H12697

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

DESCRIPTIVE REPORT

Type of Survey:	Navigable Area
Registry Number:	H12697

LOCALITY

State(s):	Maine
General Locality:	Gulf of Maine
Sub-locality:	Bibb Rock to Boon Island

2014

CHIEF OF PARTY
LCDR Marc S. Moser, NOAA

LIBRARY & ARCHIVES

Date:

U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	REGISTRY NUMBER:
HYDROGRAPHIC TITLE SHEET	**H12697**

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):	**Maine**
General Locality:	**Gulf of Maine**
Sub-Locality:	**Bibb Rock to Boon Island**
Scale:	**40000**
Dates of Survey:	**04/27/2014 to 05/29/2014**
Instructions Dated:	**04/30/2014**
Project Number:	**OPR-A321-FH-14**
Field Unit:	**NOAA Ship *Ferdinand R. Hassler***
Chief of Party:	**LCDR Marc S. Moser, NOAA**
Soundings by:	**Multibeam Echo Sounder**
Imagery by:	**Multibeam Echo Sounder Backscatter**
Verification by:	**Atlantic 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 Geophysical Data Center (NGDC) and can be retrieved via http://www.ngdc.noaa.gov/.

Table of Contents

List of Tables

List of Figures

Descriptive Report to Accompany Survey H12697

Project: OPR-A321-FH-14

Locality: Gulf of Maine

Sublocality: Bibb Rock to Boon Island

Scale: 1:40000

April 2014 - May 2014

NOAA Ship *Ferdinand R. Hassler*

Chief of Party: LCDR Marc S. Moser, NOAA

A. Area Surveyed

The survey area is located in the Gulf of Maine, within the sub-locality of Bibb Rock to Boon Island as shown in Figure 1.

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
43° 17' 11.24" N 70° 35' 49.18" W	43° 5' 39.81" N 70° 21' 26.34" W

Table 1: Survey Limits

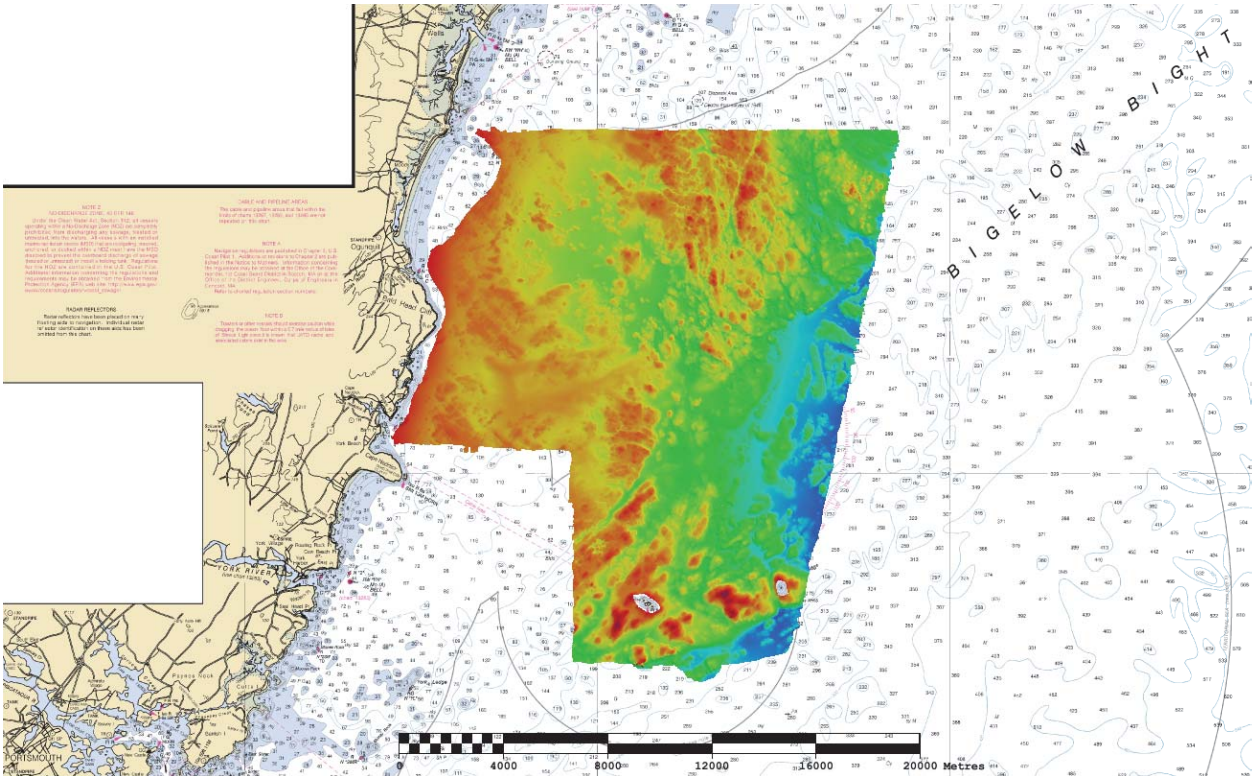


Figure 1: General locality of survey H12697

Object detection coverage is not achieved to the assigned sheet limits due to the lack of an appropriate near shore vessel and/or the presence of large amounts of fishing gear, mainly lobster pots. Additional work still needs to be completed at a future date utilizing a vessel that is capable of collecting data near shore. The areas where significant coverage was not acquired, highlighted with red arrows, are shown in Figures 2 and 3.

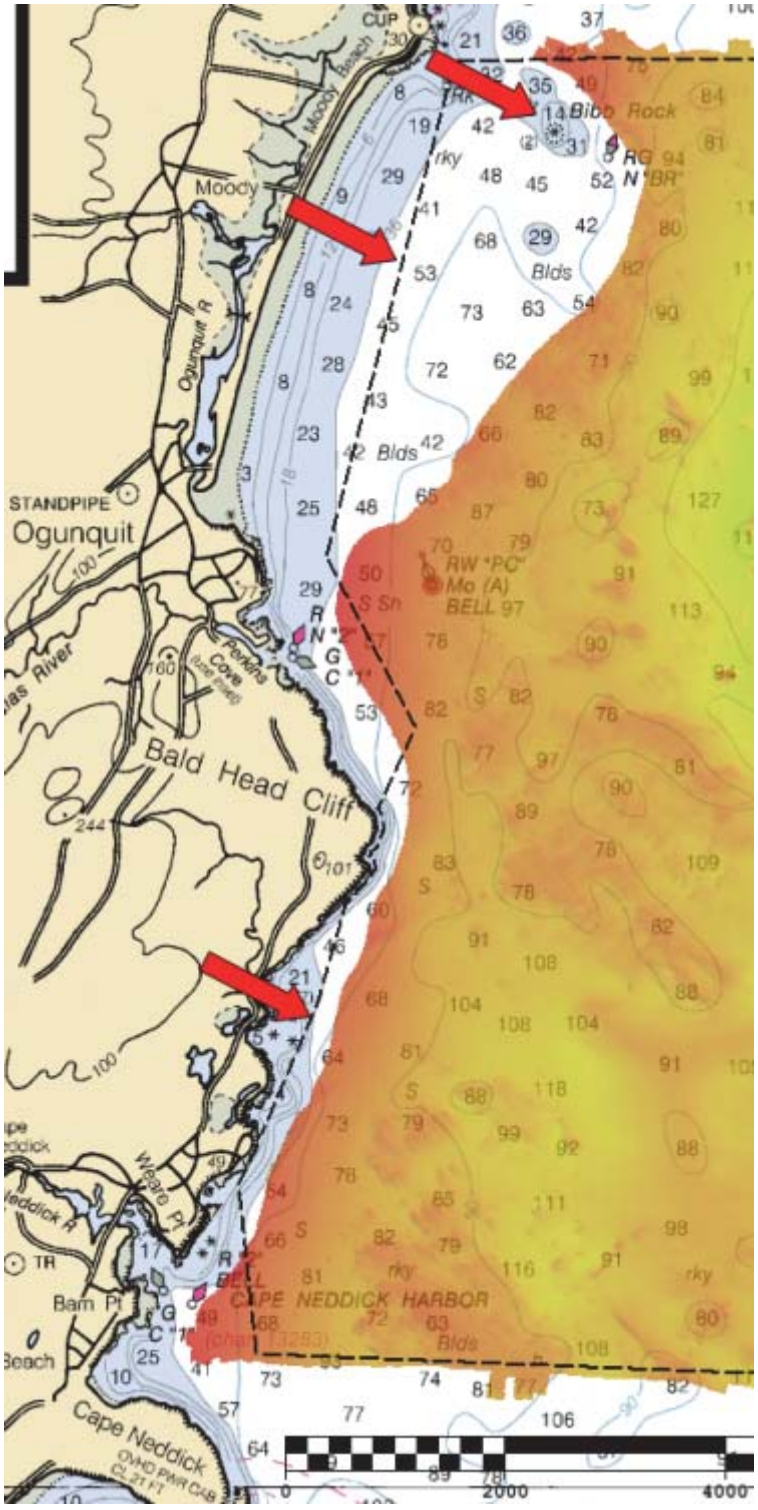


Figure 2: Extents of MBES coverage off the coast of Cape Neddick and Ogunquit - future data will need to be acquired with vessel especially suited for near shore work

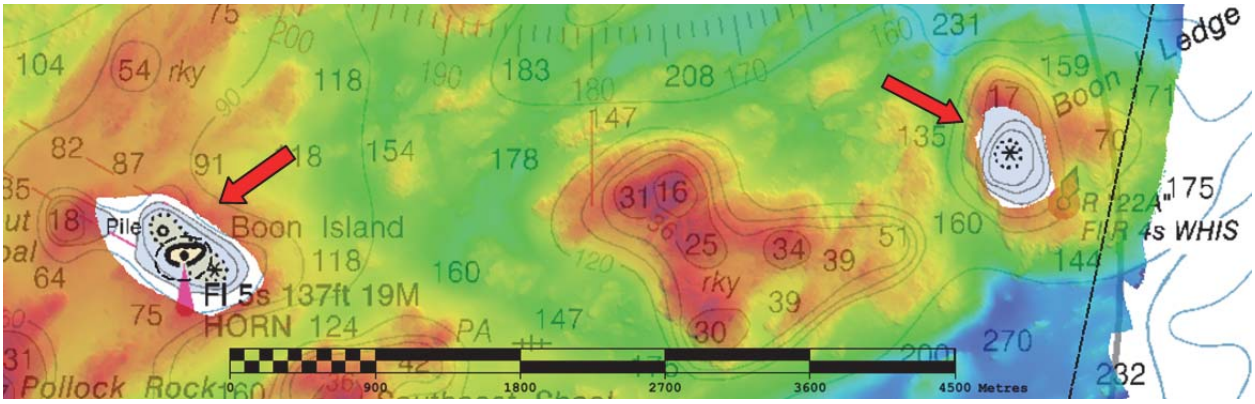


Figure 3: Extents of MBES coverage around Boon Island and Boon Island Ledge - future data will need to be acquired with vessel especially suited for near shore work

A.2 Survey Purpose

The purpose of this project is to provide contemporary surveys to update National Ocean Service (NOS) nautical charting products.

A.3 Survey Quality

The entire survey is adequate to supersede previous data.

