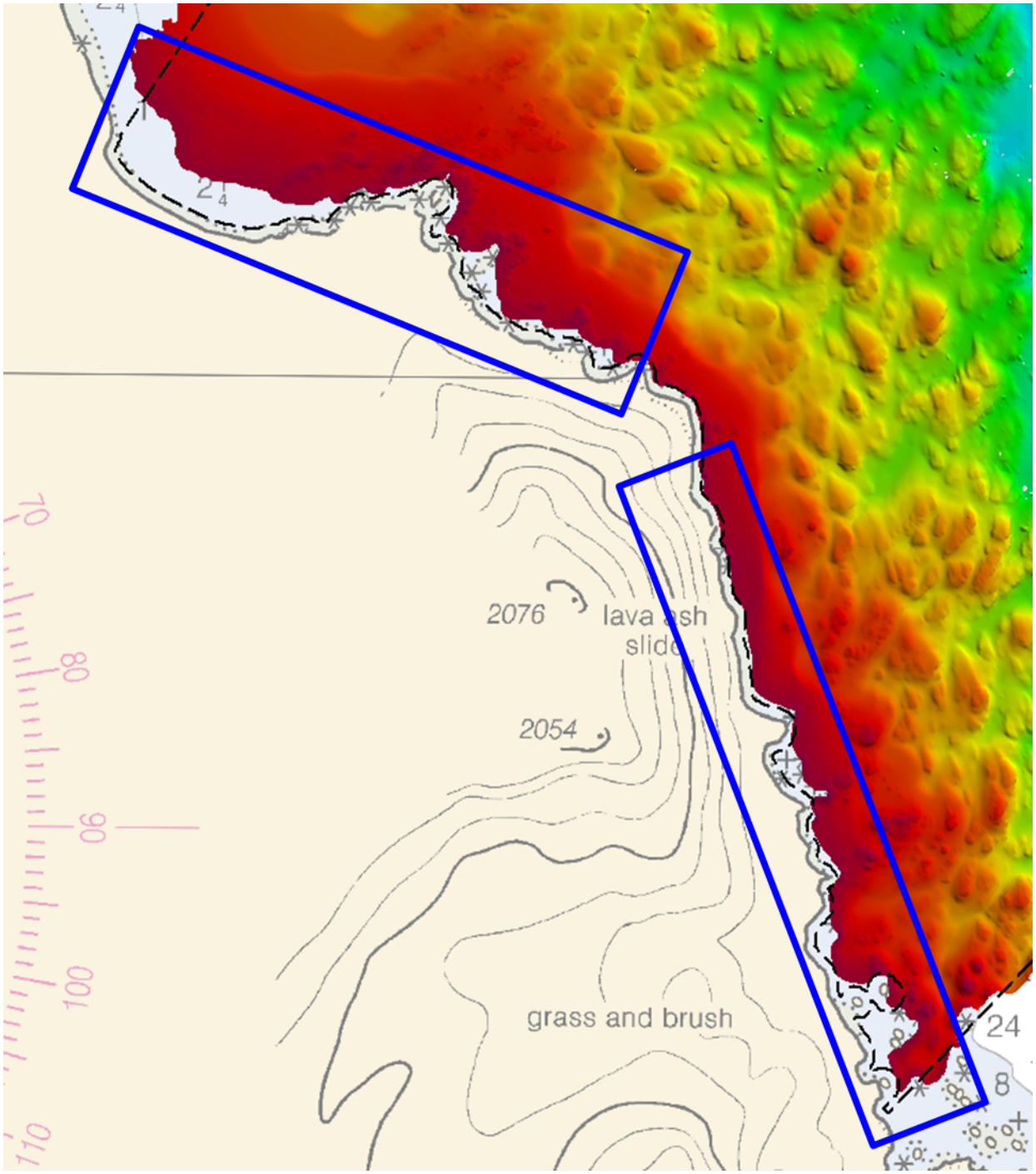

Figure 8: Coverage did not extend to sheet limits due to unsafe conditions.

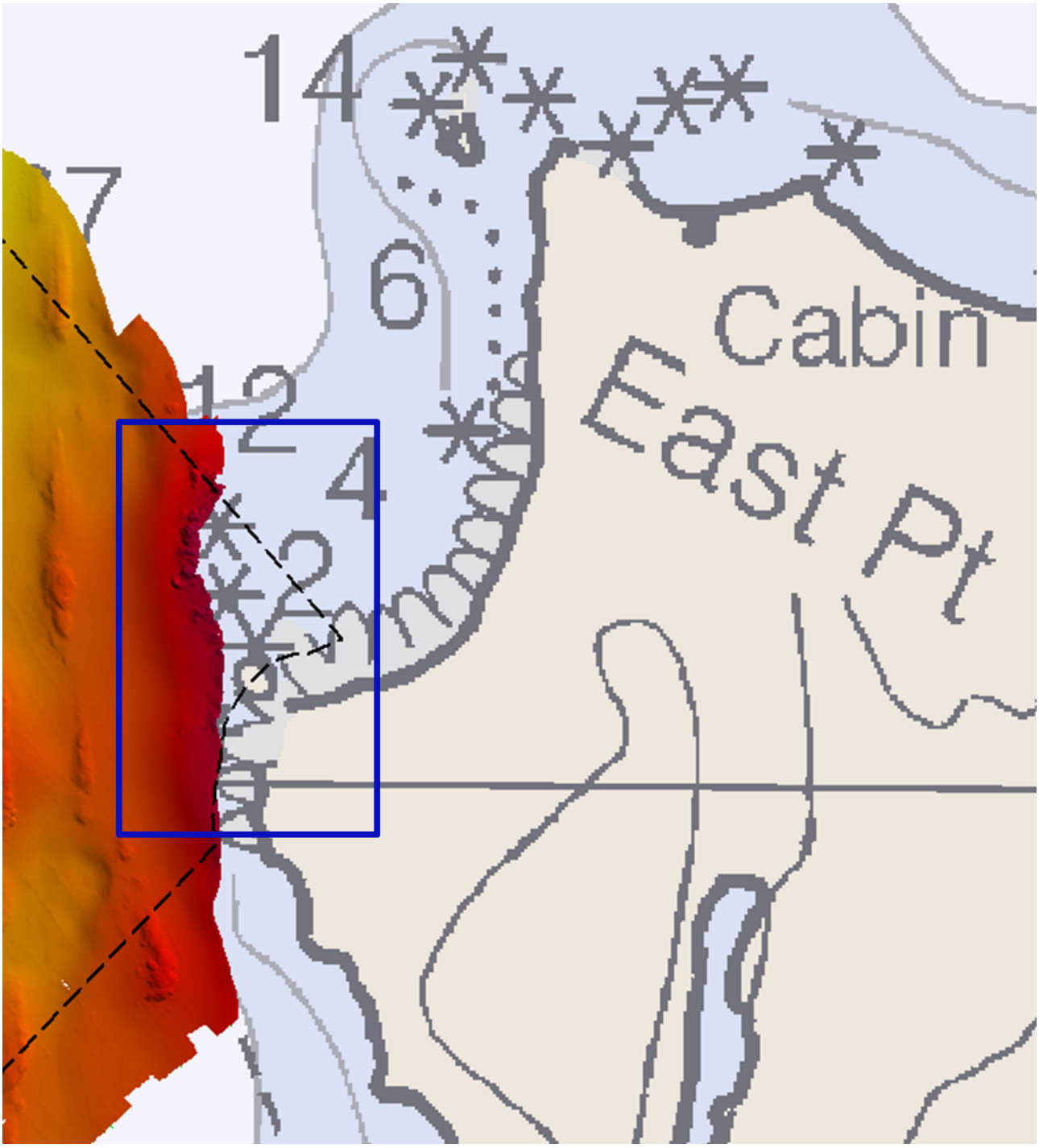

Figure 9: Coverage did not extend to sheet limits due to unsafe condtions.

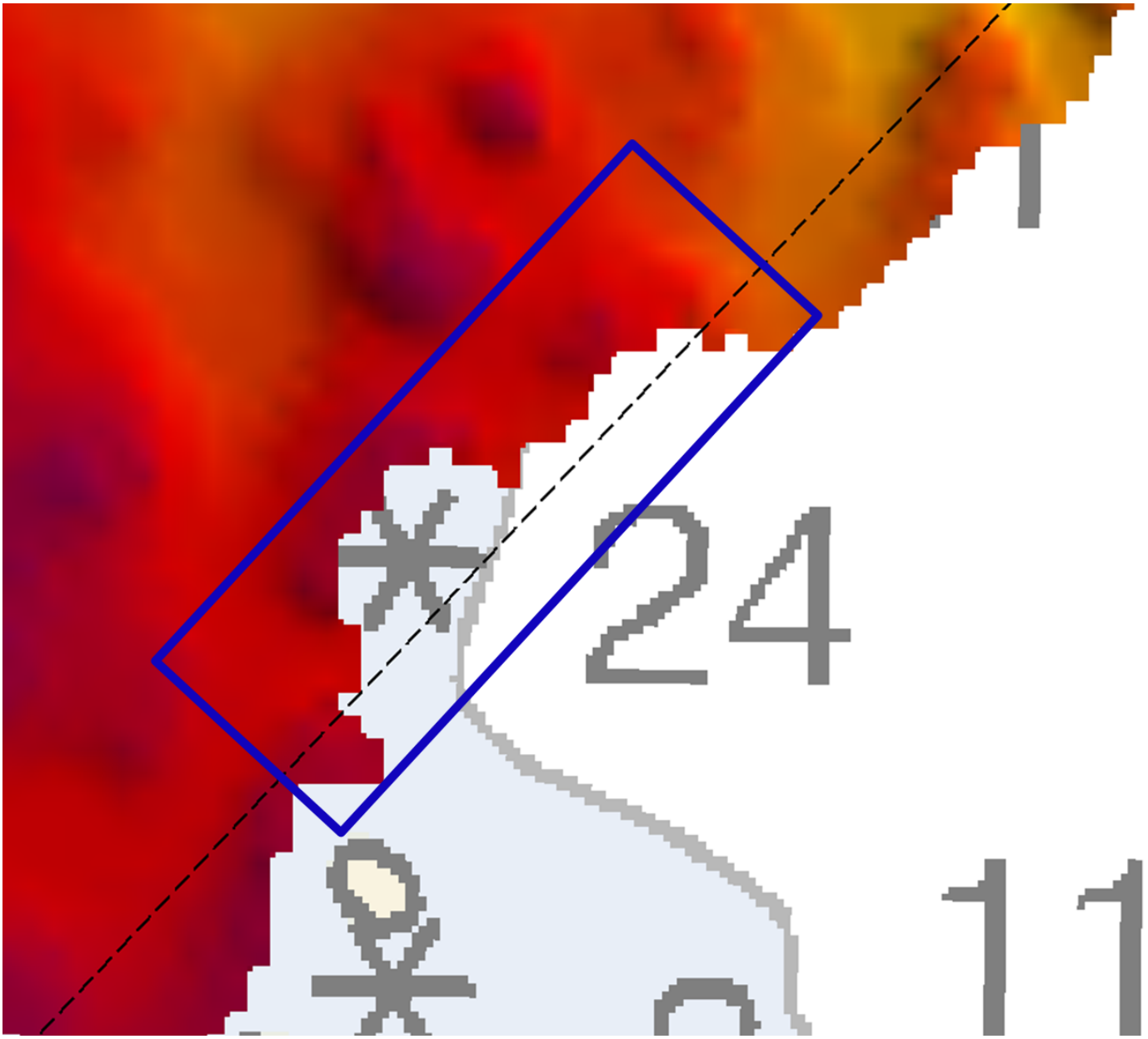

Figure 10: Complete coverage was not achieved due to rocks and safety concerns (sheet limits in black).