A.4 Survey Coverage

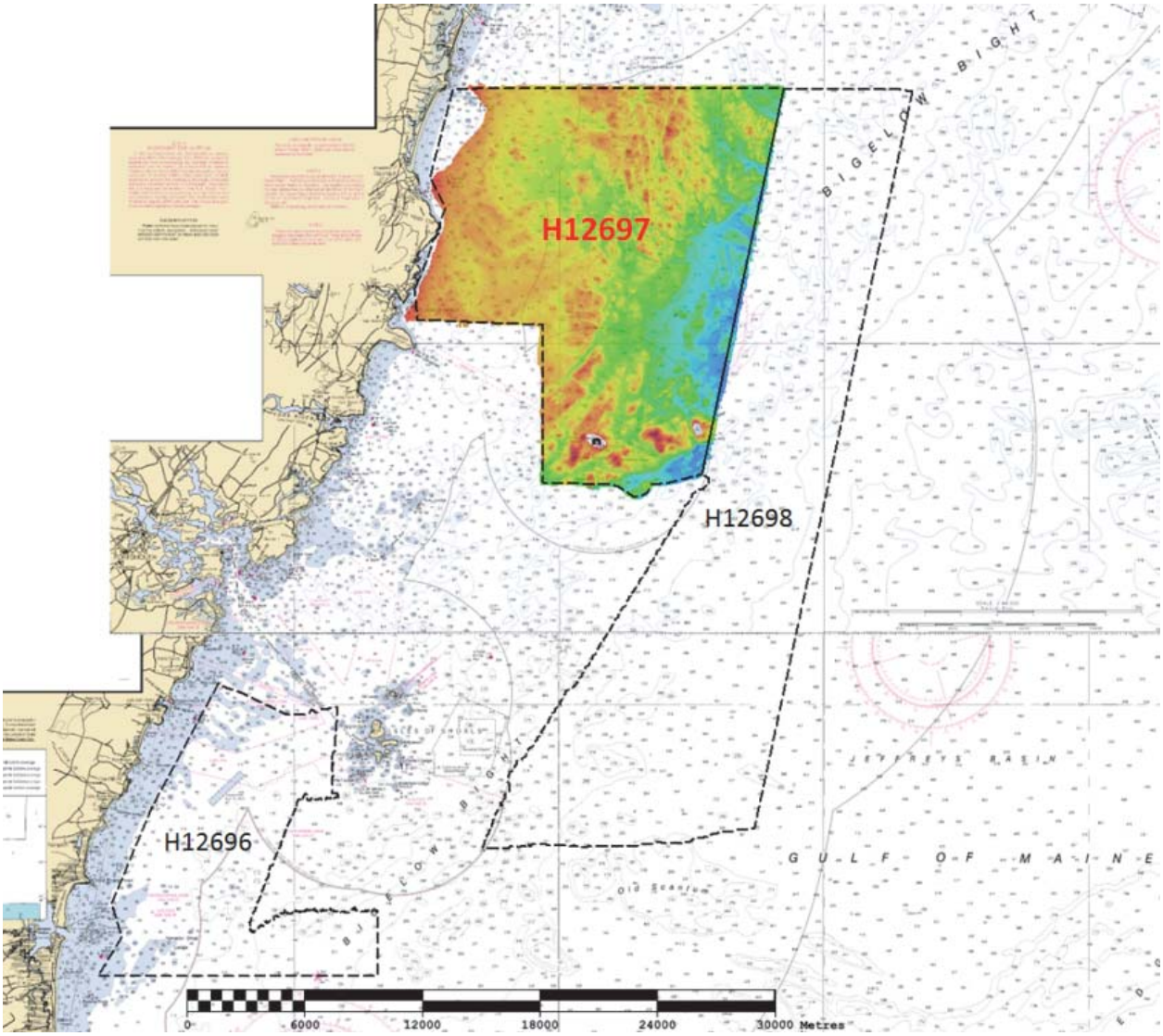


Figure 4: Survey layout for OPR-A321-FH-14 plotted over raster charts 13278 and 13286

Some holidays exist in the coverage for this survey. Analyses of surrounding data show that the least depths over features have been achieved and holidays do not compromise data integrity. Additional discussion can be found in section B.2.9

A.5 Survey Statistics

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

	HULL ID	*S250*	*Total*
LNM	**SBES Mainscheme**	0	0
	MBES Mainscheme	1094.3	1094.3
	Lidar Mainscheme	0	0
	SSS Mainscheme	0	0
	SBES/MBES Mainscheme	0	0
	SBES/SSS Mainscheme	0	0
	MBES/SSS Mainscheme	0	0
	SBES/MBES Crosslines	63.3	63.3
	Lidar Crosslines	0	0
Number of Bottom Samples			26
Number of AWOIS Items Investigated			4
Number Maritime Boundary Points Investigated			0
Number of DPs			0
Number of Items Investigated by Dive Ops			0
Total SNM			80.0

Table 2: Hydrographic Survey Statistics

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

Survey Dates	Day of the Year
04/27/2014	117
04/28/2014	118
04/29/2014	119
05/07/2014	127
05/08/2014	128
05/09/2014	129
05/10/2014	130
05/14/2014	134
05/15/2014	135
05/16/2014	136
05/20/2014	140
05/21/2014	141
05/23/2014	143
05/24/2014	144
05/25/2014	145
05/29/2014	149

Table 3: Dates of Hydrography

Mainscheme survey lines were run with a dual-head multibeam echosounder. Linear nautical miles for the dual-head system were calculated using statistics from the starboard head.

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	***S250***
LOA	37.7 meters
Draft	3.77 meters

Table 4: Vessels Used

NOAA Ship FERDINAND R. HASSLER (S250) acquired all data within the limits of H12697.

B.1.2 Equipment

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

Manufacturer	**Model**	**Type**
Reson	7125	MBES
Applanix	POS M/V 320 V5	Positioning and Attitude System
Hemisphere	MBX-4	Positioning System
Brooke Ocean	MVP-200	Sound Speed System
AML	Micro CTD	Conductivity, Temperature, and Depth Sensor
Reson	SVP-70	Sound Speed System

Table 5: Major Systems Used

B.2 Quality Control

B.2.1 Crosslines

Crosslines, acquired for this survey, totalled 5.8% of mainscheme acquisition.

A geographic plot of crosslines is shown in Figure 5. Crosslines were filtered to remove soundings greater than 45 degrees from nadir. To evaluate crossline agreement, two 4-meter surfaces were created: one from crossline soundings, the other from mainscheme soundings. These two surfaces were differenced using

CARIS HIPS and SIPS. The statistical analysis of the differences between the mainscheme and crossline surfaces is shown in Figure 6. The average difference between the surfaces is 0.01 meters with a standard deviation of 0.21 meters; 95% of all differences were less than 0.31 meters from the mean. The high standard deviation is thought to result from high relief in particular areas of the survey shown in Figure 7.

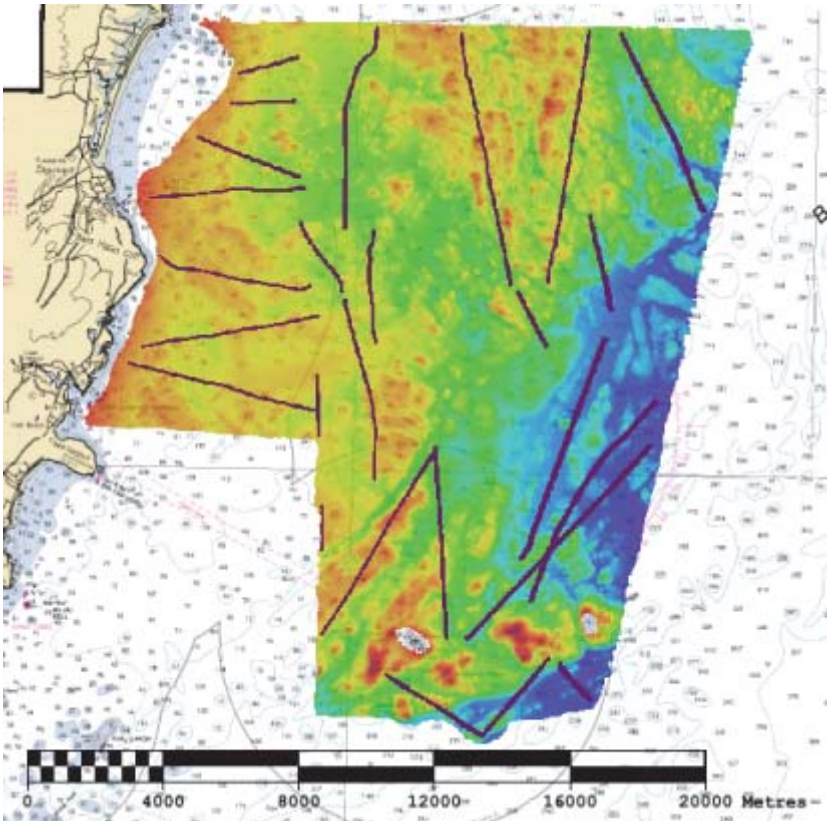


Figure 5: Location of crosslines, shown in purple and mainscheme data for H12697

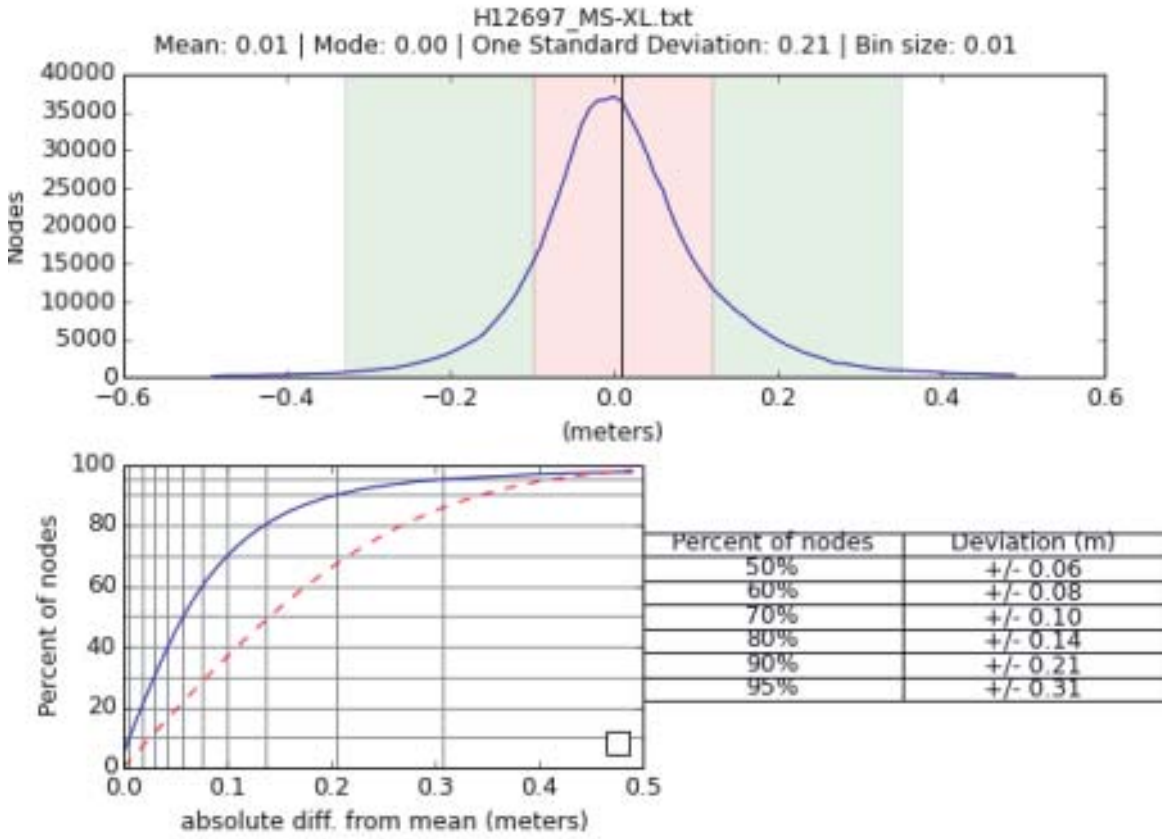


Figure 6: H12697 crossline difference statistics: mainscheme minus crossline

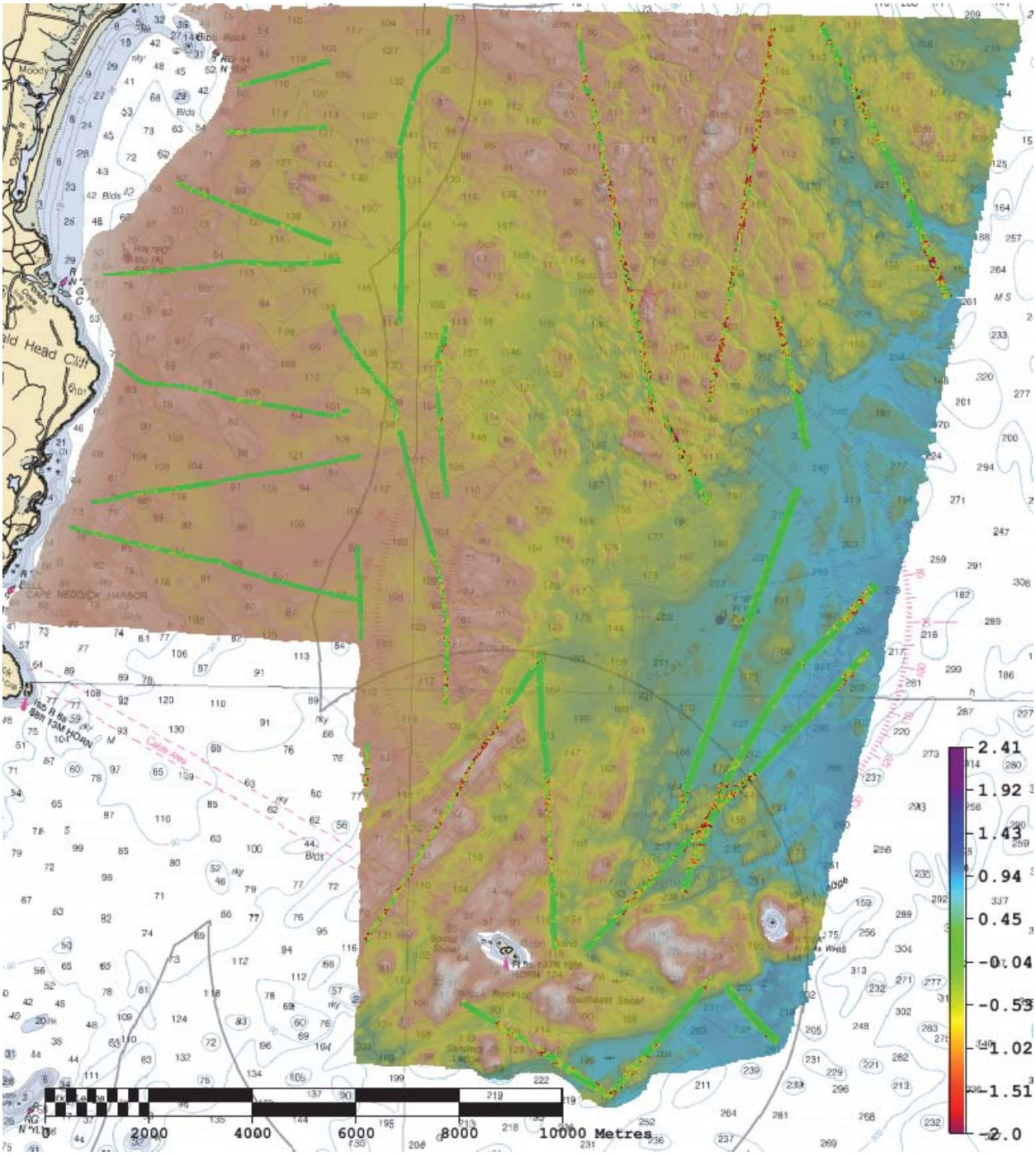


Figure 7: Mainscheme minus crossline differenced surface shown overlaid on mainscheme data. The color range scale shown is for the differenced surface. Large differences (primarily red and blue) appear to be greatest in areas of high relief.

B.2.2 Uncertainty

The following survey specific parameters were used for this survey:

Measured	Zoning
0.01 meters	0.21 meters
0.01 meters	0.081 meters

Table 6: Survey Specific Tide TPU Values

Hull ID	Measured - CTD	Measured - MVP	Surface
S250	1.0 m/s	1.0 m/s	0.5 m/s

Table 7: Survey Specific Sound Speed TPU Values

CO-OPS provided the tidal zoning uncertainty of 0.21 meters in the Project Instructions for project OPR-A321-FH-14. Seventeen lines, listed below, are corrected with zoned tides and received this uncertainty estimate. For these lines the TPU is calculated using "vessel settings" in CARIS.

The 0.081 meter uncertainty value was provided by HSD in the project instructions and is based on the VDatum uncertainty of the area. For all lines except those noted below, TPU is calculated using the loaded post-processed SMRMSG file values and the "realtime" selection in CARIS.

The 17 lines listed below exhibited unrealistic vertical offsets after Smooth Best Estimate of Trajectory (SBET) files were applied and GPS Tides computed. These lines have been reduced to chart datum using zoned water levels. Figures 8 and 9 show an example of soundings reduced via VDatum and discrete zoning, respectively. For the example illustrated, discrete zoning shows much better agreement. Regardless of better agreement being shown with discrete zoned tides, the remaining lines are still corrected with GPS Tides if within vertical uncertainty specifications. More information can be found in section C of this report and the VDatum evaluation report submitted in Appendix II.

Port -
20140508_063717
20140508_050242
20140508_054902
20140508_072055
20140509_040529
20140509_045023
20140509_053952
20140509_130443

Starboard -
20140508_050241

20140508_063717
20140508_084244
20140508_213918
20140509_045024
20140509_053952
20140509_130442
20140509_133327
20140525_162037

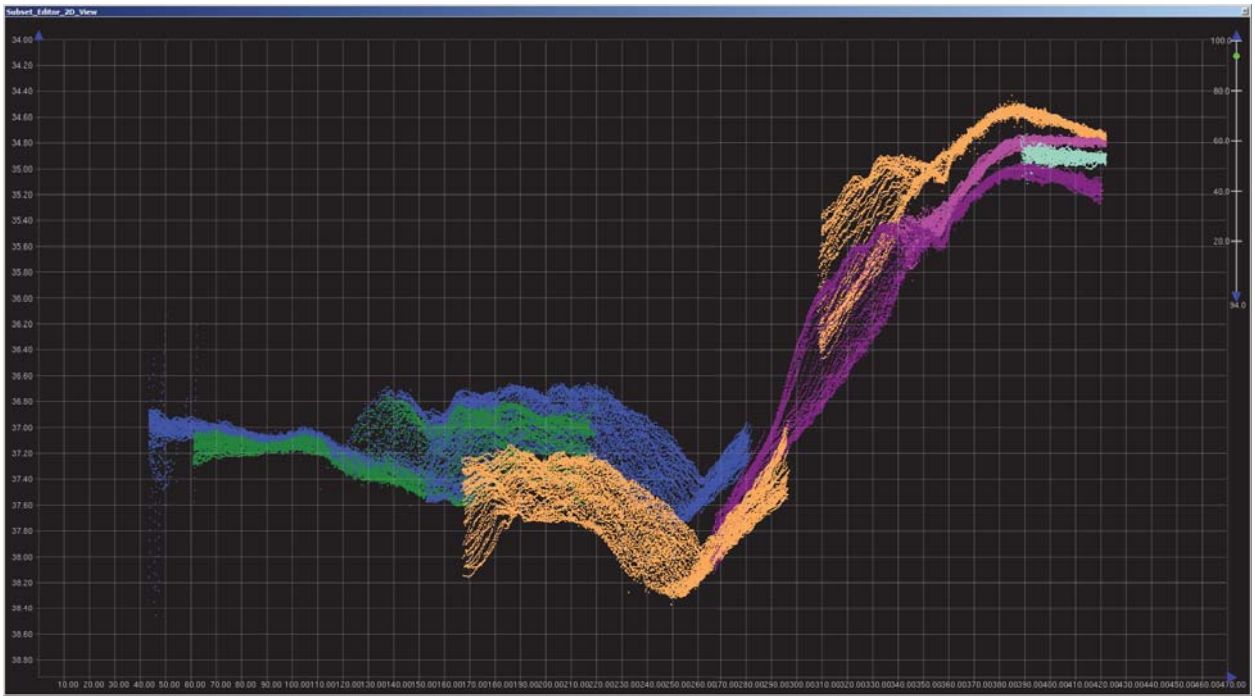


Figure 8: Soundings reduced via VDatum

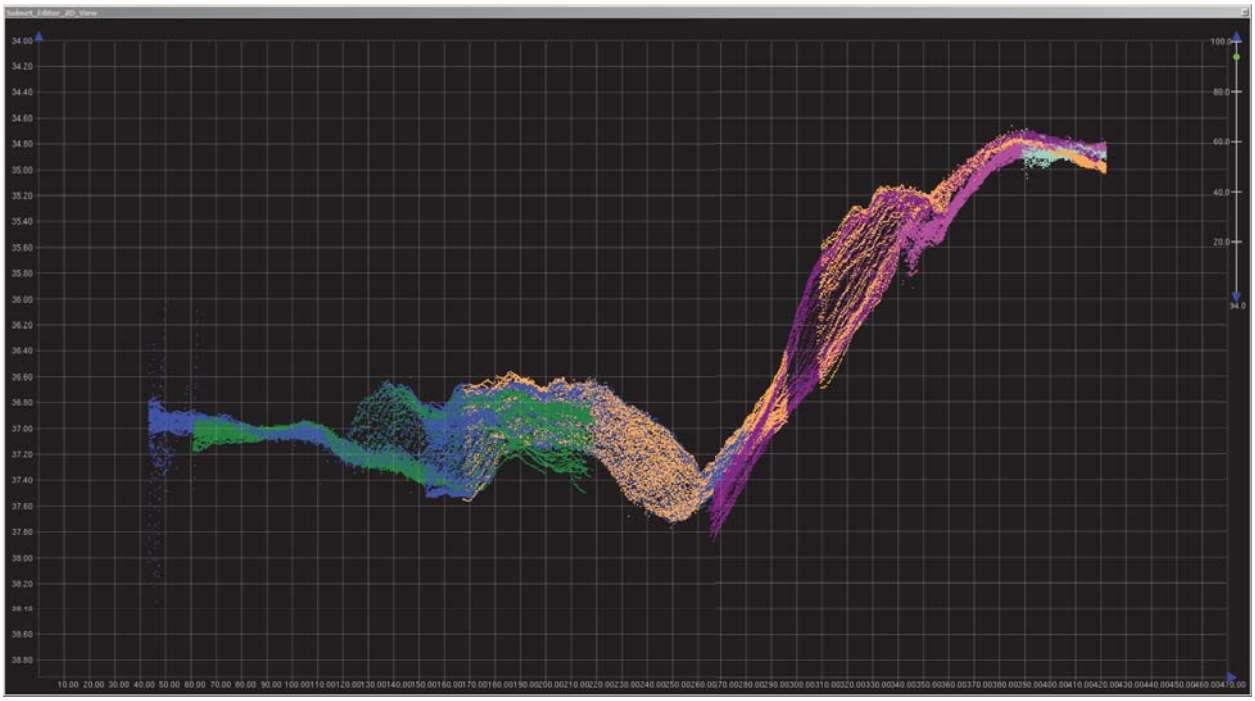


Figure 9: Soundings reduced via discrete tides

B.2.3 Junctions

The areas of overlap between sheet H12697 and its junction sheets, shown in Figure 6, were reviewed in CARIS Subset Editor. The junctioning surfaces were subtracted from the surface of H12697 to assess sounding consistency.