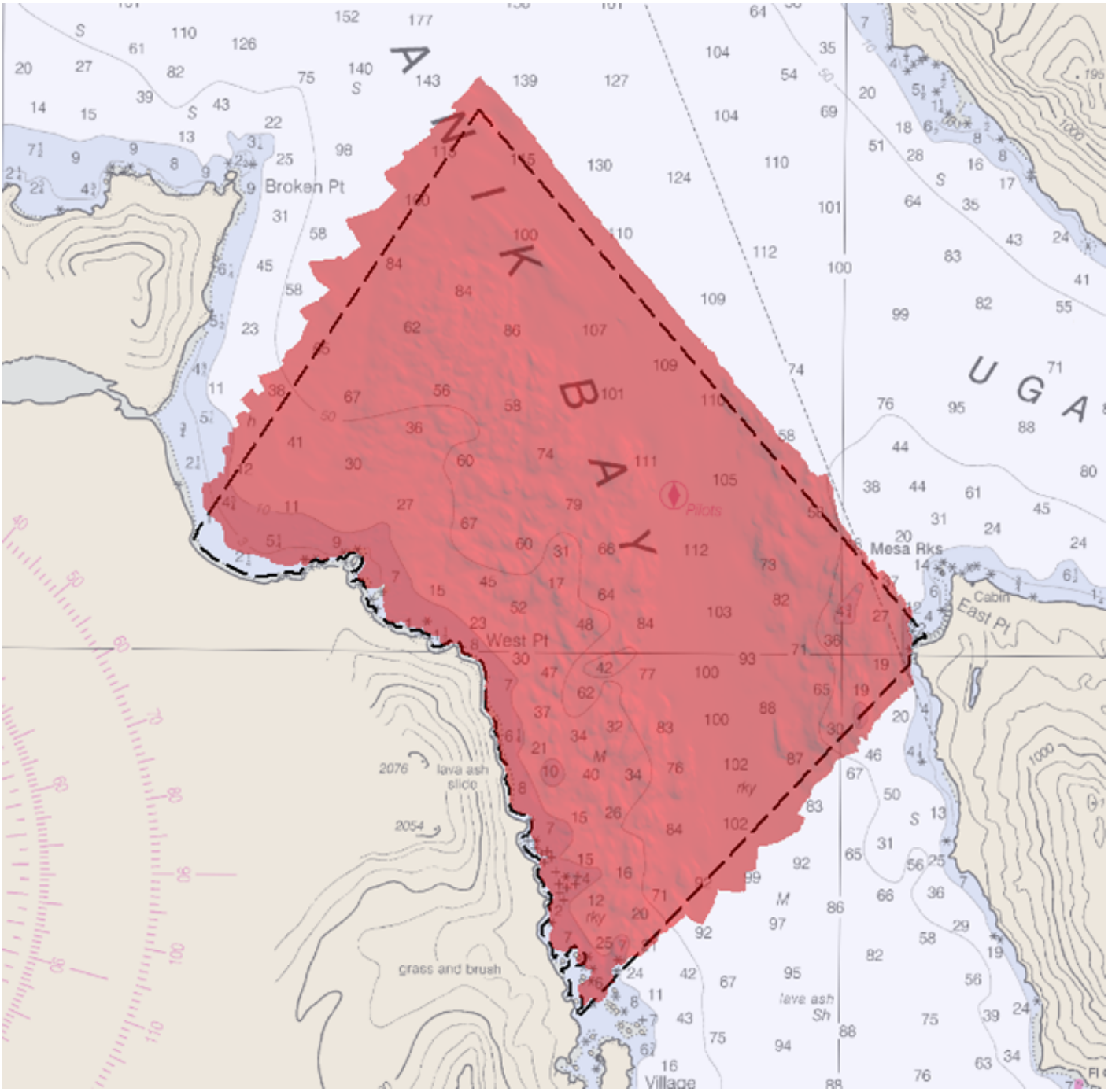

Figure 11: H12851 Survey Coverage (Chart 16597)

A.5 Survey Statistics

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

	HULL ID	*2801*	*2802*	*2803*	*2804*	*Total*
LNM	**SBES Mainscheme**	0	0	0	0	0
	MBES Mainscheme	64.87	4.05	69.21	45.61	183.74
	Lidar Mainscheme	0	0	0	0	0
	SSS Mainscheme	0	0	0	0	0
	SBES/SSS Mainscheme	0	0	0	0	0
	MBES/SSS Mainscheme	0	0	0	0	0
	SBES/MBES Crosslines	3.55	11.83	0	0	15.38
	Lidar Crosslines	0	0	0	0	0
Number of Bottom Samples						4
Number Maritime Boundary Points Investigated						0
Number of DPs						48
Number of Items Investigated by Dive Ops						0
Total SNM						12.53

Table 2: Hydrographic Survey Statistics

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

Survey Dates	Day of the Year
09/16/2016	260
09/19/2016	263
09/28/2016	272
09/30/2016	274
10/03/2016	277
10/04/2016	278
10/06/2016	280
10/14/2016	288

Table 3: 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	*2801*	*2802*	*2803*	*2804*	*1905*	*1906*
LOA	8.8 meters	8.8 meters	8.8 meters	8.8 meters	5.7 meters	5.8 meters
Draft	1.1 meters	1.1 meters	1.1 meters	1.1 meters	0.3 meters	0.3 meters

Table 4: Vessels Used

All data for survey H12851 was acquired by survey launches 2801, 2802, 2803, and 2804, and skiffs 1905 and 1906. The launches acquired MBES depth soundings, backscatter data, sound velocity profiles, and bottom samples. The skiffs conducted shoreline verification.

B.1.2 Equipment

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

Manufacturer	Model	Type
Applanix	POS-MV V5	Positioning and Attiude System
Reson	SVP71	Sound Speed System
Reson	SeaBat 7125 SV2	MBES
Reson	SeaBat 7125-B	MBES
Sea Bird Electronics, Inc.	19 plus SEACAT Profiler	Conductivity, Temperature, and Depth Sensor

Table 5: Major Systems Used

B.2 Quality Control

B.2.1 Crosslines

Crosslines acquired for this survey totaled 8.37% of mainscheme acquisition.

Multibeam crosslines were acquired using the Reson 7125 on launches 2801 (RA-4) and 2802 (RA-5). A 4-meter CUBE surface was created using only mainscheme lines, and a second 4-meter CUBE surface was created using only crosslines (Figure 12). A difference surface was generated from these two surfaces in CARIS at a 4-meter resolution. The absolute difference was compared to the IHO allowable total vertical uncertainty (TVU) standards for Order 1 depths (0-100 meters) and Order 2 depths (greater than 100 meters). In total, 99.79% of the depth differences between H12851 mainscheme and crossline data met HSSD TVU standards (Figure 13). This analysis was performed on H12851 data reduced to Mean Lower-Low Water (MLLW) using Ellipsoidally Referenced Zoned Tides (ERZT) methods.

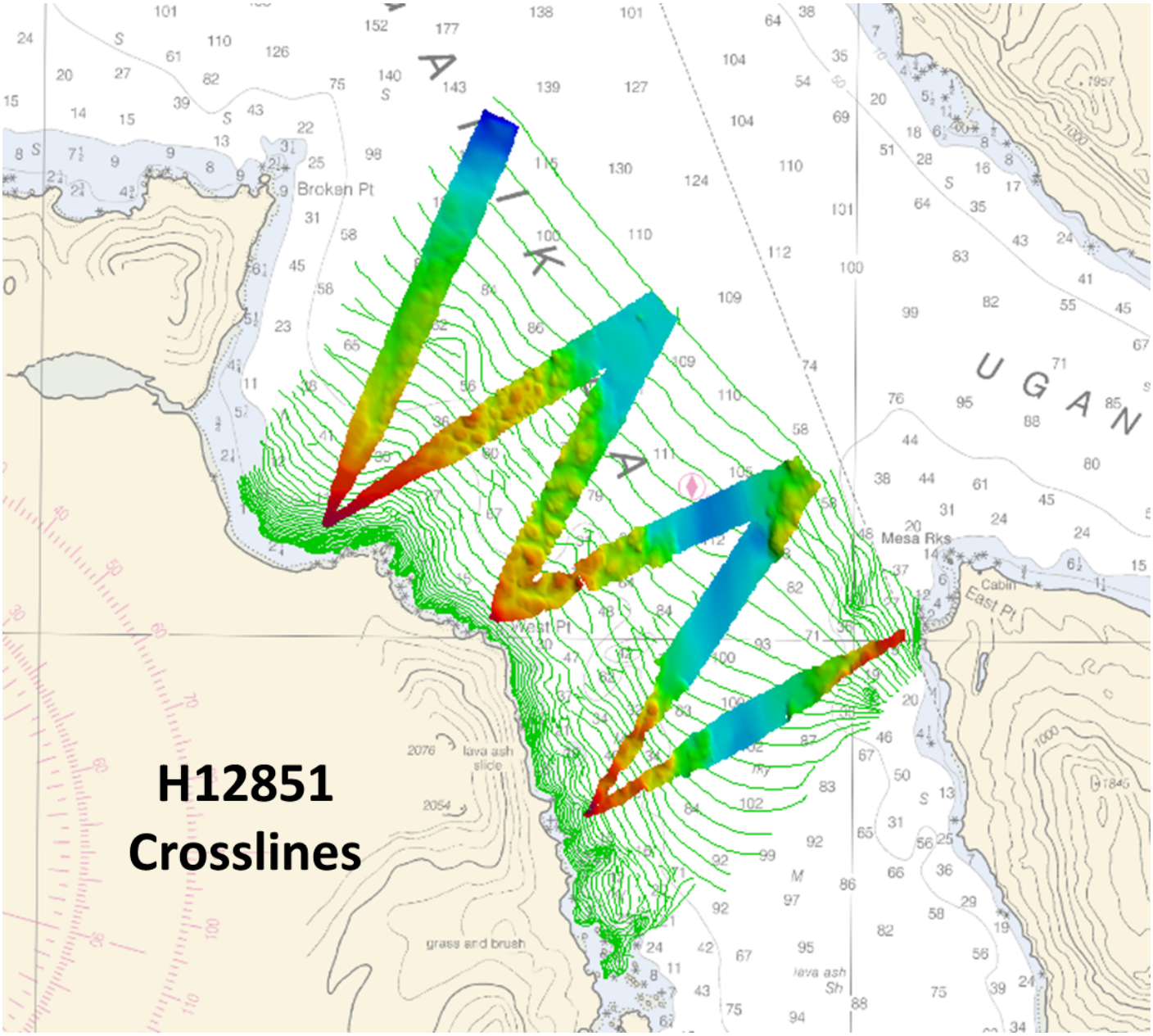

Figure 12: H12851 Crosslines

Crossline IHO-compliance Statistics (see previous tabs)

Depth range	IHO Order	Number of nodes	Nodes satisfying HSSD	Percent nodes satisfying HSSD accuracy
Less than 100m	Order 1	182,844	182,761	99.95%
Greater than 100m	Order 2	469,249	467,934	99.72%
	TOTAL:	652,093	650,695	99.79%

Figure 13: Crossline-based HSSD Compliance Statistics

B.2.2 Uncertainty

The following survey specific parameters were used for this survey:

Measured	Zoning	Method
0 meters	0.034 meters	ERS via ERZT

Table 6: Survey Specific Tide TPU Values.

Hull ID	Measured - CTD	Measured - MVP	Surface
2801, 2802, 2803, 2804	3.0 meters/second		0.15 meters/second

Table 7: Survey Specific Sound Speed TPU Values.

Total Propagated Uncertainty (TPU) values for H12851 were derived from a combination of fixed values for equipment and vessel characteristics, as well as field assigned values for sound speed uncertainties. Tidal uncertainties were accounted for by examining the field generated 1000-meter separation model and statistically determining a measured uncertainty. The measured tide uncertainty value of 0.034 meters was entered to account for ERZT processing methods. See the OPR-P136-RA-16 ERS Capability memo included in Supplemental Correspondence for further information.

In addition to the usual a priori estimates of uncertainty, some real-time and post processed uncertainty sources were also incorporated into the depth estimates of this survey. Real-time uncertainties from Reson MBES sonars were recorded and applied during post processing. Applanix TrueHeave (POS) files, which record estimates of heave uncertainty, were also applied during post processing. Finally, the post processed uncertainties associated with vessel roll, pitch, yaw and navigation, were applied in CARIS HIPS using SBET / RMS files generated using POSPac software.

Uncertainty values of submitted finalized grids were calculated in CARIS HIPS and SIPS using the "Greater of the Two" of uncertainty and standard deviation (scaled to 95%). The QC Tools - Grid QA tool within Pydro Explorer was used to analyze H12851 MBES data (Figures 14-18).