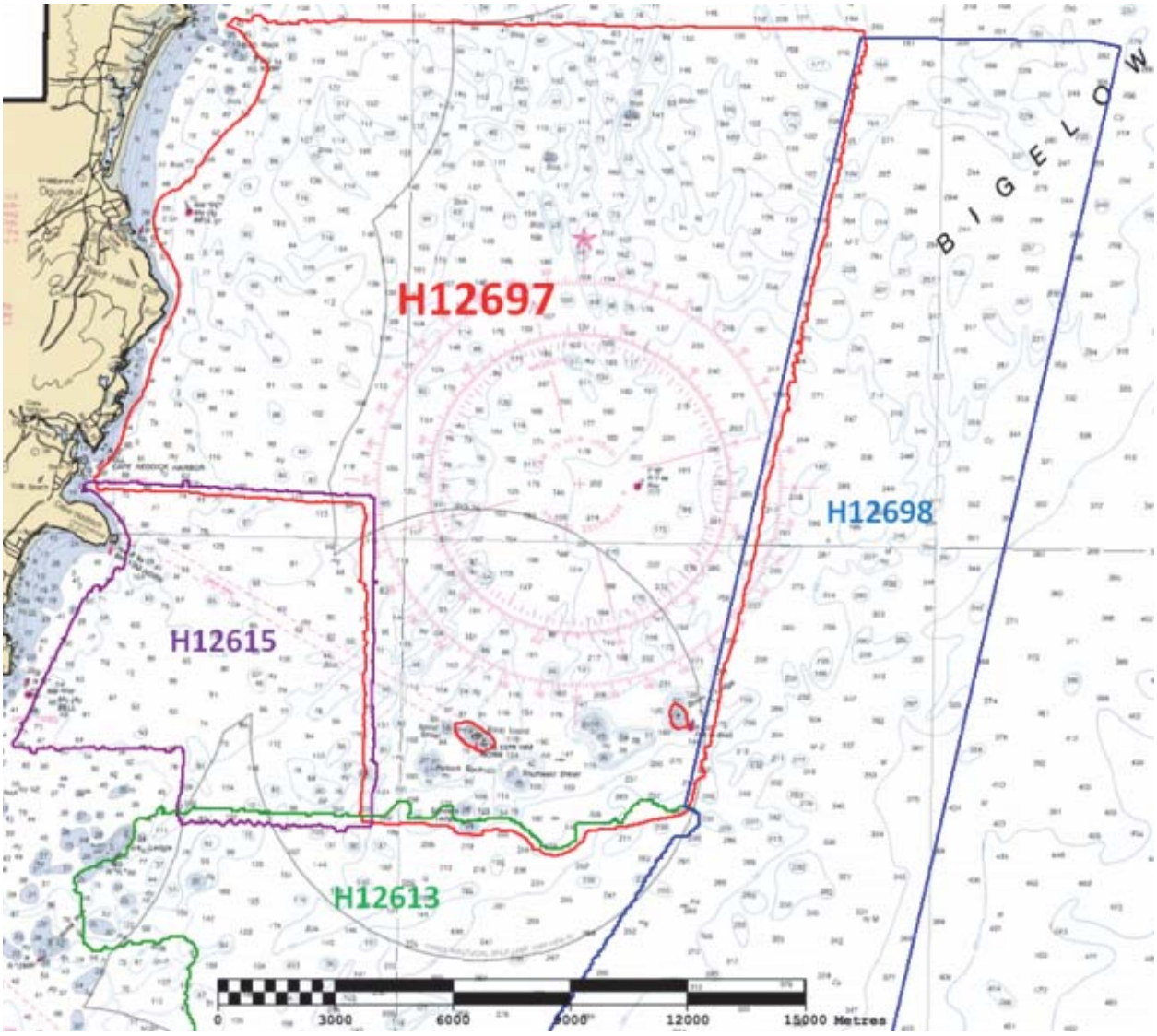


Figure 10: H12697 junctions

The following junctions were made with this survey:

Registry Number	Scale	Year	Field Unit	Relative Location
H12613	1:40000	2013	NOAA Ship FERDINAND R. HASSLER	S
H12615	1:10000	2013	NOAA Ship FERDINAND R. HASSLER	S
H12698	1:40000	2014	NOAA Ship FERDINAND R. HASSLER	E

Table 8: Junctioning Surveys

H12613

This survey was assigned as a part of project OPR-A321-FH-13. The location is shown in Figure 10. Of the over 500 thousand overlapping nodes, the average difference is 0.10 meters with a standard deviation of 0.23 meters. 95% of all differences are less than +/- 0.45 meters from the mean, as shown in Figure 11. Survey H12613 was reduced to MLLW by discrete zoned tides, while H12697 was reduced to MLLW by VDatum. This may account for higher mean differences and standard deviation.

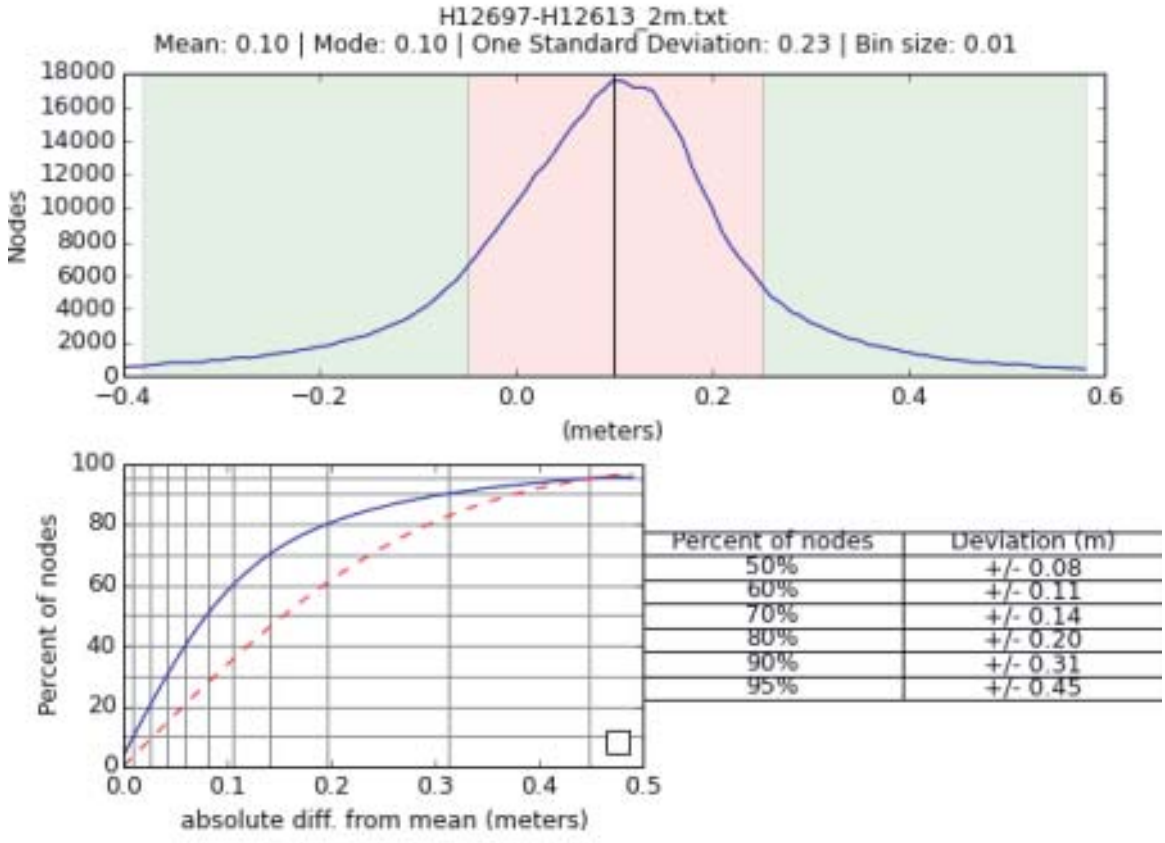


Figure 11: Differenced surface statistics - H12697 minus H12613

H12615

This survey was assigned as a part of project OPR-A321-FH-13. The location is shown in Figure 10. Of the over 800 thousand overlapping nodes, the average difference is 0.01 meters with a standard deviation of 0.16 meters. 95% of all differences are less than +/- 0.31 meters from the mean, as shown in Figure 12.

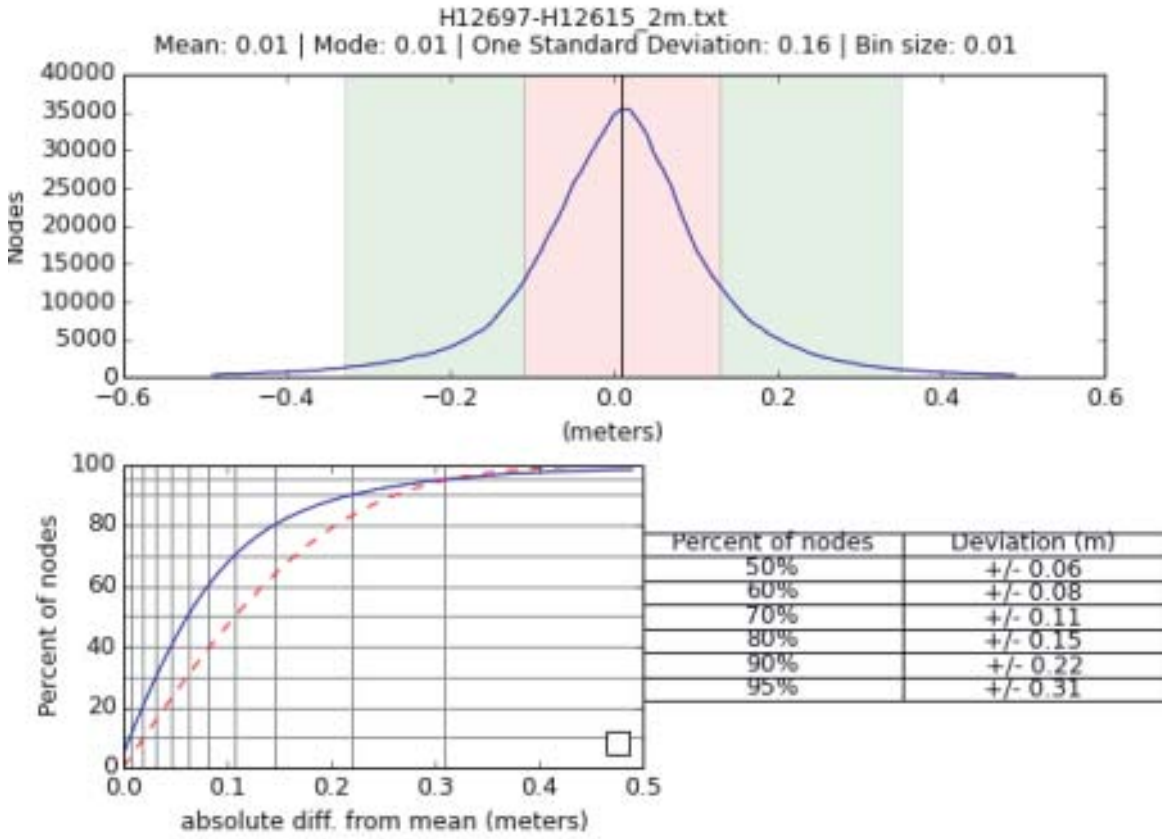


Figure 12: Differenced surface statistics - H12697 minus H12615

H12698

This survey was assigned as a part of project OPR-A321-FH-14. The location is shown in Figure 10. Of the over 400 thousand overlapping nodes, the average difference is -0.05 meters with a standard deviation of 0.34 meters. 95% of all differences are less than +/- 0.66 meters from the mean, as shown in Figure 13. The higher than usual standard deviation appears to be on the outer edges of the overlapping swaths and is likely due to sound speed refraction, portrayed in Figure 14. The differences are within the allowable uncertainty for the depth.

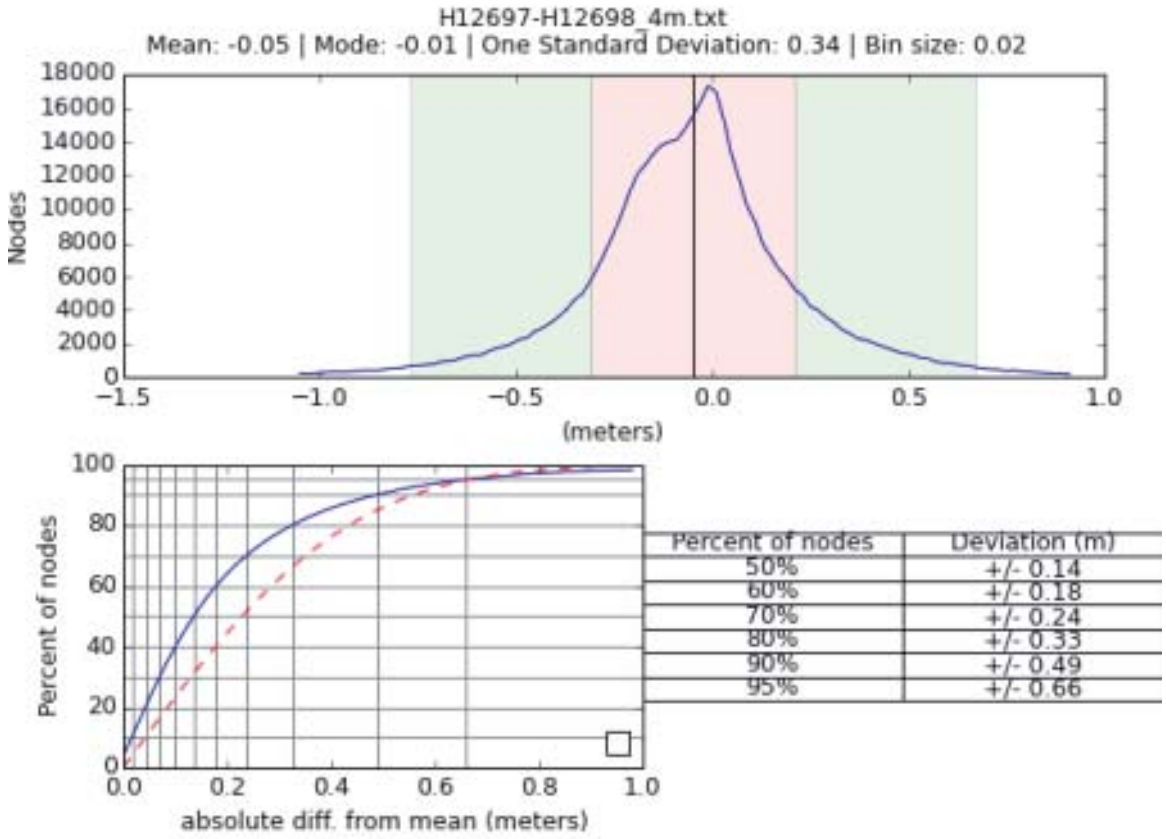


Figure 13: Differenced surface statistics - H12697 minus H12698

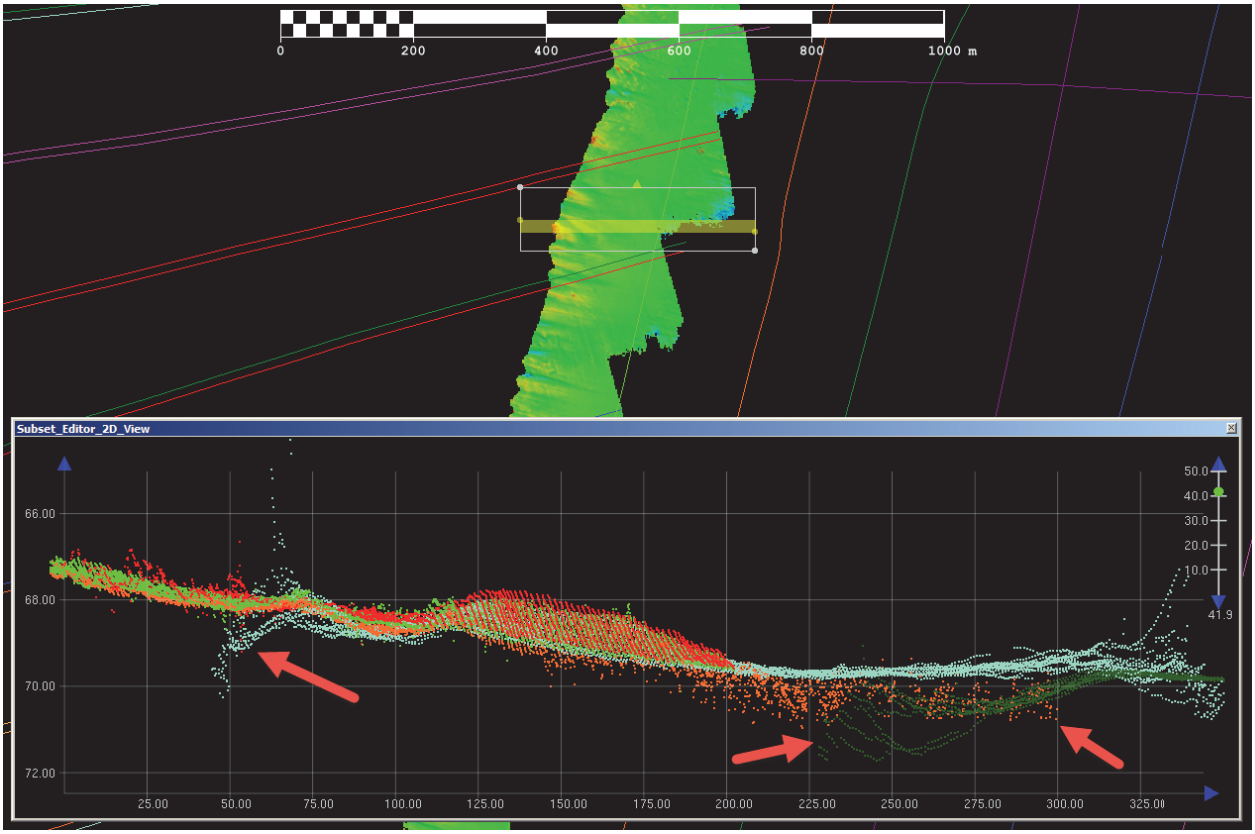


Figure 14: Differenced surface, tracklines, and subset image of H12697 and H12698 - Shown with arrows, the largest differences appear to be on the outer edges of the overlapping swaths.

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

None Exist

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

B.2.6 Factors Affecting Soundings

Deployed Fishing / Lobster Gear

Throughout the survey area for H12697 there were deployed lobster pots and buoys, visible from the bridge and verified in the Reson display during acquisition. During data processing it was not possible to distinguish active lobster traps on the seabed from derelict traps, rocks, or other obstructions. Therefore, some temporary fishing gear may be reflected in the final dataset. These features may resemble small obstructions and meet the technical definition based on size alone, however, should not be designated as such (ref. HSSD 5.2.1.2 and FPM 4.2.6.1).

B.2.7 Sound Speed Methods

Sound Speed Cast Frequency: CTD casts using the MVP-200 were taken approximately every 3-4 hours. Comparisons were made by the survey watch and sound speed in the watercolumn was believed to be mainly a function of space, not time.

Sound speed corrections are applied in CARIS using Nearest in Distance Within Time (NIDWT) of 4 hours for the entire survey.

The changing sound speed was not sampled enough to capture all spatial and time variances. As shown in Figure 15, outer beam refraction error cause some areas of MBES to vary up to 50 centimeters. Enough overlap was acquired with other lines that these outer beam soundings are not the only soundings available for the CUBE surfaces to honor. In areas where the outer beam soundings affected the final surface, the soundings were rejected using CARIS Subset Editor.

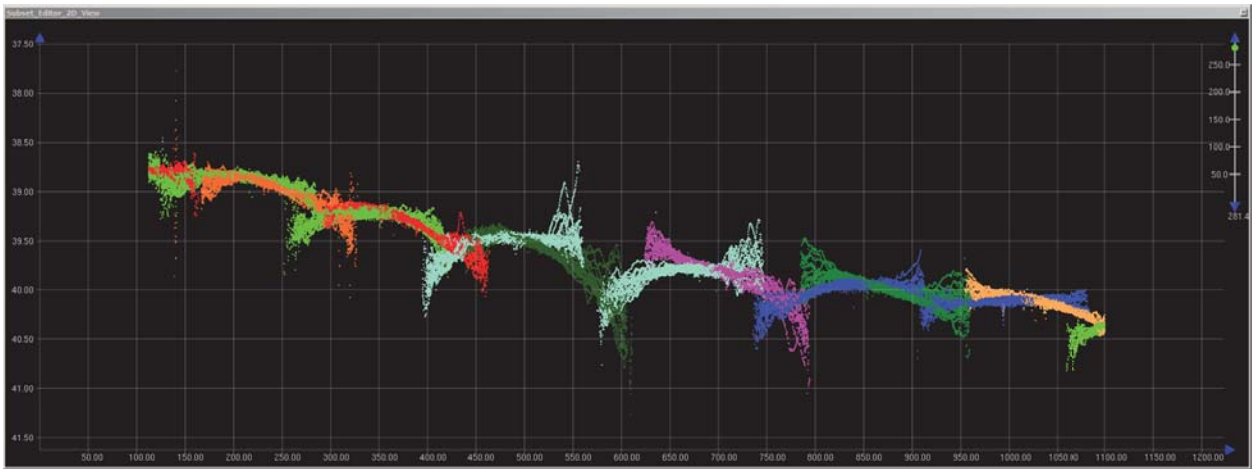


Figure 15: Outer beam refraction errors shown in CARIS Subset Editor - These soundings remain with the submitted data unless adversely affecting the final surfaces, in which case the soundings are rejected

B.2.8 Coverage Equipment and Methods

A density analysis was run to calculate the number of soundings per surface node. Five or more soundings per node are present in over 99.8% of the 2-meter, 4-meter and 8-meter surfaces. The 50-centimeter surface contains 98.9% of nodes with five or more soundings. For additional detail refer to H12697_Standards_Compliance report submitted in Appendix II of this report.

The density analysis only includes nodes which are populated by at least one sounding and does not account for holidays located within the surface, which will be discussed in the following section of this report.

B.2.9 Holidays

Survey H12697 contains one particularly large holiday located on the sheet limits and measuring approximately 7 meters x 15 meters (Figure 16). However, this holiday was covered completely by HASSLER's 2013 junctioning survey, H12615.

Numerous small holidays exist as a result of acoustic shadows at the base of rocks and other areas of high relief. An example of these holidays are shown in Figure 17. These holidays have been examined by the hydrographer and deemed insignificant as the least depths in the area have been obtained.

Along the limits of hydrography, mainly in the 50-centimeter resolution range along the western extents and around Boon Island, the seabed was ensonified from only one angle without an adjacent line of coverage to densify the bathymetry from the opposite direction. The result is small gaps in coverage as shown in Figure 18. These areas should not be included in the sheet's final survey outline and additional work (Section D.2.10), when assigned, should be planned to the extents of good survey coverage.