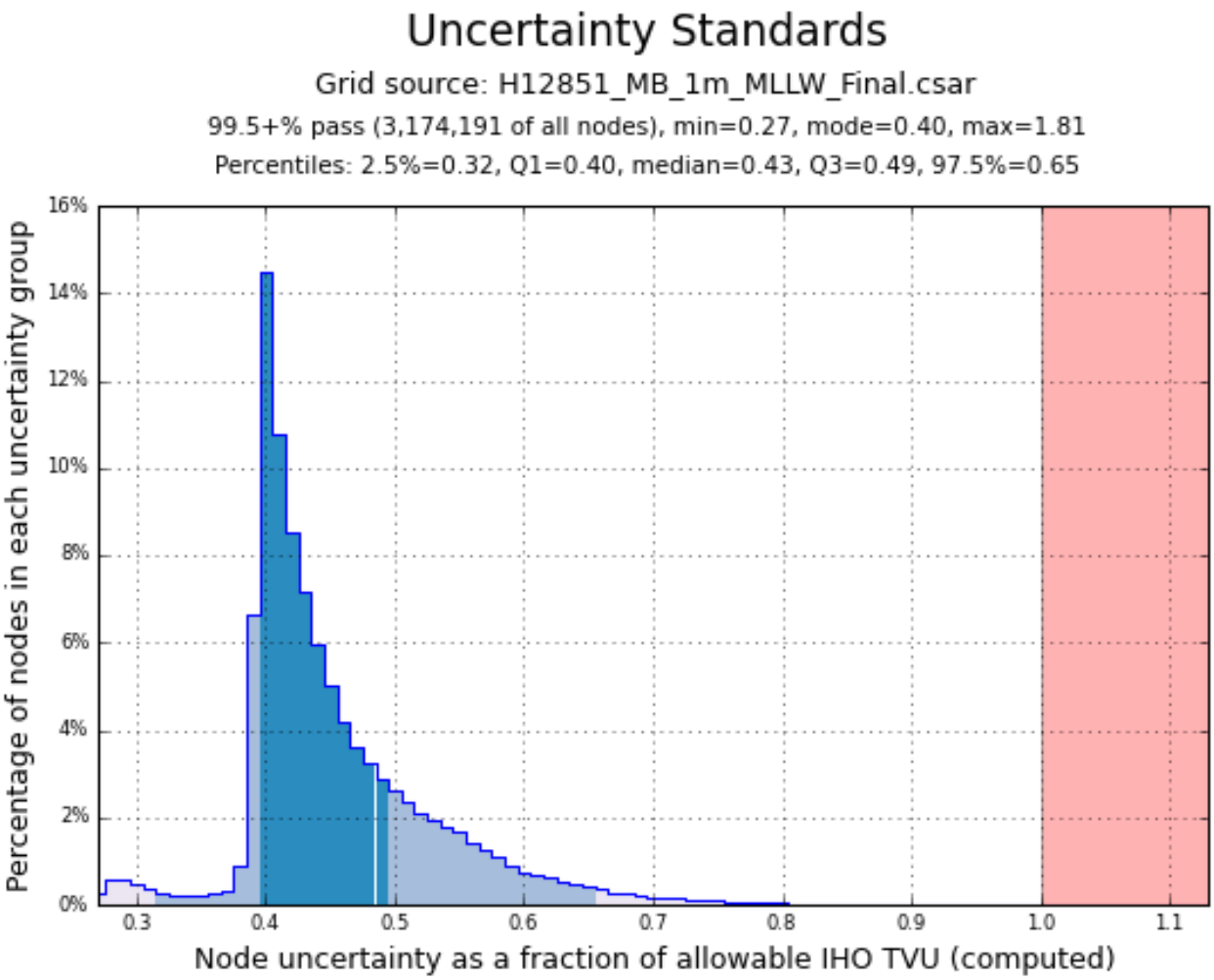

Figure 14: 1-meter finalized surface meets HSSD uncertainty standards

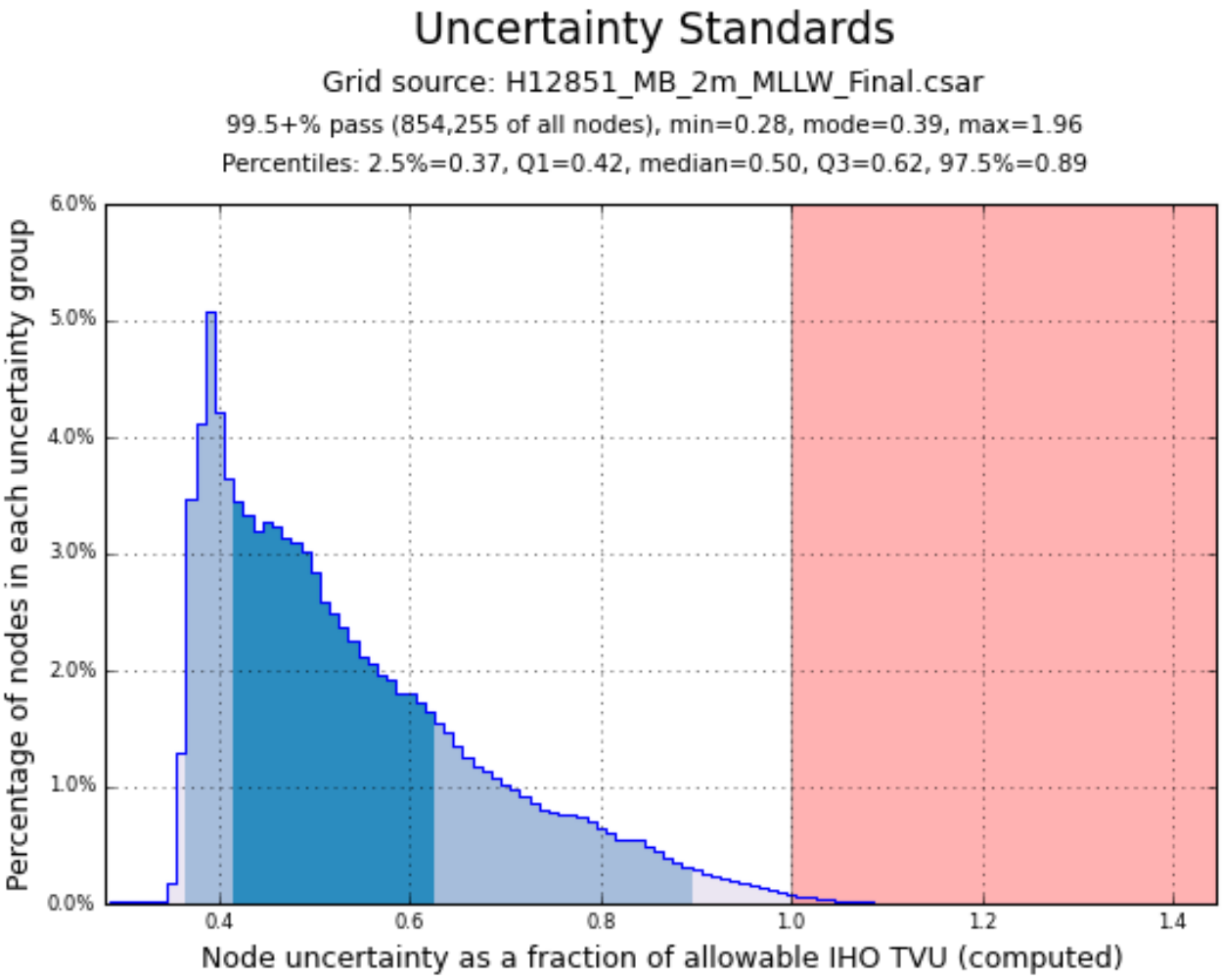

Figure 15: 2-meter finalized surface meets HSSD uncertainty standards

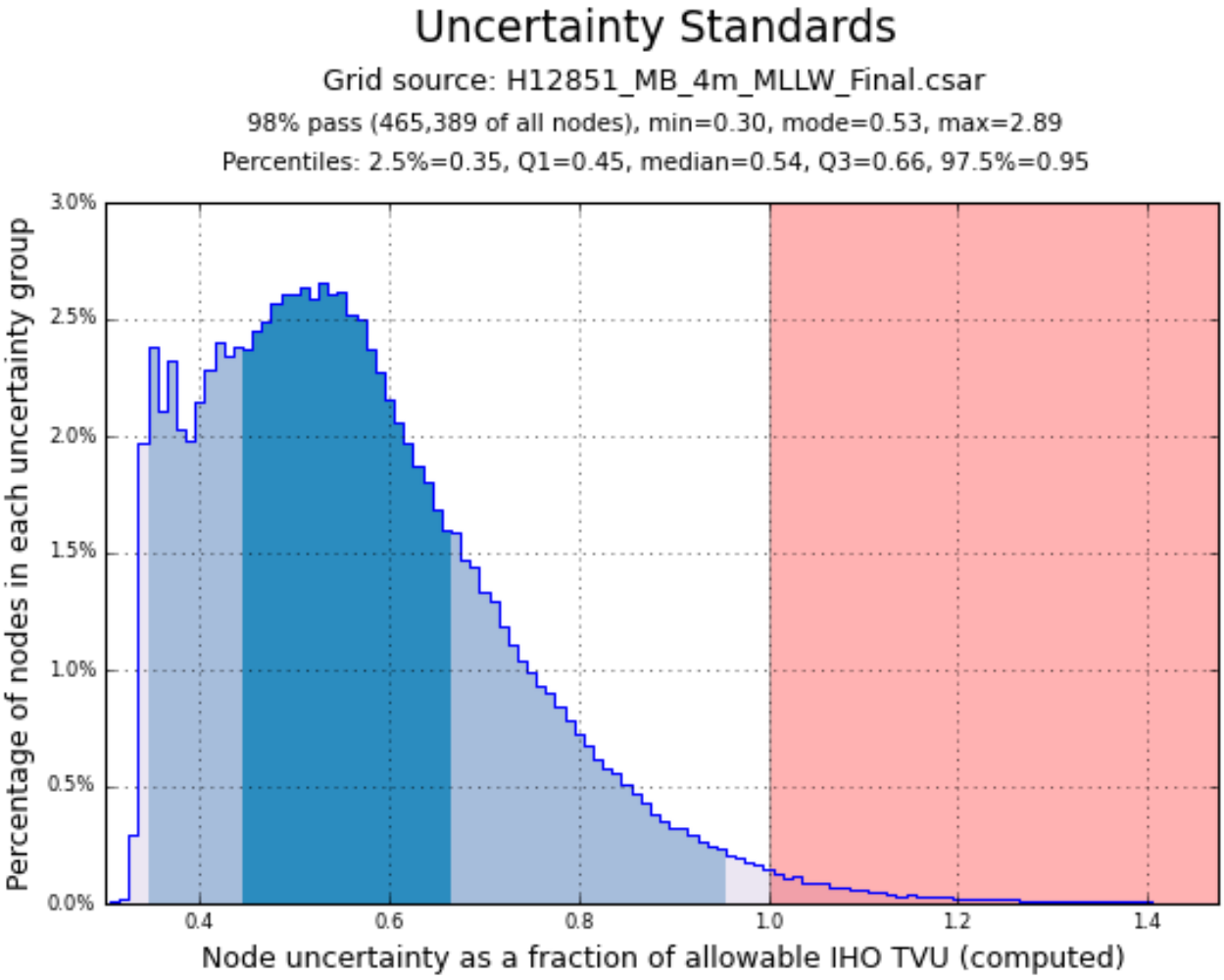

Figure 16: 4-meter finalized surface meets HSSD uncertainty standards

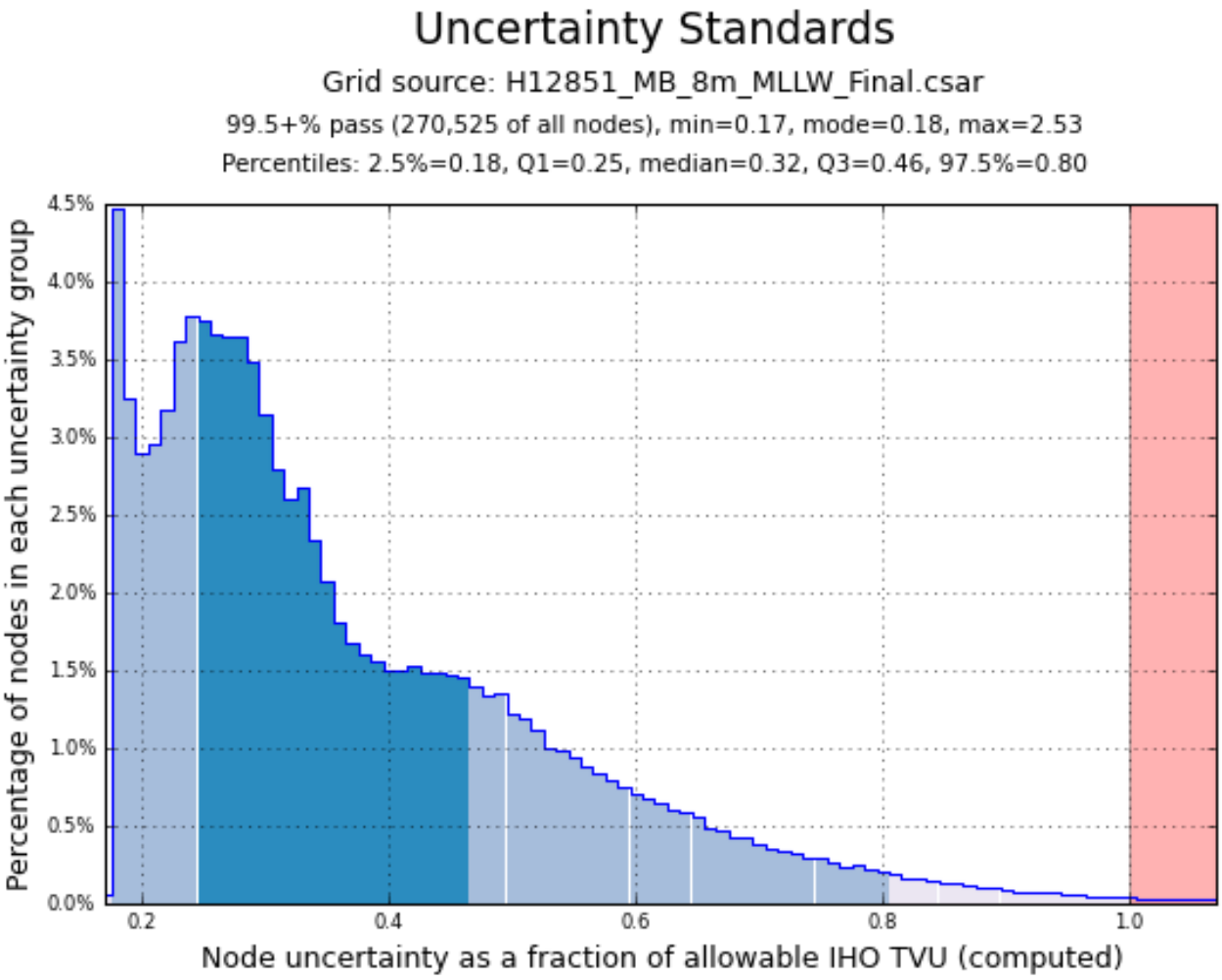

Figure 17: 8-meter finalized surface meets HSSD uncertainty standards

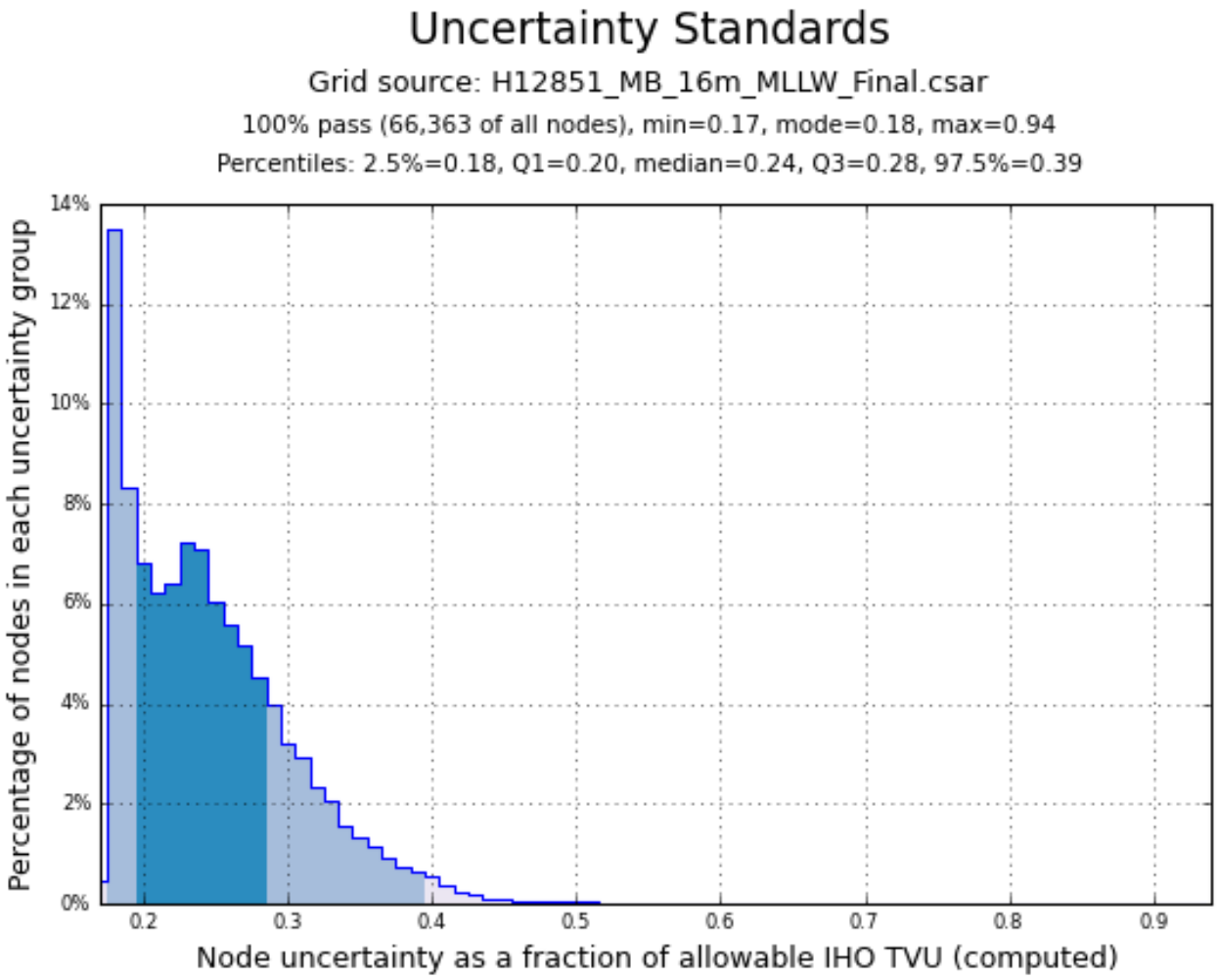

Figure 18: 16-meter finalized surface meets HSSD uncertainty standards

B.2.3 Junctions

H12851 junctions with three other surveys, H12850, H12916, and H12917. All surveys are part of project OPR-P136-RA-16 (Figure 19).

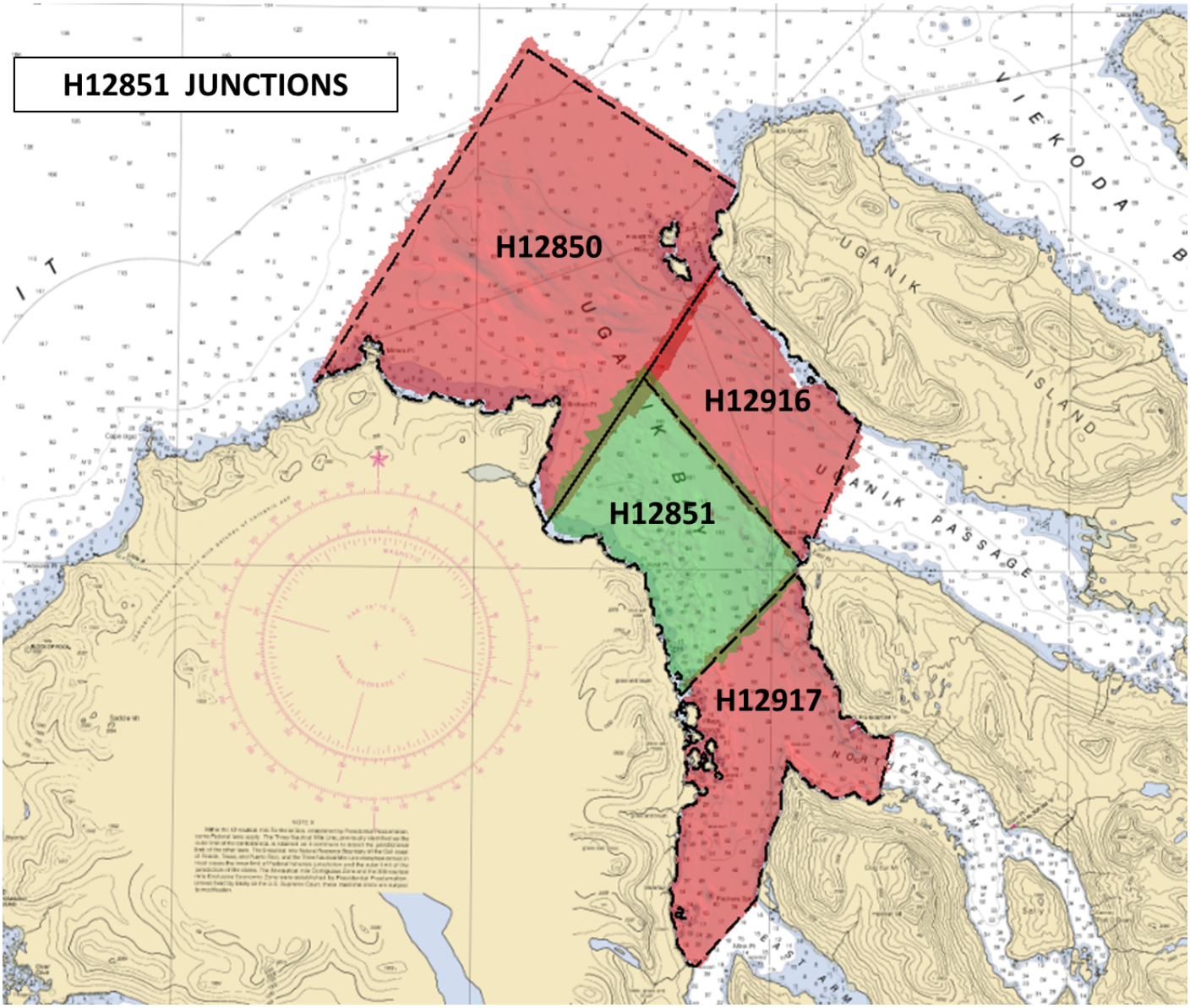

Figure 19: H12851 Junction Surveys.

The following junctions were made with this survey:

Registry Number	Scale	Year	Field Unit	Relative Location
H12916	1:40000	2016	NOAA Ship RAINIER	NE
H12850	1:40000	2016	NOAA Ship RAINIER	NW
H12917	1:40000	2016	NOAA Ship RAINIER	SE

Table 8: Junctioning Surveys

H12916

Overlap with Survey H12916 was approximately 4.37 nautical miles along the north eastern boundary of H12851 (Figure 20). The width of overlap between these two sheets varied from 130 meters to 465 meters. Depths in the junction area range from 4 meters to 260 meters. For the respective depths, the difference surface was compared to the allowable TVU standards specified in the HSSD. Analysis of the IHO Order 1 difference surface indicated a mean difference of 0.85 meters with a standard deviation of 0.45 meters. Analysis of the IHO Order 2 difference surface indicated a mean difference of 4.1 meters with a standard deviation of 0.79 meters. In total, 99.34% (Figure 21) of the depth differences between H12851 and junction survey H12916 are within allowable uncertainties.

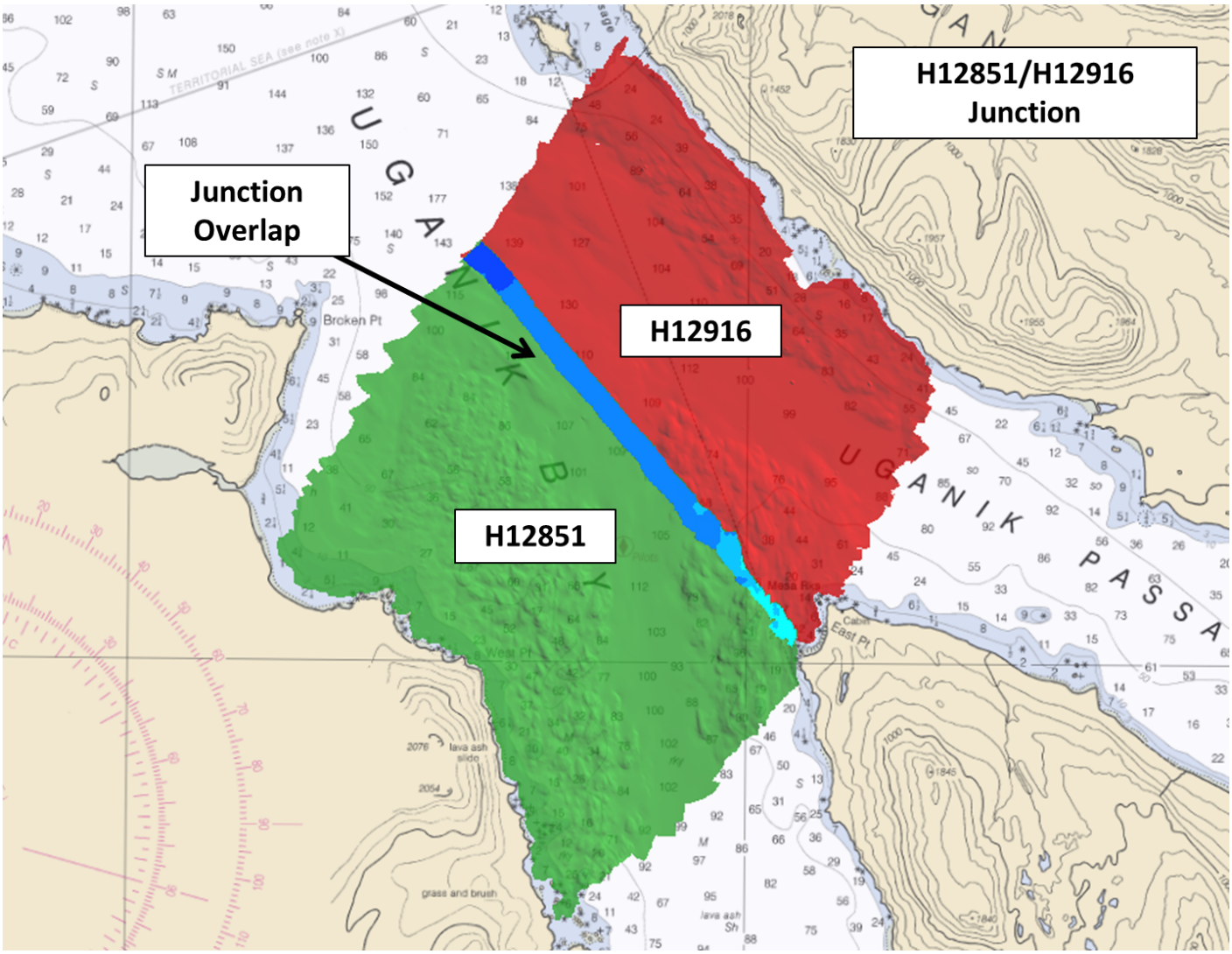

Figure 20: H12851 junction with H12916 (overlap in blue).

Junction IHO-compliance Statistics (see previous tabs)

Depth range	IHO Order	Number of nodes	Nodes satisfying HSSD accuracy	Percent nodes satisfying HSSD accuracy
Less than 100m	Order 1	32,438	31,337	96.61%
Greater than 100m	Order 2	139,093	139,064	99.98%
	TOTAL:	171,531	170,401	**99.34%**

Figure 21: Summary table indicating the percentage of nodes from the junction overlap that met HSSD allowable TVU standards.