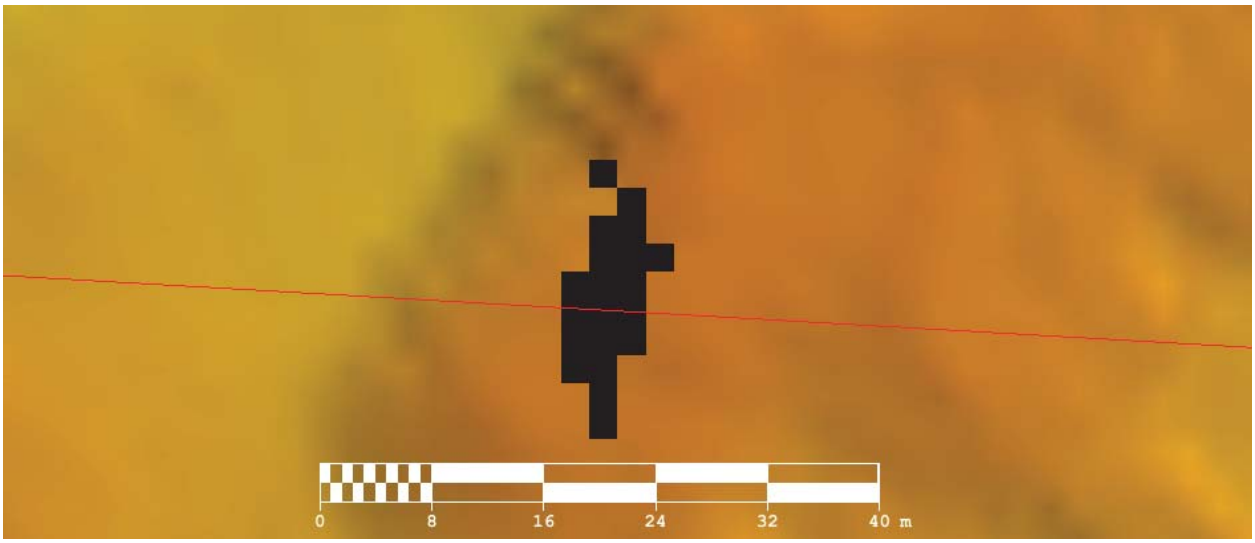


Figure 16: Significant holiday in H12697 coverage - Red line shows assigned sheet limits, this holiday was covered completely by junctioning 2013 survey, H12615

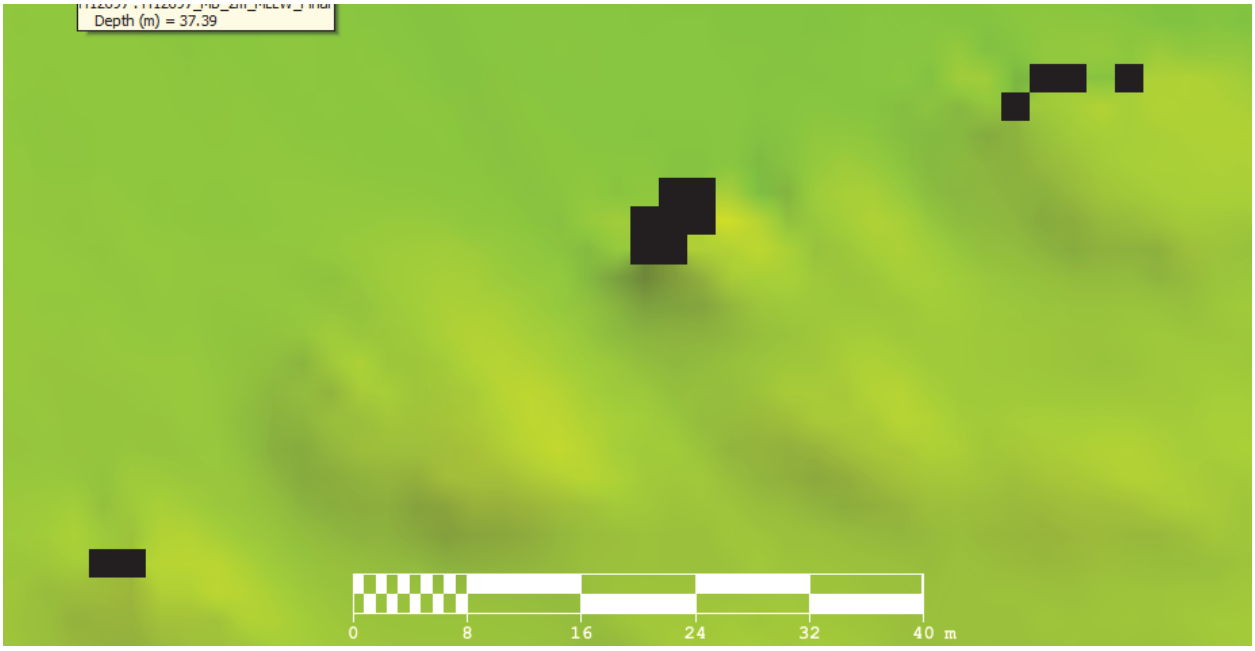


Figure 17: Example of holidays in H12697 coverage - These are the result of acoustic shadows and are deemed insignificant after review by the hydrographer

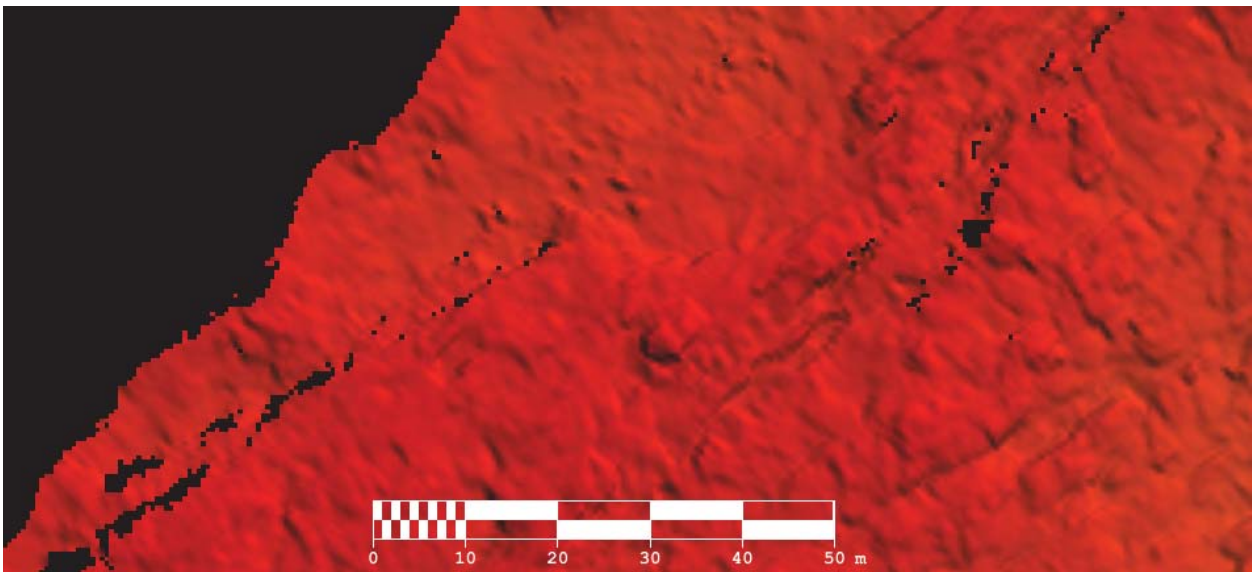


Figure 18: Holidays on outer edge of coverage - final survey coverage should be modified to account for lack of data on outer edges

B.3 Echo Sounding Corrections

B.3.1 Corrections to Echo Soundings

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

B.3.2 Calibrations

All sounding systems were calibrated as detailed in the DAPR.

B.4 Backscatter

Backscatter was logged in Reson datagram 7008 snippets record in the raw .s7k files. The .s7k file also holds the navigation record and bottom detections for all lines of survey H12697. The files were paired with the CARIS HDCS data, imported and processed using Fledermaus Geocoder Toolbox.

The GSF files containing the extracted backscatter are submitted with the data in this survey. The processed mosaic is saved as a Geo-Tiff and also submitted.

B.5 Data Processing

B.5.1 Software Updates

There were no software configuration changes after the DAPR was submitted.

The following Feature Object Catalog was used: NOAA Profile Version 5.3.2.

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
H12697_MB_50cm_MLLW	CUBE	0.5 meters	4.63 meters - 172.27 meters	NOAA_0.5m	Object Detection
H12697_MB_2m_MLLW	CUBE	2 meters	4.73 meters - 130.78 meters	NOAA_2m	Complete MBES
H12697_MB_4m_MLLW	CUBE	4 meters	4.74 meters - 89.77 meters	NOAA_4m	Complete MBES

Surface Name	Surface Type	Resolution	Depth Range	Surface Parameter	Purpose
H12697_MB_8m_MLLW	CUBE	8 meters	4.93 meters - 89.74 meters	NOAA_8m	Complete MBES
H12697_MB_50cm_MLLW_Final_0to20	CUBE	0.5 meters	4.63 meters - 20.0 meters	NOAA_0.5m	Object Detection
H12697_MB_2m_MLLW_Final_18to40	CUBE	2 meters	18 meters - 40 meters	NOAA_2m	Complete MBES
H12697_MB_4m_MLLW_Final_36to80	CUBE	4 meters	36 meters - 80 meters	NOAA_4m	Complete MBES
H12697_MB_8m_MLLW_Final_72plus	CUBE	8 meters	72 meters - 89.74 meters	NOAA_8m	Complete MBES

Table 9: Submitted Surfaces

B.5.3 Designated Soundings

Within the limits of H12697, six soundings are submitted flagged as designated in CARIS HIPS and SIPS. Of these six soundings; five are designated for feature creation and one is to preserve the shoal depth in the finalized surfaces.

B.5.4 Total Vertical Uncertainty Analysis

A custom layer was created on finalized surfaces showing the uncertainty of individual nodes in relation to the allowable uncertainty for their depths. This layer was exported and run through a custom Python script resulting in statistical analysis. 100% of nodes within survey H12697 meet the vertical uncertainty standards of section 5.1.3 of the Hydrographic Surveys Specifications and Deliverables (2014). See H12697_Standards_Compliance report submitted in Appendix II of this report.

C. Vertical and Horizontal Control

All vertical and horizontal control activities conducted during the course of this survey are fully addressed in the following sections. Therefore, no separate HVCR is submitted.

C.1 Vertical Control

The vertical datum for this project is Mean Lower Low Water.

Standard Vertical Control Methods Used:

Discrete Zoning

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

Station Name	Station ID
Fort Point, NH	8423898

Table 10: NWLON Tide Stations

File Name	Status
8423898.tid	Verified Observed

Table 11: Water Level Files (.tid)

File Name	Status
A321FH2013CORP.zdf	Preliminary

Table 12: Tide Correctors (.zdf or .tc)

A request for final approved tides was sent to N/OPS1 on 06/02/2014. The final tide note was received on 06/16/2014.

Preliminary zoning is accepted as the final zoning for project OPR-A321-FH-2014, H12697, during the time period between April 27 - May 29, 2014.

Non-Standard Vertical Control Methods Used:

VDatum

Ellipsoid to Chart Datum Separation File:

2014_A321_VDatum_NAD83Ellip_MLLW.csar

Soundings submitted as H12697 are referenced to MLLW reduced by ellipsoidal methods using the ellipsoid to chart datum separation file, with the exception of those lines discussed in section B.2.2 that were reduced to chart datum using zoned water levels.

As required by the Project Instructions, the hydrographer evaluated VDatum for the survey area prior to H12697 final processing. Based on this evaluation, the hydrographer recommended VDatum for final datum reduction. The Chief, Hydrographic Surveys Division, concurred with this recommendation. See Appendix II for the VDatum evaluation report and correspondence associated with the decision.

C.2 Horizontal Control

The horizontal datum for this project is North American Datum of 1983 (NAD83).

The projection used for this project is UTM Zone 19N.

The following PPK methods were used for horizontal control:

Smart Base

All data submitted as H12697 have SBETs applied for post-processed horizontal position and attitude.

The following CORS Stations were used for horizontal control:

HVCR Site ID	Base Station ID
ACUSHNET 5, Acushnet, MA	ACU5
ACUSHNET 6, Acushnet, MA	ACU6
BAR HARBOR, Bar Harbor, ME	BARH
GORHAM, Gorham, ME	MEGO
AUGUSTA, Augusta, ME	MEOW
NHDOT CONCORD, Concord, NH	NHCO
U NEW HAMPSHIRE, Durham, NH	NHUN
GUNSTOCKMRNH2008, Gilford, NH	P776
MTS FOX COOP, Foxborough, MA	XMTS
MTS YARMOUTH, Yarmouth, MA	YMTS

Table 13: CORS Base Stations

DGPS was used for real-time positioning during acquisition. All lines submitted are corrected using post-processed horizontal solutions.

The following DGPS Stations were used for horizontal control:

DGPS Stations
Brunswick NAS, ME (316 kHz)

Table 14: USCG DGPS Stations

D. Results and Recommendations

D.1 Chart Comparison

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
13283	1:20000	22	04/2013	06/17/2014	06/28/2014
13286	1:80000	32	12/2013	06/17/2014	06/28/2014
13278	1:80000	28	08/2013	06/10/2014	06/14/2014

Table 15: Largest Scale Raster Charts

13283

A comparison was performed with Chart 13283 (1:20,000) using a CARIS sounding and contour layer based on the 8-meter combined surface. Both soundings and contours were overlaid on Chart 13283 (Figure 19). All charted depths agree to within 1-3 feet of H12697 surveyed soundings.