H12850

Junction analysis specifics between H12851 and H12850 are located in the H12850 DR.

According to the H12850 DR, "The overlap with survey H12851 encompassed 1.09 square nautical miles along the southeastern boundary of H12850. A comparison was made using a difference surface derived from 8-meter CUBE surfaces of each survey. Analysis of the difference surface indicated that H12850 is an average of 0.02 meters deeper than H12851 with a standard deviation of 0.31 meters. For the respective depths, the difference surface was compared to the allowable TVU standards specified in the HSSD. 99.78% of the depth differences between H12850 and junction survey H12851 were within allowable uncertainties. The highest uncertainties corresponded with areas of steeply sloping seafloor."

H12917

Junction analysis specifics between H12851 and H12917 are located in the H12917 DR.

According to the H12917 DR, "The overlap with survey H12851 encompassed 0.52 square nautical miles along the northern boundary of H12917. A comparison was made using a difference surface derived from the 8-meter CUBE surfaces of each survey. Analysis of the difference surface indicated that H12917 is an average of 0.08 meters deeper than H12851 with a standard deviation of 0.54 meters. For the respective depths, the difference surface was compared to the allowable TVU standards specified in the HSSD. In total, 94.67% of the depth differences between H12917 and junction survey H12851 were within allowable uncertainties. The highest uncertainties corresponded with areas of dynamic seafloor topography."

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: Sound speed profiles were acquired using the SBE 19plus CTD probes at discrete locations within the survey area at least once every four hours, when significant changes in surface speed were observed, or where surveying a new area. In total 25 casts were taken for H12851. All casts were concatenated into a master file and applied to lines using the "Nearest distance within time" (4 hours) profile selection method.

B.2.8 Coverage Equipment and Methods

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

B.3 Echo Sounding Corrections

B.3.1 Corrections to Echo Soundings

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

B.3.2 Calibrations

All sounding systems were calibrated as detailed in the DAPR.

B.4 Backscatter

Raw Backscatter was logged as a 7k file and will be sent to the Processing Branch. Backscatter was not formally processed by the field unit.

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/SIPS	9.1.7

Table 9: Primary bathymetric data processing software

The following Feature Object Catalog was used: NOAA Profile V_5_4

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
H12851_MB_1m_MLLW	CUBE	1 meters	-2.59 meters - 261.15 meters	NOAA_1m	Complete MBES
H12851_MB_1m_MLLW_Final	CUBE	1 meters	-2.94 meters - 20 meters	NOAA_1m	Complete MBES
H12851_MB_2m_MLLW	CUBE	2 meters	-2.40 meters - 261.15 meters	NOAA_2m	Complete MBES
H12851_MB_2m_MLLW_Final	CUBE	2 meters	18 meters - 40 meters	NOAA_2m	Complete MBES
H12851_MB_4m_MLLW	CUBE	4 meters	-2.33 meters - 260.46 meters	NOAA_4m	Complete MBES
H12851_MB_4m_MLLW_Final	CUBE	4 meters	36 meters - 80 meters	NOAA_4m	Complete MBES
H12851_MB_8m_MLLW	CUBE	8 meters	-1.79 meters - 259.87 meters	NOAA_8m	Complete MBES

Surface Name	Surface Type	Resolution	Depth Range	Surface Parameter	Purpose
H12851_MB_8m_MLLW_Final	CUBE	8 meters	72 meters - 160 meters	NOAA_8m	Complete MBES
H12851_MB_16m_MLLW	CUBE	16 meters	-0.63 meters - 259.54 meters	NOAA_16m	Complete MBES
H12851_MB_16m_MLLW_Final	CUBE	16 meters	144.00 meters - 259.54 meters	NOAA_16m	Complete MBES

Table 10: Submitted Surfaces

All CARIS CUBE surfaces were created with lines reduced to MLLW via ERZT methods. A total of twenty seven soundings were designated: three as DTONs, twenty one as least depths for features found by multibeam, and three that were designated to force the submitted finalized surface to honor least depths in accordance with HSSD requirements.

The 1-meter grid resolution range was expanded to include the full range of survey coverage. See Supplemental Correspondence for Project Manager approval.

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.

Traditional Methods Used:

TCARI

The following National Water Level Observation Network (NWLON) stations served as datum control for this survey:

Station Name	Station ID
Seldovia	9455500

Table 11: NWLON Tide Stations

File Name	Status
9455500.tid	Final Approved

Table 12: Water Level Files (.tid)

File Name	Status
P136RA2016.tc	Final

Table 13: Tide Correctors (.zdf or .tc)

A request for final approved tides was sent to N/OPS1 on 10/19/2016. The final tide note was received on 10/28/2016.

See attached Tide Note dated October 16, 2016.

ERS Methods Used:

ERS via ERZT

Ellipsoid to Chart Datum Separation File:

H12851_WGS84_MLLW_SEP_1000m.csar

Ellipsoidally Referenced Zoned Tides (EZRT) methods were used to transform between the ellipsoid and water level data. A 1000-meter resolution separation model between the ellipsoid and MLLW was computed using the real-time position measurements observed during the survey relative to the water line and the loaded TCARI tide file. "GPS tides" were then computed using the above separation model and the corrected GPS-height-to-water level data (SBET). The 1000-meter resolution separation model was generated in WGS84 due to the SBETs being exported in WGS84. For additional information see the OPR-P136-RA-16 ERS Capability Memo included with the supplemental correspondence.

See attached ERS Capability Memo dated March 15, 2017.

C.2 Horizontal Control

The horizontal datum for this project is World Geodetic System of 1984 (WGS84(G1674)).

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

The following PPK methods were used for horizontal control:

Single Base

The Wide Area Augmentation System (WAAS) served as the real time horizontal control source for survey launches.

The following user installed stations were used for horizontal control:

HVCR Site ID	Base Station ID
Greg's Vista	9715

Table 14: User Installed Base Stations

D. Results and Recommendations

D.1 Chart Comparison

Chart comparisons were made using a CARIS sounding and contour layer derived from a 16-meter combined CUBE surface. The contours and soundings were overlaid on the charts and compared for general agreement and to identify areas of significant change.

D.1.1 Raster Charts

The following are the largest scale raster charts, which cover the survey area:

Chart	Scale	Edition	Edition Date	LNM Date	NM Date
16597	1:80000	10	04/2015	04/05/2016	04/09/2016
16576	1:80000	5	04/2015	04/05/2016	04/09/2016
16594	1:78900	14	01/2015	04/05/2016	04/09/2016

Table 15: Largest Scale Raster Charts

16597

Chart 16597 covers the entire H12851 survey area. Deviations in 50, 10, and 3 fathom contours were found both inshore and offshore from what is charted. The 50 fathom contour deviates from the charted contour in

some areas over 1000 meters (Figure 22). Large discrepancies between charted and H12851 soundings are highlighted in yellow circles (Figures 23-25). Though these soundings were up to 18 fathoms different than what was charted, they were not chosen as DTONs because they do not pose a danger to surface navigation for the vessel traffic in the area.

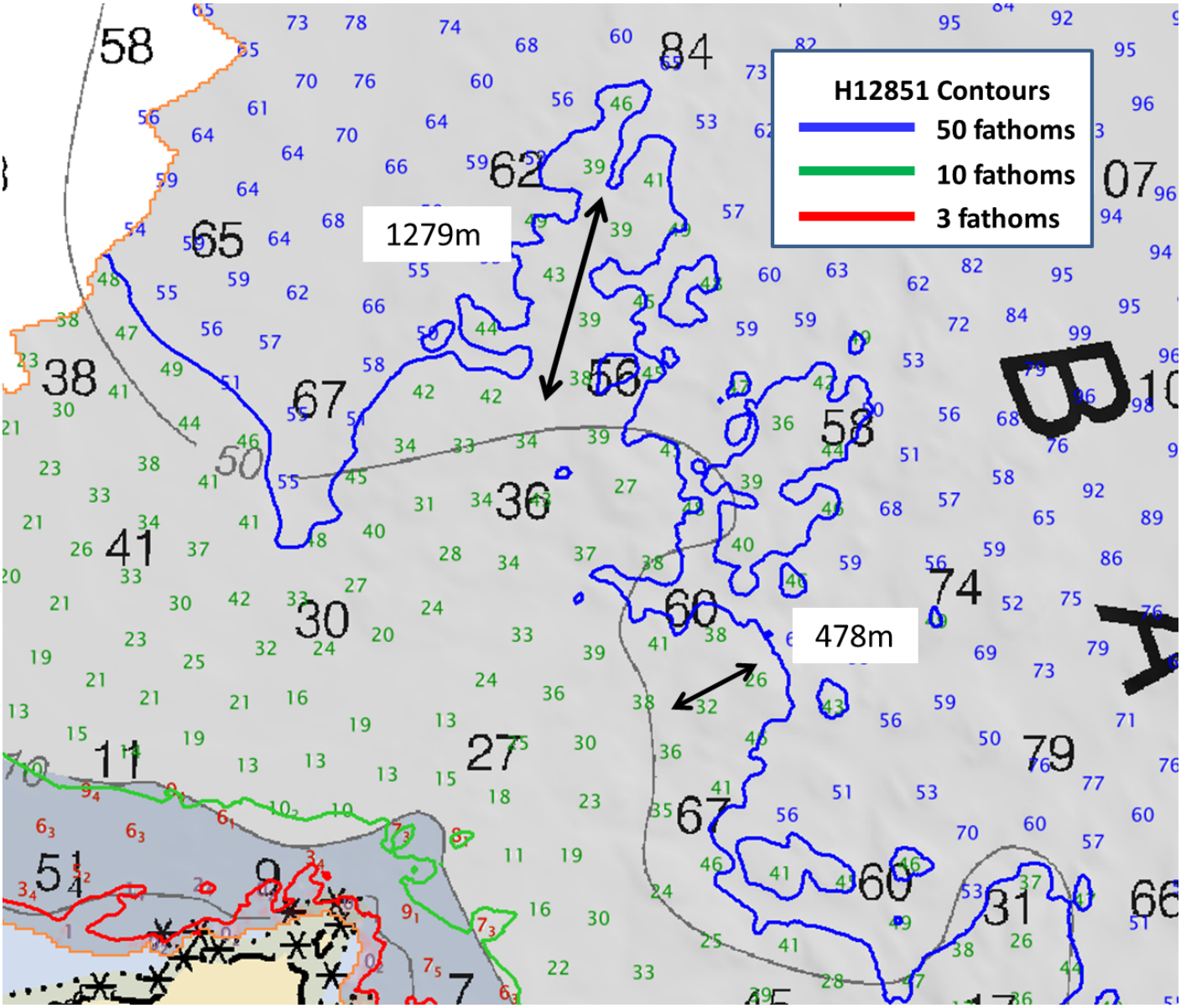

Figure 22: 50 fathom contour line shows shallower depths offshore of what is charted.

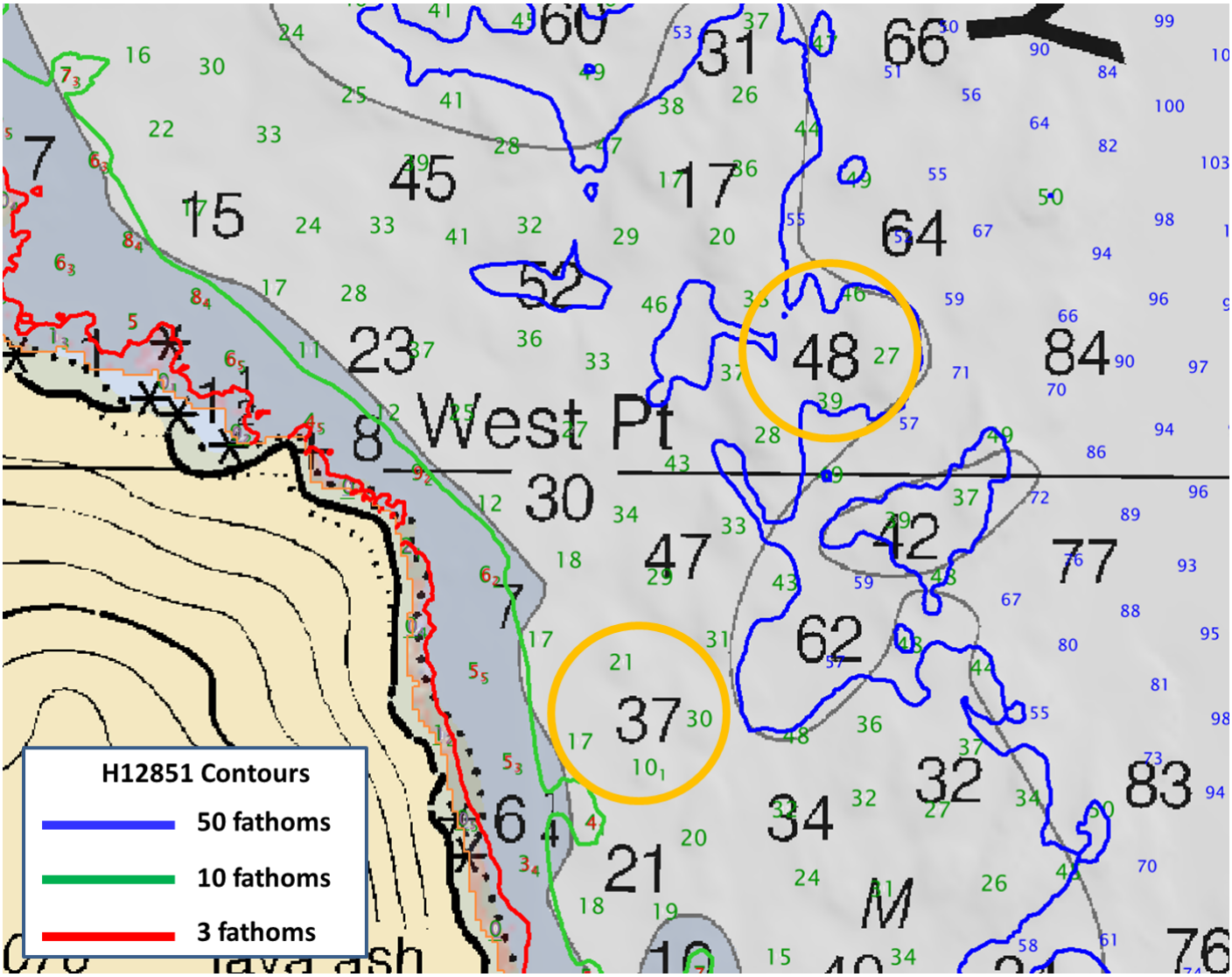

Figure 23: Shoaler soundings exist than charted in the area east of West Point.