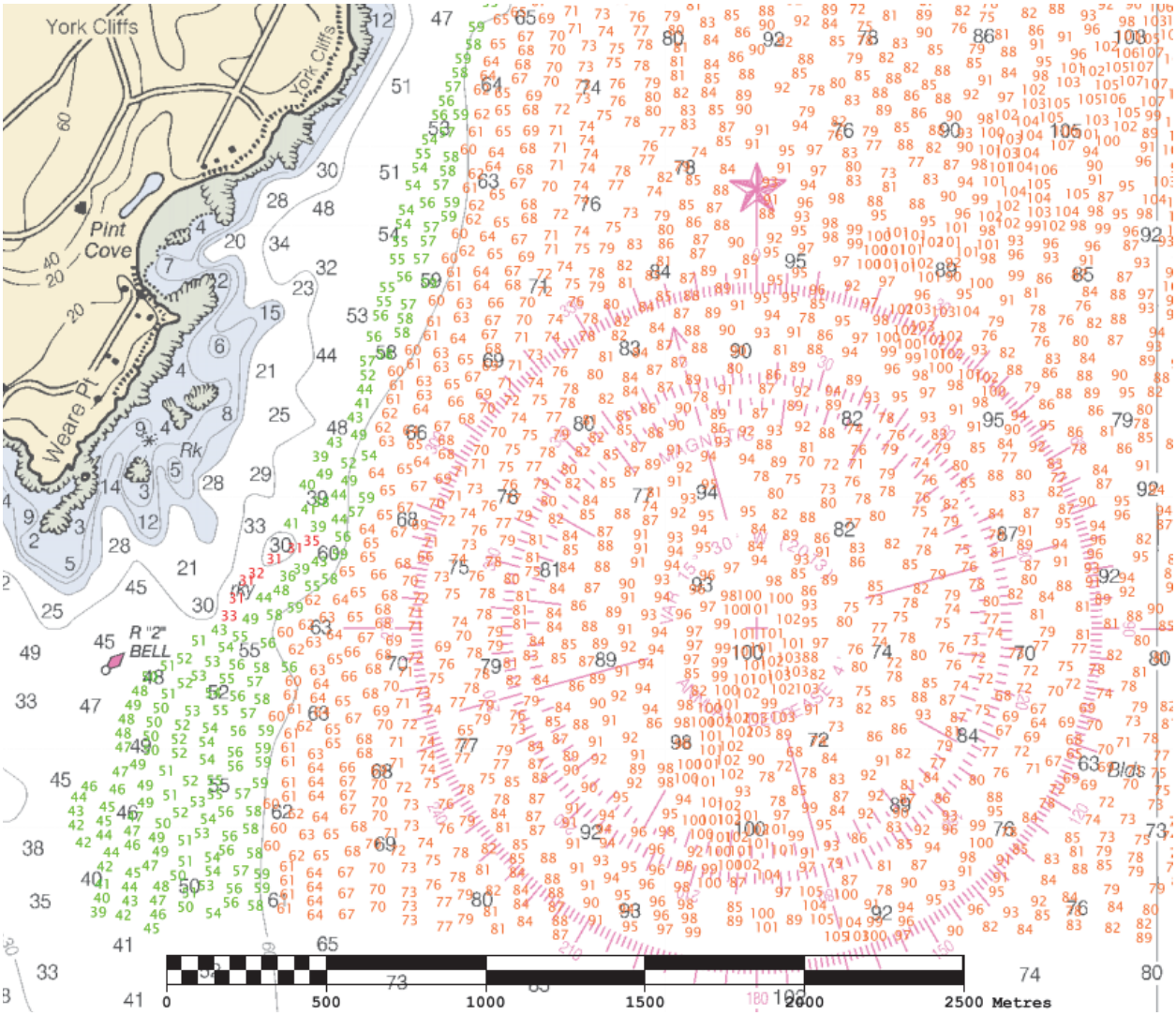


Figure 19: Charted depths and surveyed soundings overlaid on RNC 13283, surveyed soundings are colored within contour ranges.

13286

A comparison was performed with Chart 13286 (1:80,000) using a CARIS sounding and contour layer based on the 8-meter combined surface. In general, charted depths and depth curves, although generalized, agree with surveyed soundings and contours, respectively. Charted depths compare to within 4-9 feet of H12697 surveyed soundings. A few areas around the vicinity of Boon Island, described in more detail below, appear to be deeper than charted and the chart should be updated to reflect the current surveyed soundings.

Spout Shoal (Figure 20) appears to have a least depth of 30 feet, however the full extents of this feature may not have been achieved. The hydrographer recommends relocating the 18-foot charted depth east towards Boon Island.

Sanders Ledge (Figure 21) is charted correctly for the southern 28-foot charted depth but the northern 28-foot depth was covered with complete MBES and has a least depth value of 51 feet. The hydrographer recommends charting the area around Sanders Ledge to include only one blue tinted 28-foot charted depth.

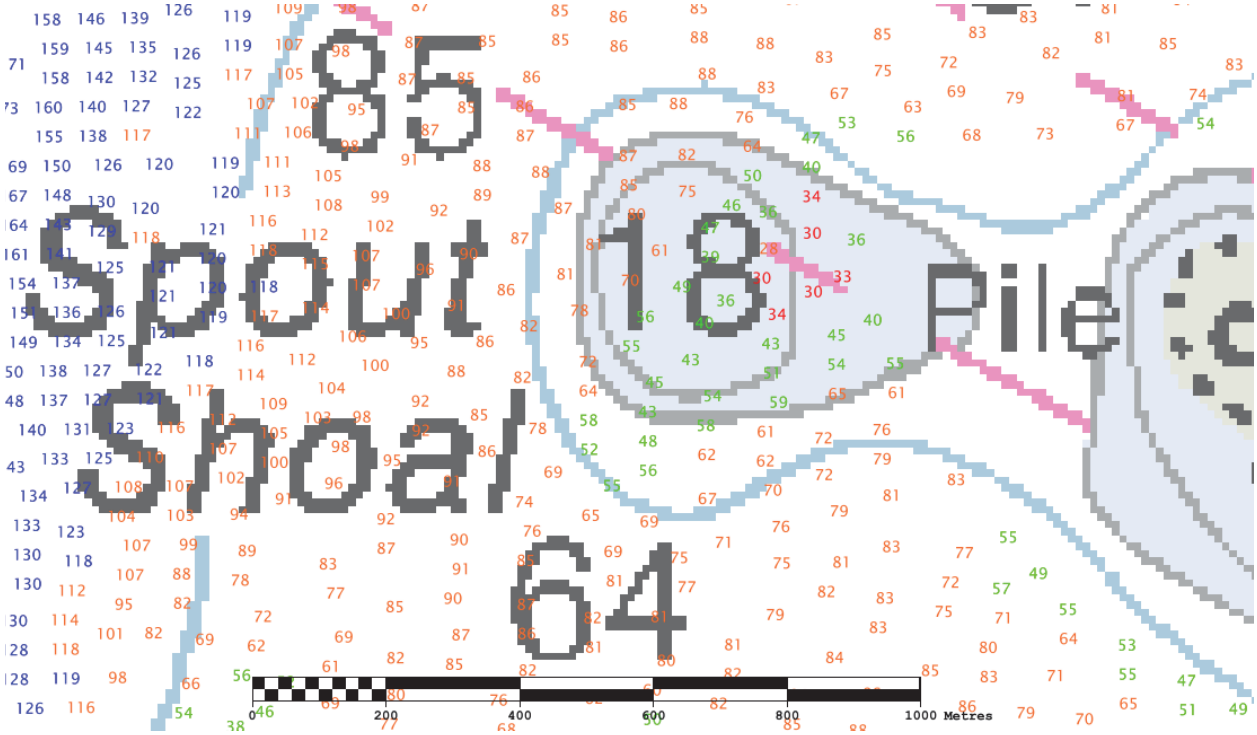


Figure 20: Charted depths and surveyed soundings overlaid on RNC 13286 in the vicinity of Spout Shoal, surveyed soundings are colored within contour ranges.

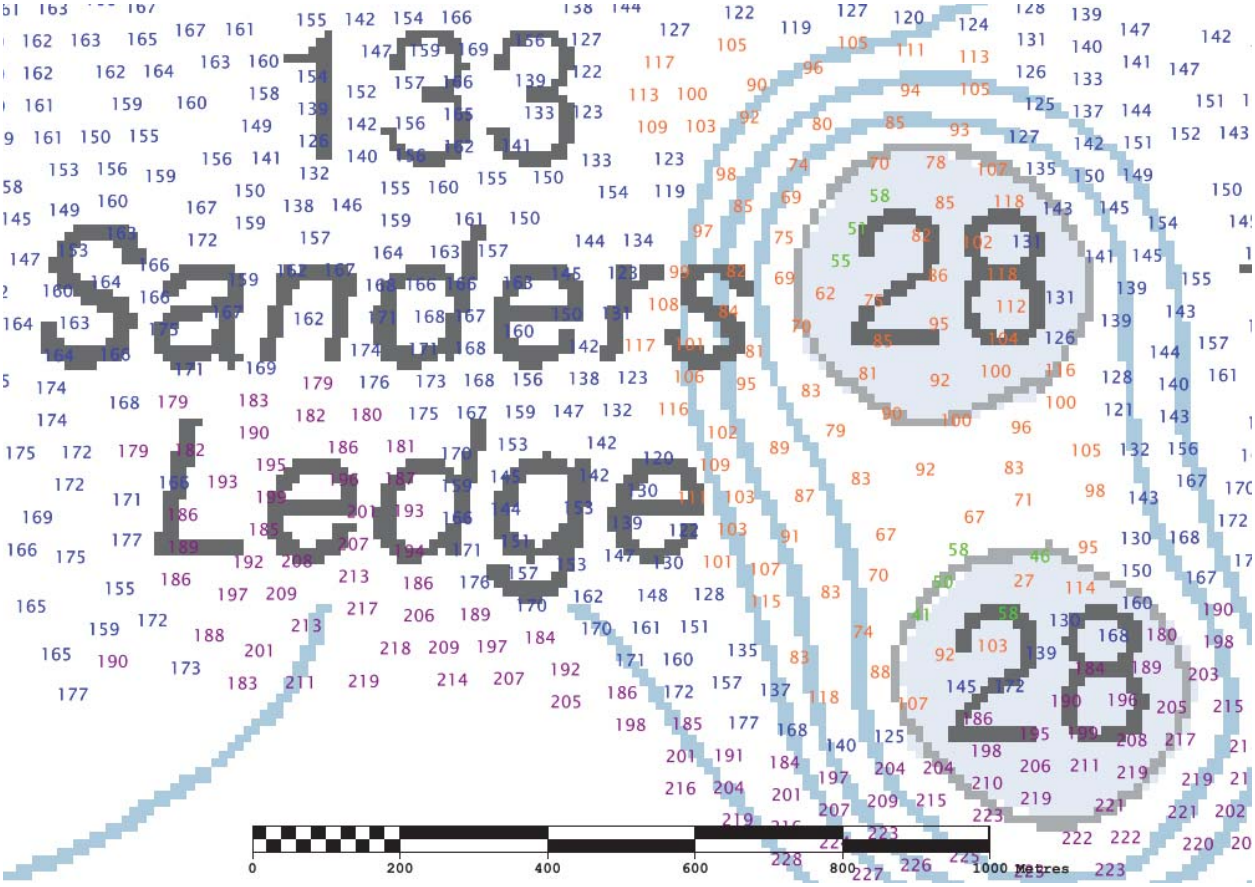


Figure 21: Charted depths and surveyed soundings overlaid on RNC 13286 in the vicinity of Sanders Ledge, surveyed soundings are colored within contour ranges.

13278

No comparison was performed with RNC 13278 as the area surveyed is overlapped completely with RNC 13286. Charted depths and depth curves agree as described in previous chart comparison discussion with RNC 13286.