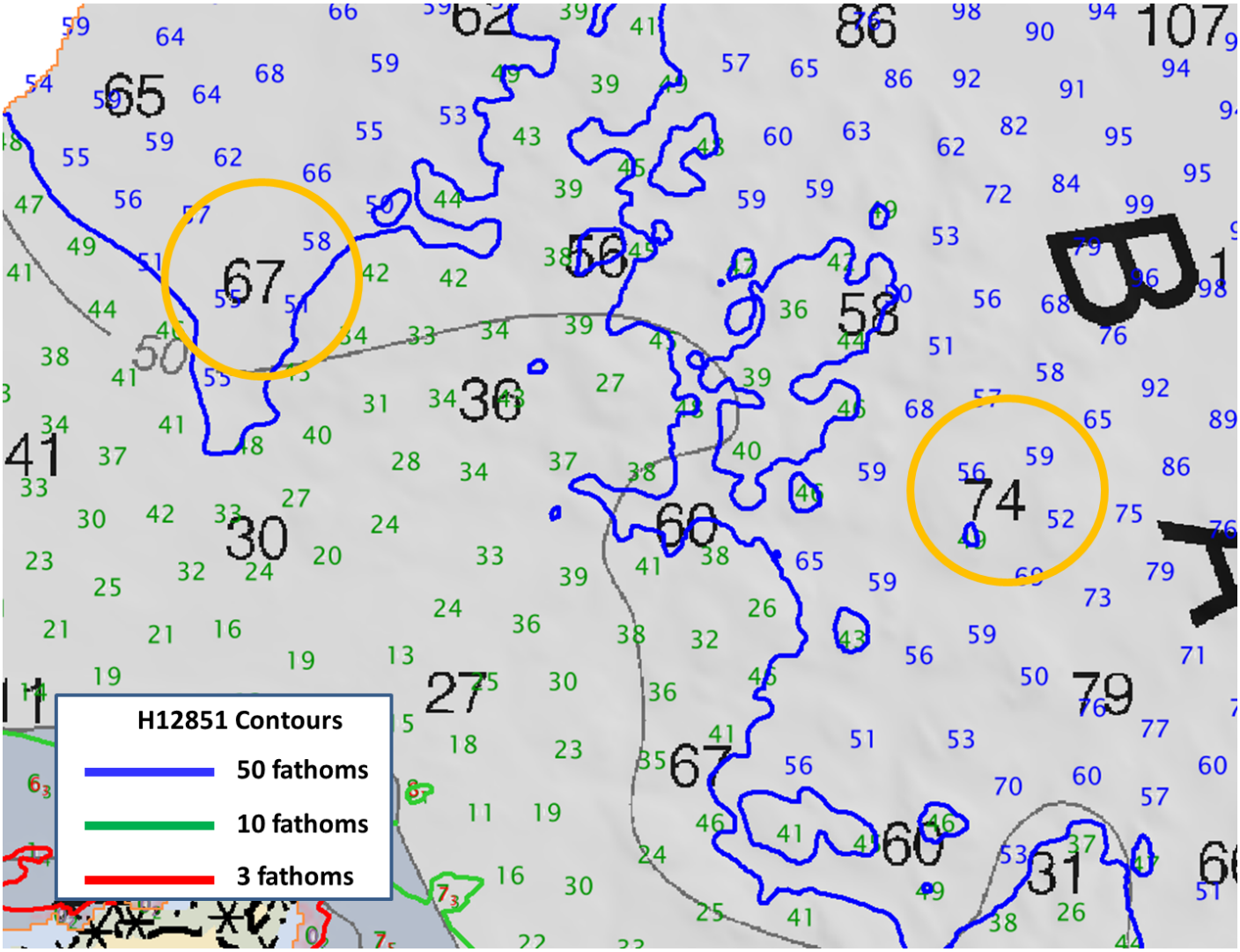

Figure 24: Shoaler soundings exist than charted in the area north of West Point.

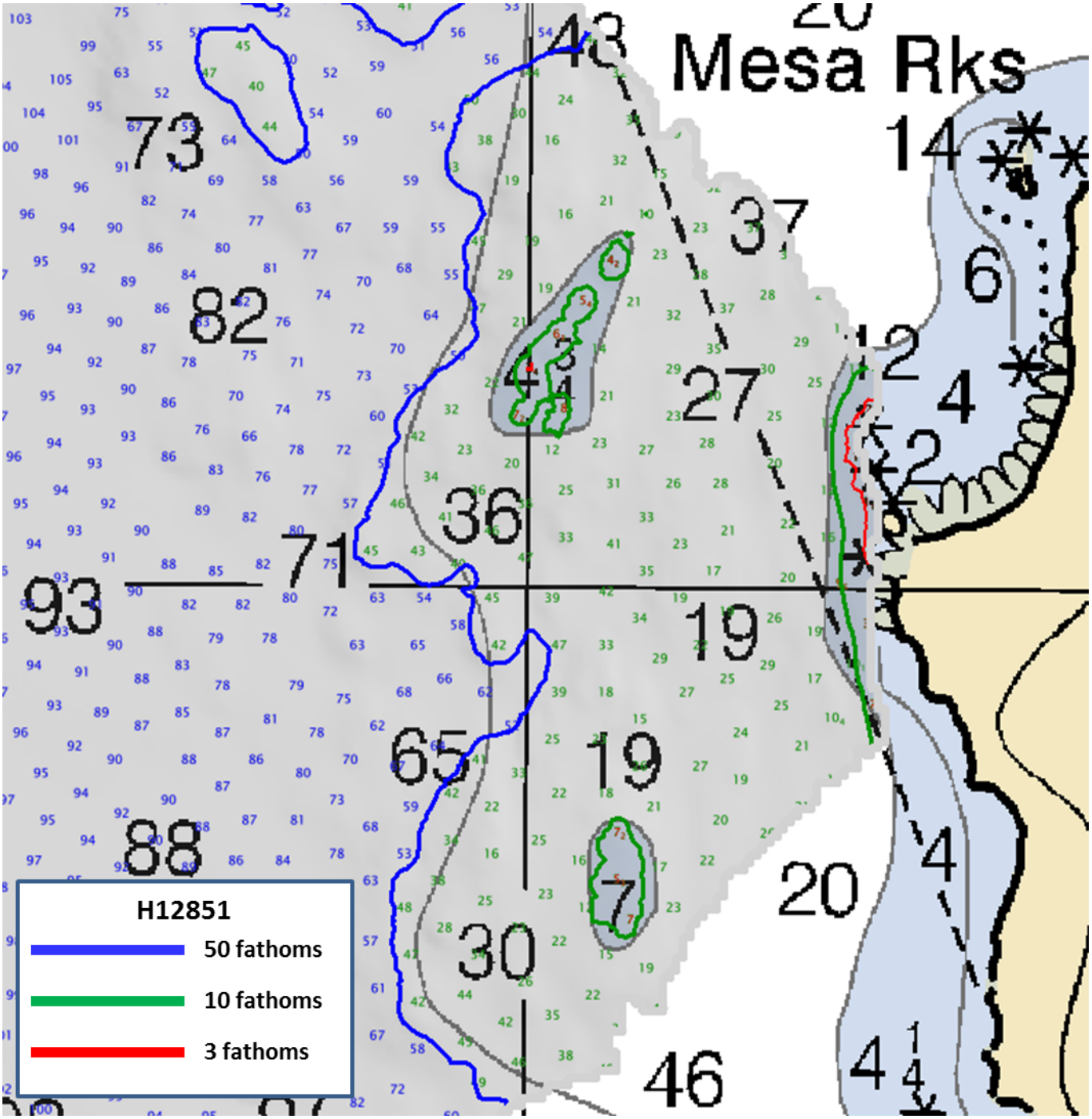

Figure 25: Charted 50 fathom contour aligns poorly with H12851 contour near East Point.

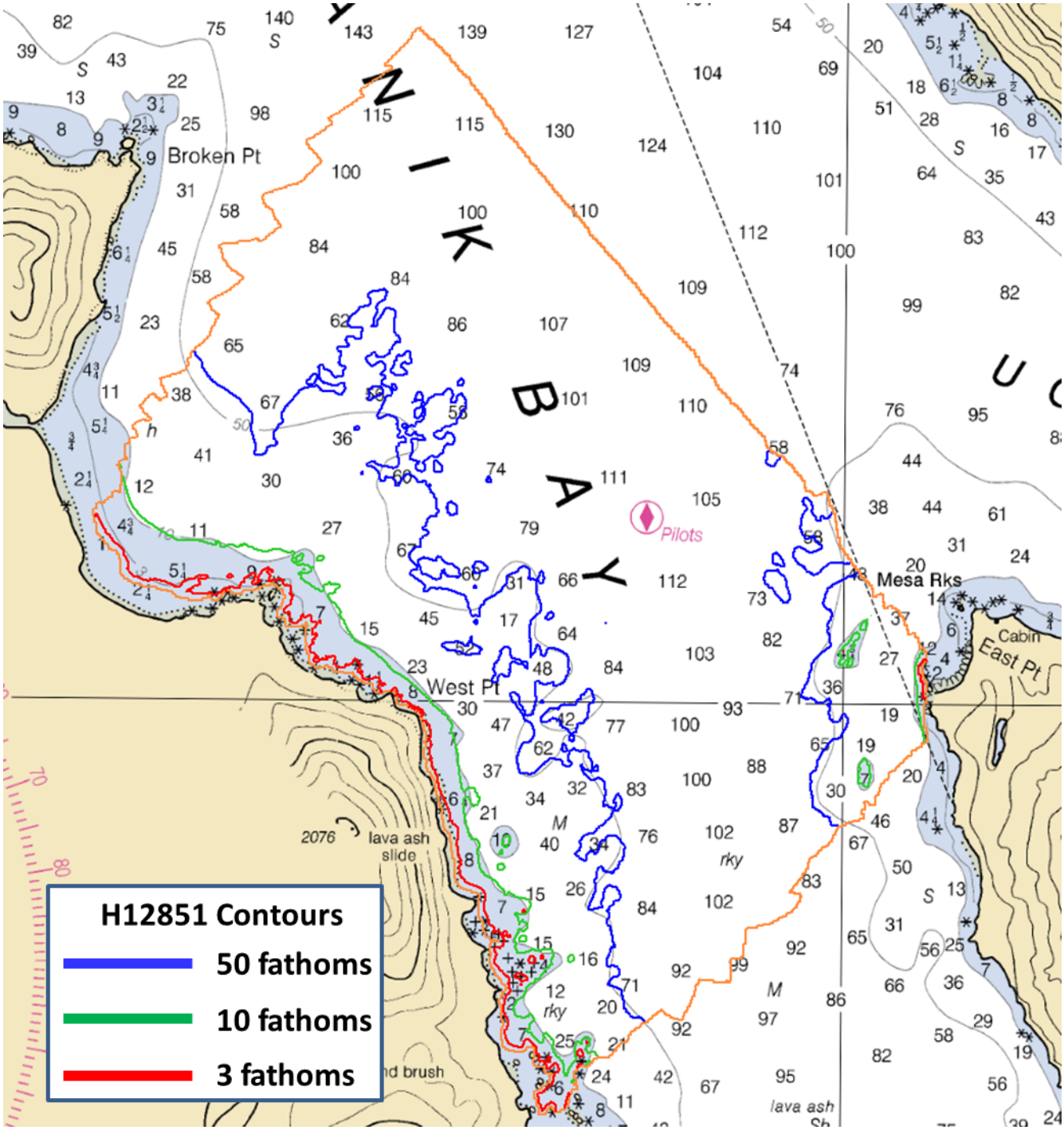

Figure 26: Overview of charted contours and H12851 contours.

16576

Chart 16576 covers the northern half of survey H12851. H12851 soundings were generally more shallow than charted soundings, and H12851 contour lines deviate from charted contour lines in many areas.

Discrepancies between charted contours and H12851 contours were similar to the comparison made with Chart 16597.

16594

In the area of survey H12851, Chart 16594 has no comparable data and therefore no comparison was made.

D.1.2 Electronic Navigational Charts

The following are the largest scale ENCs, which cover the survey area:

ENC	Scale	Edition	Update Application Date	Issue Date	Preliminary?
US4AK5QM	1:80000	6	04/17/2016	04/17/2016	NO

Table 16: Largest Scale ENCs

US4AK5QM

In the area of survey H12851, Electronic Navigation Chart (ENC) US4AK5QM coincides with Chart 16597. Therefore a comparison between H12851 and the ENC is equivalent to the preceding comparison with Chart 16597.

D.1.3 Maritime Boundary Points

No Maritime Boundary Points were assigned for this survey.

D.1.4 Charted Features

No charted features exist for this survey.

D.1.5 Uncharted Features

No uncharted features exist for this survey.

D.1.6 Dangers to Navigation

The following DTON reports were submitted:

DTON Report Name	Date Submitted
H12851_DTON_Report	2016-12-09

Table 17: DTON Reports

Danger to Navigation Reports are included in Appendix II of this report.

D.1.7 Shoal and Hazardous Features

All shoals and hazardous features were investigated in accordance with the Project Instructions and the HSSD. They are addressed in the Final Feature File submitted with this report.

D.1.8 Channels

One pilot boarding area exists within H12851, located in the area between East Point and West Point. Evaluated soundings within the area agree with charted soundings. The area appears to be safe for pilot boarding operations.

D.1.9 Bottom Samples

Four bottom samples were acquired for this survey and are detailed in the Final Feature File accompanying this report.

D.2 Additional Results

D.2.1 Shoreline

Shoreline verification was conducted near predicted mean lower low water in accordance with applicable sections of the FPM and HSSD. There were 43 assigned features for this survey and all but 6 were addressed. The six not addressed features were located in foul areas too dangerous to pursue. New features found in the field as well as recommendations to update, retain, or delete assigned features have also been documented. All features were addressed as required with the S-57 attribution and recorded in the H12851 Final Feature File to best represent the features at survey scale.

D.2.2 Prior Surveys

No prior survey comparisons exist for this survey.

D.2.3 Aids to Navigation

No Aids to navigation (ATONs) exist 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 Ferry Routes and Terminals

No ferry routes or terminals exist for this survey.

D.2.7 Platforms

No platforms exist for this survey.

D.2.8 Significant Features

No Significant Features exist for this survey.

D.2.9 Construction and Dredging

No present or planned construction or dredging exist within the survey limits.

D.2.10 New Survey Recommendation

No new surveys or further investigations are recommended for this area.

D.2.11 Inset Recommendation

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 and Specifications Deliverables Manual, 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
Edward J. Van Den Ameele CAPT/NOAA	Commanding Officer, NOAA Ship Rainier	05/04/2017	Digitally signed by LOMNICKY.JOHN.JOSEPH.1257920239 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=NOAA, cn=LOMNICKY.JOHN.JOSEPH.1257920239 Reason: I am signing for CAPT Van Den Ameele Date: 2017.05.11 14:55:32 -08'00'
Steven Loy, LT/NOAA	Field Operations Officer, NOAA Ship Rainier	05/04/2017	BROO.SCOTT.EDWARD.1396599976 c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=NOAA, cn=BROO.SCOTT.EDWARD.1396599976 2017.05.05 09:10:53 -08'00'
James B. Jacobson	Chief Survey Techinician, NOAA Ship Rainier	05/04/2017	JACOBSON.JAMES.BRYAN. 1269664017 I have reviewed this document 2017.05.04 21:23:43 -08'00'
Daniel Prince	Hydrographic Assistant Survey Technician, NOAA Ship Rainier	05/04/2017	JACOBSON.JAMES.BRYAN. 1269664017 I am signing for Daniel Prince 2017.05.04 21:24:26 -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	Continually Operating Reference Staiton
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
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
HSSD	Hydrographic Survey Specifications and Deliverables

Acronym	Definition
HSTP	Hydrographic Systems Technology Programs
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	Local Notice to Mariners
LNM	Linear Nautical Miles
MCD	Marine Chart Division
MHW	Mean High Water
MLLW	Mean Lower Low Water
NAD 83	North American Datum of 1983
NAIP	National Agriculture and Imagery Program
NALL	Navigable Area Limit Line
NM	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
PST	Physical Science Technician
RNC	Raster Navigational Chart
RTK	Real Time Kinematic
SBES	Singlebeam Echosounder
SBET	Smooth Best Estimate and Trajectory
SNM	Square Nautical Miles
SSS	Side Scan Sonar
ST	Survey Technician
SVP	Sound Velocity Profiler
TCARI	Tidal Constituent And Residual Interpolation
TPE	Total Propagated Error
TPU	Topside Processing Unit
USACE	United States Army Corps of Engineers
USCG	United Stated Coast Guard
UTM	Universal Transverse Mercator
XO	Executive Officer
ZDA	Global Positiong System timing message
ZDF	Zone Definition File

UNITED STATES DEPARMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Ocean Service
Silver Spring, Maryland 20910

PROVISIONAL TIDE NOTE FOR HYDROGRAPHIC SURVEY

DATE : October 26, 2016

HYDROGRAPHIC BRANCH: Pacific
HYDROGRAPHIC PROJECT: OPR-P136-RA-16
HYDROGRAPHIC SHEET: H12851
LOCALITY: Uganik Bay, North Coast of Kodiak
TIME PERIOD: September 16 - October 15, 2016

TIDE STATION USED: 9455500 Seldovia, AK
Lat. 59° 26.4'N Long. 151° 43.2' W
PLANE OF REFERENCE (MEAN LOWER LOW WATER): 0.000 meters
HEIGHT OF HIGH WATER ABOVE PLANE OF REFERENCE: 5.252 meters

REMARKS: RECOMMENDED GRID Please use the TCARI grid "P136RA2016.tc" as the final grid for project OPR-P136-RA-16, H12851, during the time period between September 16 - October 15, 2016.

Refer to attachments for zoning information.

Note 1: Provided time series data are tabulated in metric units(meters), relative to MLLW and on Greenwich Mean Time on the 1983-2001 National Tidal Datum Epoch (NTDE).

Note 2: Annual leveling for Seldovia, AK (9455500) was not completed in FY16. A review of the verified leveling records from June 2005 - July 2015 shows the tide station benchmark network to be stable within an allowable 0.009 m tolerance. This Tide Note may be used as final stability verification for survey OPR-P136-RA-16, H12851. CO-OPS will immediately provide a revised Tide Note should subsequent leveling records indicate any benchmark network stability movement beyond the allowable 0.009 m tolerance.

Note 3: Survey tracklines fall outside of the TCARI grid boundaries in some areas due to inaccurate shoreline. TCARI will extrapolate the tide corrector to cover these soundings.

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DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=OTHER, cn=HOVIS.GERALD.THOMAS.JR.1365860250
Date: 2016.10.28 07:42:00 -04'00'

CHIEF, PRODUCTS AND SERVICES BRANCH


9455500 SELDOVIA, COOK INLET
Preliminary as Final TCARI Grid for
OPR-P136-RA-2016, H12851
Uganik Bay, North Coast of Kodiak
Afognak Island
Afognak Mountain
Raspberry Island
Whale Island
Uganik Island
Shelikof Strait
Port Lions
0
10
nautical miles
Karluk
Uyak Bay
Larsen Bay
Mount Glottof
bing
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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Office of Marine and Aviation Operations
NOAA Ship *Rainier* (S-221)
2002 SE Marine Science Dr, Newport, OR 97365

March 15, 2017

MEMORANDUM FOR: Lieutenant Russell Quintero, NOAA
Chief, Operations Branch
Hydrographic Surveys Division

Digitally signed by LOMNICKY.JOHN.JOSEPH.1257920239
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=NOAA, cn=LOMNICKY.JOHN.JOSEPH.1257920239
Date: 2017.03.17 09:48:22 -07'00'

FROM: Commander John J. Lomnicky Jr., NOAA
Commanding Officer, NOAA Ship Rainier

SUBJECT: OPR-P136-RA-16 ERS/ERZT Capability Memorandum, Continued Surveys

Survey project OPR-P136-RA-16 included a requirement to reference survey data to the NAD83 ellipsoid. This report fulfills the project requirement to submit an Ellipsoidally Referenced Survey (ERS) Capability Memorandum describing the degree to which the ERS surveying campaign was successful for surveys H12693, H12849, H12850, H12851, H12917, and H12918, conducted in July, September, and October 2016. These six surveys encompass all project surveys considered in this memo, unless otherwise specified.

NOAA Ship *Rainier* personnel conducted a comparison of Ellipsoid Referenced Zoned Tides (ERZT) methods and results versus Tidal Constituent and Residual Interpolation (TCARI) vertical transformation techniques using crosslines per the OPR-P136-RA-16 Project Instructions. While there are differences between the two data reduction methods, results indicate that the differences are within acceptable limits and both are valid methods for reducing sounding data to chart datum. Results and analysis of the comparison are in the attached report.

It is recommended that surveys H12693, H12849, H12850, H12851, H12917, and H12918 be reduced to Mean Lower-Low Water (MLLW) using ERZT as detailed in the attached report.

1.0 Introduction

This document is a report describing methods and results of the vertical datum analysis component of the vertical control requirements of the Hydrographic Survey Project Instructions for OPR-P136-RA-16 Area of Operations, concerning surveys H12693, H12849, H12850, H12851, H12917, and H12918 (Figure 1).

The Project Instructions required *Rainier* to describe the success of ERZT as a vertical transformation method. The recommendations and supporting data included in this report are intended for use by the Hydrographic Surveys Division (HSD) and Pacific Hydrographic Branch (PHB) to support the decision on the use of ERZT to reduce hydrographic data to chart datum in lieu of TCARI or Poor Man's VDatum (PMVD) for the OPR-P136-RA-16 surveys.

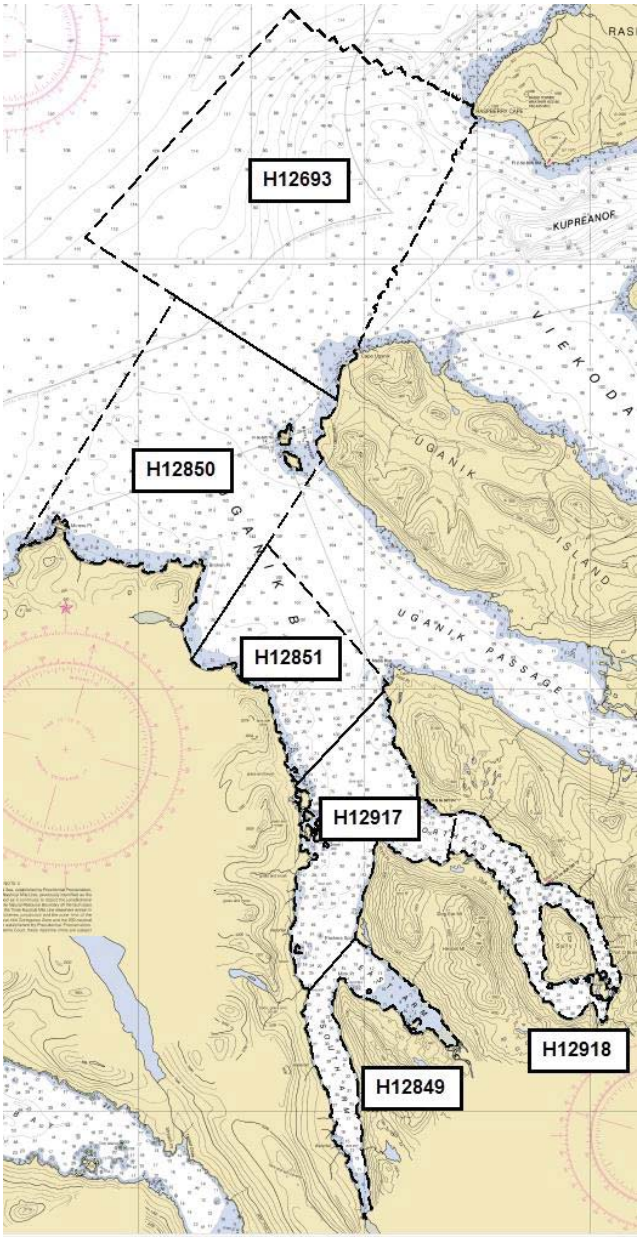

Figure 1: *Survey limits for OPR-P136-RA-16, surveyed by NOAA Ship Rainier.*

2.0 Procedure

The evaluation was conducted according to requirements of OPR-P136-RA-16 using guidance from NOAA HSD, HSTB, AHB and PHB Physical Scientists, and Rainier crew. Methodology typically followed ERZT analysis procedures established in previous surveys for OPR-P136-RA-16. Please see Addendum H12848 H12916 H12919 ERZT Memo and Report for further detail.

2.1 ERZT Creation

ERZT separation models (SEP) of100m resolution were generated for each survey to analyze and target vertical solution busts (Table 1). SBETs for each survey were examined in Pydro's AutoQC for errors and inconsistencies contributing to significant horizontal or vertical offsets in the projected data. Survey H12849 had one SBET interpolated to correct for vertical positioning spikes for three periods of less than 3 minutes each (Table 2). The resulting SEP was re-examined and 1000m ERZT models were created for each. The ERZT separation surfaces were free of gaps and anomalies within project OPR-P136-RA-16 survey areas (Figure 2). Individual ERZT separation model (SEP) surfaces were generated for each survey.

Survey	1000m Separation Model
H12693	H12963_SEP_1000m.csar
H12849	H12849_WGS84_MLLW_SEP_1000m.csar
H12850	H12850_WGS84_MLLW_SEP_1000m.csar
H12851	H12851_WGS84_MLLW_SEP_1000m.csar
H12917	H12917_WGS84_MLLW_SEP_1000m.csar
H12918	H12918_WGS84_MLLW_SEP_1000m.csar

Table 1: *Names of ERZT Separation model surfaces discussed in this report.*

Survey	SBET
H12849	2016_262_2801_A_SBET_Interp

Table 2: *SBET interpolated for survey.*

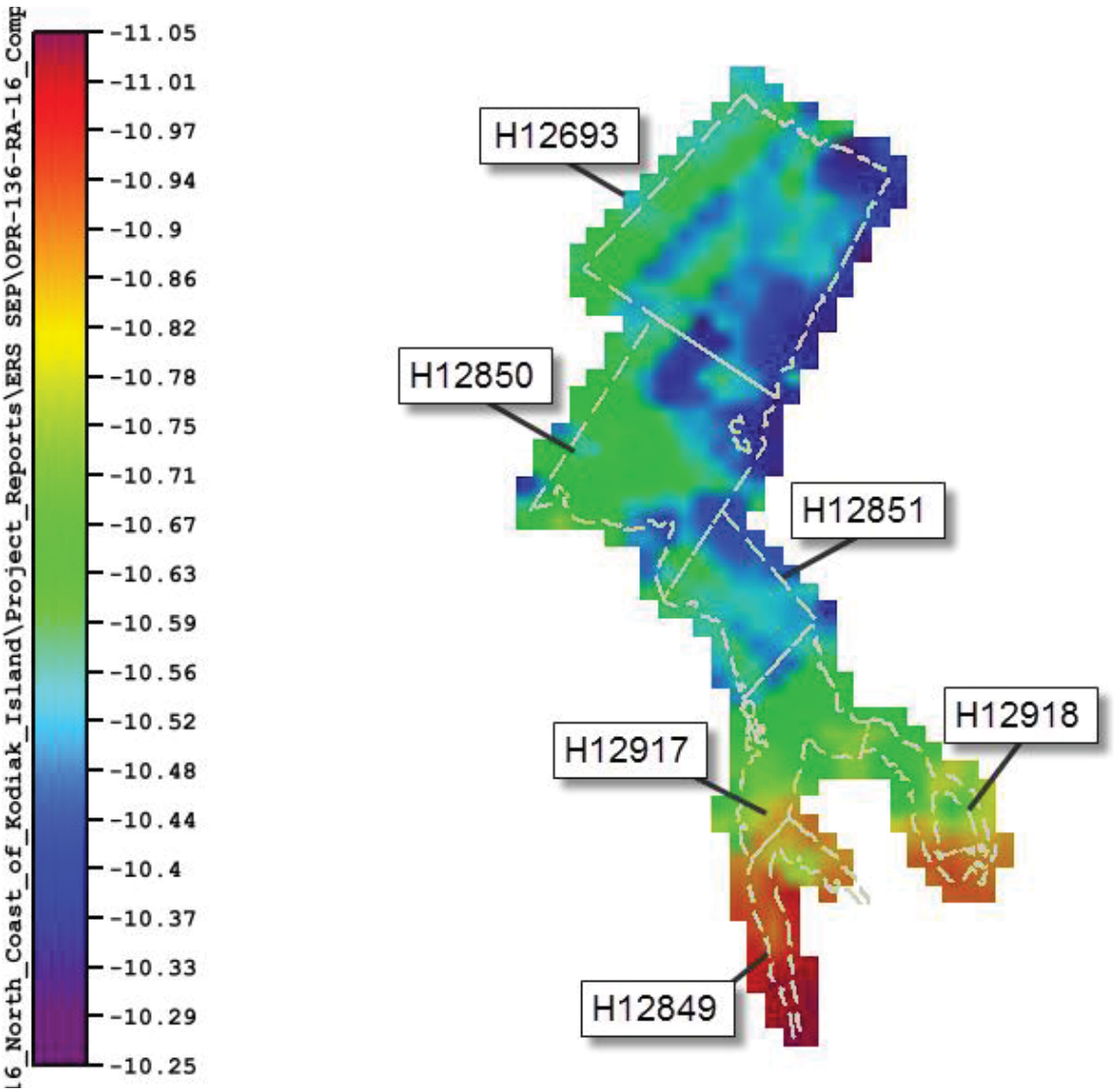

Figure 2: *OPR-P136-RA-16 1000-m separation models their respective survey limits, color bands at 4cm intervals.*

The 100m separation model for survey H12849 demonstrated a notable step in the ellipsoid height values in the northeast arm (Figure 3). Data were investigated for systematic error, including vessel offset values, SBET files, and processing inconsistencies, with none found. Resulting reduced sounding data using the 1000m SEP were examined to ensure no major offsets or height anomalies were attributed to SEP values.

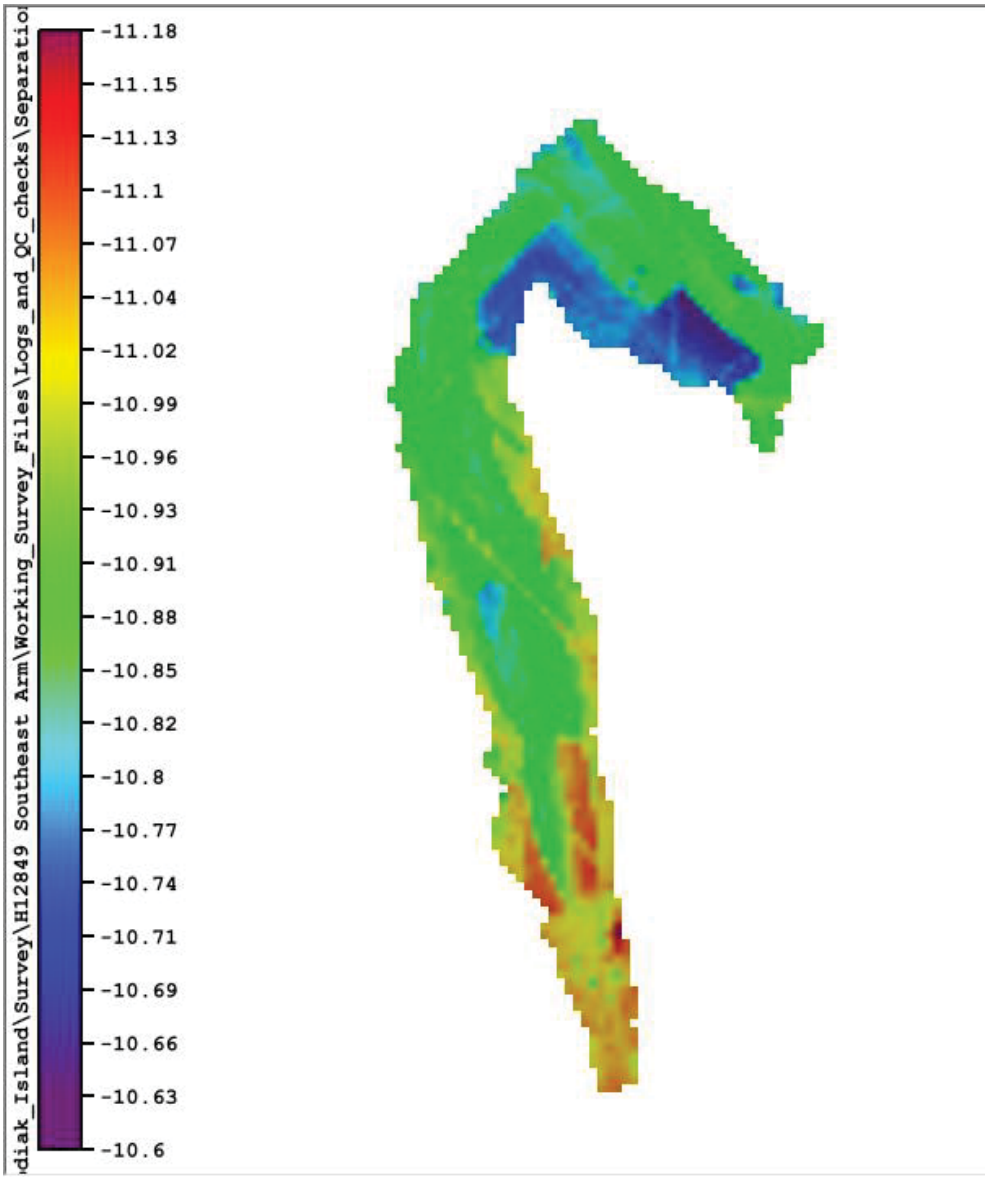

Figure 3: *Survey H12849 100-m separation model*

2.2 TCARI and ERZT Comparison

Project crossline data were reduced to Mean Lower Low Water (MLLW) using provided TCARI grid (P136RA2016.tc) and final verified water levels to produce crossline tidally reduced surfaces. In CARIS HIPS, an ERZT 1000m separation model for each survey was generated using all survey lines

and applied to the data with CARIS Compute GPS tides; the data were then merged. Crossline surfaces were differenced and compared using CARIS HIPS.

2.3 PMVD and ERZT Comparison

The final computed 1000m ERZT separation models were compared to an HSTB-provided PMVD model, P136RA2016_PMVD_UTM-NAD83-5n_WGS84-MLLW, for overall consistency and average differences (Figure 4). ERZT SEP and PMVD surfaces were differenced and analyzed for significant deviations.

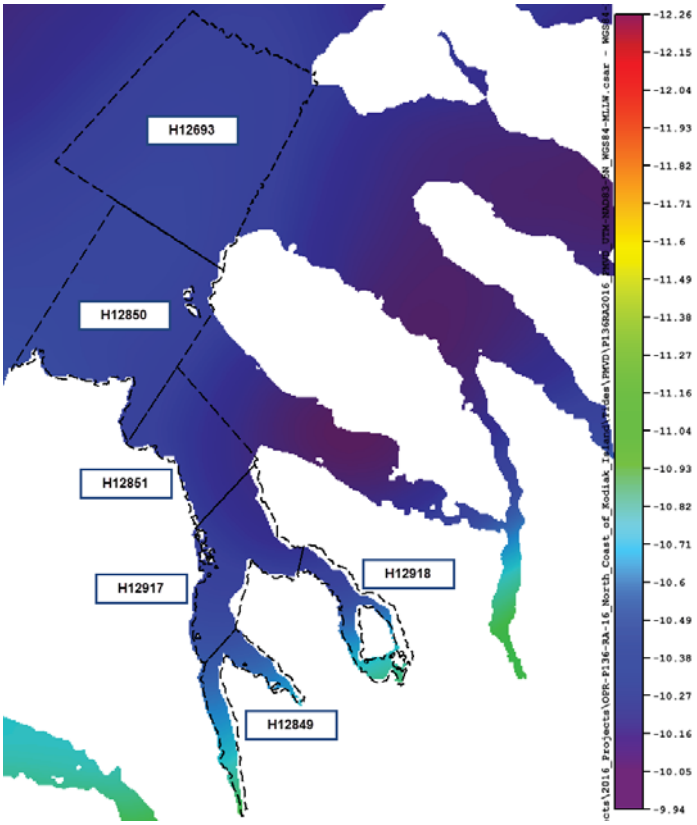

Figure 4: *P136RA2016_PMVD_UTM-NAD83-5N_WGS84-MLLW.csar separation model overlaid with the survey limits considered in this memo. Colored bands correspond to 11cm intervals.*

3.0 Results

This report will address three questions:

- What are the quantitative differences between TCARI, ERZT, and PMVD reduction methods?
- Which method of reduction to MLLW is most appropriate for each survey?
- What suggestions and options exist for improving this process in the future?

3.1 ERZT Model Accuracies: TCARI and PMVD Comparison

The 1000m ERZT models were differenced from the PMVD grid. Over the survey area considered in this memo, the PMVD SEP ranged from -10.84m to -10.17m, whereas the ERZT SEP ranged from -11.05m to -10.29m. There was a mean difference of -0.18m with a standard deviation of 0.11m between the ERZT SEP and PMVD. Survey data were not reduced with PMVD for analysis.

CARIS Compute Statistics utility was used to compare depths from data corrected with TCARI and ERZT (Table 2). The mean differences range from 0.003m to 0.089m.

Crossline TCARI to ERZT Comparison		
Survey	**Mean (m)**	**Std Deviation (m)**
H12693	0.044	+/- 0.071
H12850	0.036	+/- 0.077
H12851	-0.005	+/- 0.069
H12917	-0.038	+/- 0.076
H12849	0.003	+/- 0.079
H12918	0.089	+/- 0.088

Table 2: *Results of CARIS Compute Statistics run on crosslines differences for Project OPR-P136-RA-16.*

Surface water depths of these surveys range from 1.5m to 301.7m, with corresponding allowable total vertical uncertainties (TVU) between 0.5m and 7.02m at 95% confidence. Difference surfaces (TCARI minus ERZT) were created to examine spatial trends in the data. For the considered surveys, the mean difference between TCARI tides and ERZT for the crosslines is less than the allowable TVU. ERZT is statistically indistinguishable from TCARI, and arguably an improvement.

3.2 Uncertainty Calculations and Interpolation

ERZT uncertainty calculates standard error estimation, wherein the mean of the ERZT standard deviation layer is divided by the square root of the linear nautical miles divided by ERZT SEP nodes:

$$\sigma^2_{ERZTsep} = \frac{\mu_{ERZT\ \sigma\ Layer}}{\sqrt{\sum(Survey\ LNM)\ /\ \sum(ERZT\ Nodes)}}$$

This formula was suggested by Jack Riley and LCDR Greenaway as an improvement to earlier methodology; correspondence attached as an addendum. The calculated 1-sigma uncertainty was then applied in CARIS when computing Total Propagated Uncertainty (TPU) as a zone value (significant figures disregarded). For sheet H12850, the resultant 2-sigma uncertainty value was used as an input instead. This error was not uncovered until after submission of the survey. Despite the higher degree of uncertainty, all finalized surfaces for H12850 met uncertainty standards.

Survey	Mean of SEP Std_Dev child layer, meters (μ)	Total Linear Nautical Miles (LNM)	Estimated Total ERZT Nodes (N)	Estimated lines per node (LNM/N)	1-sigma Uncertainty, Entered Value (m)
H12693	0.0638	422	210	2.01	0.01198773
H12849	0.0553	166	55	3.01	0.031858037
H12850	0.0352	519	159	3.26	0.038
H12851	0.0569	199	72	2.76	0.034225671
H12917	0.064	241	82	2.94	0.034331753
H12918	0.062	135	57	2.36	0.010352563

Table 3: *ERZT TPU values for surveys H12693, H12849, H12850, H12851, H12917, and H12918.*

4.0 Discussion

The tide station used for this project was 945-5500 Seldovia, Alaska. This gauge is located 113 nautical miles from the project area and is separated from the project area by projecting land. No outages or abnormalities were reported for this gauge during the data collection period to suggest the TCARI model and water levels have inherent error. The base stations used for horizontal control and SBET generation are described in the project's HVCR.

5.0 Recommendation

For surveys H12693, H12849, H12850, H12851, H12917, and H12918, ERZT is the recommended separation model and preferred reduction method. Comparison between TCARI and ERZT indicate that ERZT for the project area accurately reduces the data to MLLW.

A comparison of crossline data reduced to MLLW using TCARI and a crossline-derived ERZT separation model revealed an average difference of 0.036m, which is well within the acceptable range of uncertainty. Under guidance from HSTB and HSD, use of ERZT was recommended over use of PMVD as the separation model (see additional correspondence).

We recommend the ERZT separation model be considered for use with future surveys in the area, provided position solutions are accurate.

APPROVAL PAGE

H12851

Data meet or exceed current specifications as certified by the OCS survey acceptance review process. Descriptive Report and survey data except where noted are adequate to supersede prior surveys and nautical charts in the common area.

The following products will be sent to NCEI for archive

- H12851_DR.pdf
- Collection of depth varied resolution BAGS
- Processed survey data and records
- H12851_GeoImage.pdf

The survey evaluation and verification has been conducted according current OCS Specifications.

Approved: Digitally signed by Peter Holmberg
Reason: I am approving this document
Date: 2018.04.16 11:15:22 -07'00'

Peter Holmberg
Cartographic Team Lead, Pacific Hydrographic Branch

The survey has been approved for dissemination and usage of updating NOAA's suite of nautical charts.

Approved: Digitally signed by HAUSER.OLIVIA.A.1275636009
Date: 2018.04.14 18:28:03 -07'00'

Lieutenant Commander Olivia Hauser, NOAA
Chief, Pacific Hydrographic Branch