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?
US5NH02M	1:20000	18	11/15/2013	11/15/2013	NO
US4ME01M	1:80000	10	09/11/2013	09/11/2013	NO
US4MA04M	1:80000	22	12/03/2013	12/03/2013	NO

Table 16: Largest Scale ENCs

US5NH02M

No comparison was performed with ENC US5NH02M as it contained very few soundings different than RNC 13283. See previous chart comparison discussion with RNC 13283.

US4ME01M

No comparison was performed with ENC US4ME01M as it contained very few soundings different than RNC 13286. See previous chart comparison discussion with RNC 13286.

US4MA04M

No comparison was performed with ENC US4MA04M as it contained very few soundings different than RNC 13286. See previous chart comparison discussion with RNC 13286.

D.1.3 AWOIS Items

AWOIS investigations were not assigned per the Project Instructions for OPR-A321-FH-14. Regardless, four AWOIS items exist within the limits of H12697 as shown in Figure 22. All AWOIS items were investigated fully using complete MBES techniques and the results and recommendations are listed below.

A) AWOIS item 2190 is the remains of the stern of the EMPIRE KNIGHT (Figure 23), a 428 foot British freighter that was lost at sea February 11, 1944. According to the casualty report, the ship ran aground on Boon Island Ledge, Maine, and later broke into two sections. The stern section (Figure 24) contains the ships cargo hold, important because of the large amount of mercury that remains stowed.

The following is an excerpt taken from Federal Register Vol. 60, No. 218, p. 56968 on 13 November 1995;

"The Coast Guard proposes to establish a permanent safety zone encompassing those waters of the Atlantic Ocean within 1,000 yards of the approximate position 43°06'19"N, 70°27'09"W (datum NAD 83) and from

the water's surface to the seabed floor. This rule making is being under taken to ensure that the stern portion of the sunken vessel M/V EMPIRE KNIGHT, and its cargo of mercury, is not disturbed by dredging, diving, salvage, anchoring, fishing, or other activity. This proposed rule is necessary to protect the environment, and the commercial fishery, and the general public from any adverse effects of contamination from mercury which could result from the disturbance of the stern section of the wreck."

The bow section (Figure 25), reportedly on the landward side of Boon Island Ledge, was not located during the course of H12697. It is likely that any remains are broken and dispersed as a result of the frequent battering of Atlantic storms.

B) No evidence was found of the charted PA wreck east of Boon Island. Refer to the final feature file for remarks and recommendations.

C) No evidence was found of the northern AWOIS wreck. This item was not included in the CSF and is not included in the final feature file.

D) MBES least depths were acquired on the one AWOIS obstruction. Refer to the final feature file for remarks and recommendations.

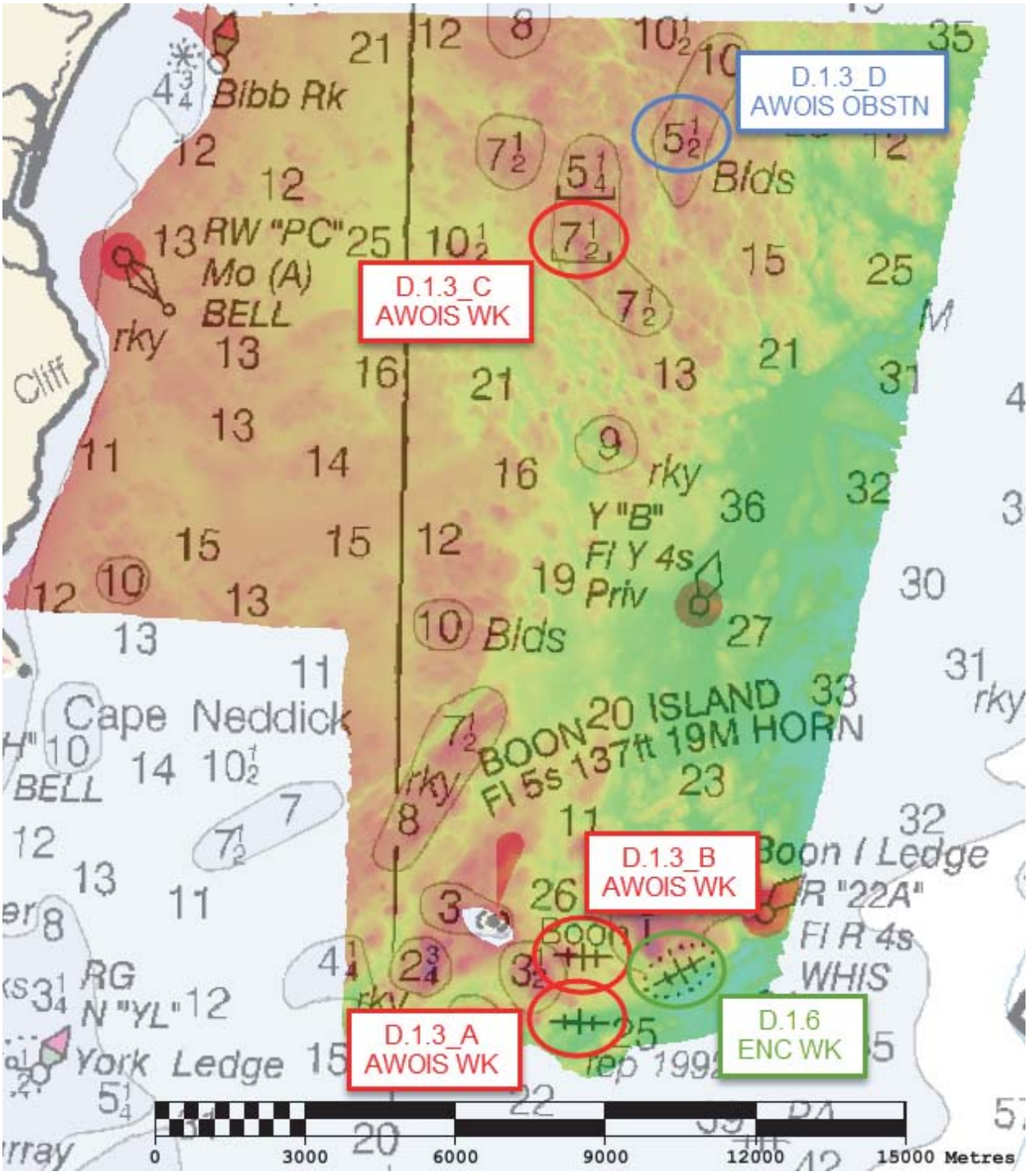


Figure 22: Special features within the acquired sheet limits - Four AWOIS items and one ENC wreck were investigated during the course of survey H12697

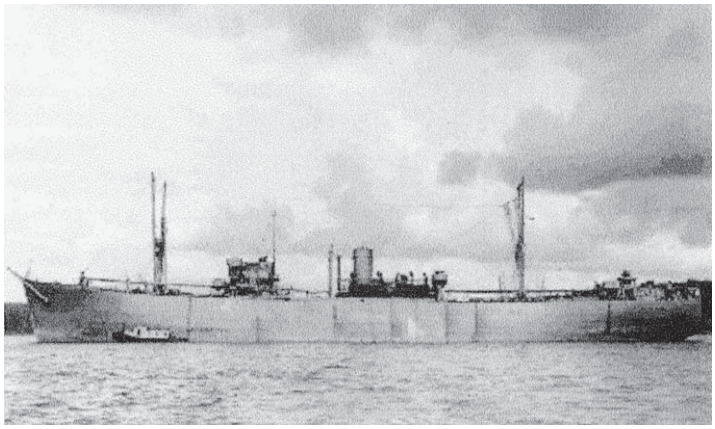


Figure 23: The 428 foot British freighter, EMPIRE KNIGHT. Photo found online courtesy of U.S. Coast Guard.

Figure 24: Side scan imagery of the EMPIRE KNIGHT's submerged stern section. Photo found online courtesy of L3 Klein Associates.

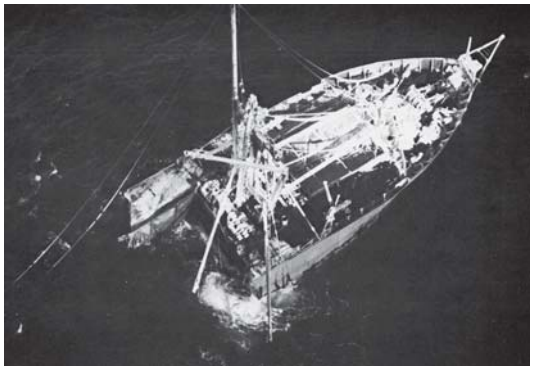


Figure 25: The EMPIRE KNIGHT bow on Boon Island Ledge. Photo found online courtesy of U.S. Navy.

D.1.4 Maritime Boundary Points

Maritime Boundary Points were not assigned with the 2014 project instructions due to the lack of an appropriate vessel suited for near shore data acquisition.

D.1.5 Charted Features

The charted obstruction that is not included in the AWOIS section was assigned and investigated during the course of survey H12697. Refer to the final feature file for remarks and recommendations.

The charted cable area, stretching from Cape Neddick to Boon Island, was fully investigated within the limits of H12697. While no evidence of the cable was found in the survey data, the hydrographer recommends that this be retained as charted.

D.1.6 Uncharted Features

One wreck contained within the composite source file (CSF), southwest of Boon Island Ledge, is not on the current version of either RNC chart 13278 or 13286. This wreck remains in the ENC and RNC 13260 as shown previously in figure 22. Through research it is believed that this is the reported position of the bow section of AWOIS #2190. Refer to section D.1.3 of this report and the final feature file for remarks and recommendations.

D.1.7 Dangers to Navigation

No Danger to Navigation Reports were submitted for this survey.

D.1.8 Shoal and Hazardous Features

Boon Island, Boon Island Ledge, Sanders Ledge, Spout Shoal, Southeast Shoal, and Pollock Rock were all investigated to the extents that were deemed safe. Throughout history there are a few instances, some of them tragic, of seagoing vessels that have had encounters with this island and cluster of dangerous shoals approximately 5NM east of the Southern Maine coast. The current charted depths agree within 1-2 feet of the surveyed soundings obtained on these hazardous features, unless previously mentioned in section D.1.1 of this report. Refer to the final feature file for remarks and recommendations on those features that were assigned and addressed during operations.

D.1.9 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.1.10 Bottom Samples

Twenty-six bottom samples, chosen from HSD OPS suggestions and acquired backscatter, were taken within the limits of H12697 and are submitted with the final feature file. Video coverage (limited to 40 meter depths) was obtained on seven of the sixteen bottom samples taken on Dn128 and Dn129. For all but one bottom sample taken on Dn145, a new housing (3000 meter maximum depth) was utilized and video coverage will be submitted. Four samples that were acquired without concurrent video coverage failed to collect sediment and are not being submitted in the final feature file.

D.2 Additional Results

D.2.1 Shoreline

Shoreline was assigned in the Hydrographic Survey Project Instructions or Statement of Work, but was not investigated. Without availability of a survey launch, HASSLER acquired data within the safe navigable limit for the ship.

D.2.2 Prior Surveys

Prior surveys were available, but not compared with current data.

D.2.3 Aids to Navigation

All aids to navigation that are within the surveyed limits of H12697 were visually confirmed to be on station and serving intended purposes.

D.2.4 Overhead Features

No overhead features exist for this survey.

D.2.5 Submarine Features

Submarine features were investigated and attributed in the final feature file if deemed significant.

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 New Survey Recommendation

The area surrounding Boon Island and the inshore area south of Bibb Rock was surveyed to the safe navigable limit achievable by HASSLER without the use of a survey launch. The region of Boon Island and Boon Island Ledge will require more maneuverability due to the proximity to the shoreline. Inshore work south of Bibb Rock will require a survey launch due to high density of lobster fishing gear and proximity to hazards. The hydrographer recommends these areas be addressed in a later survey by a platform suited for near shore work.

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.

Report Name	Report Date Sent
OPR-A321-FH-14 Data Acquisition and Processing Report	2014-07-31
OPR-A321-FH-14 VDatum Validation Report	2014-06-13
2014 Hydrographic Systems Readiness Review Memo	2014-05-06

Approver Name	Approver Title	Approval Date	Signature
LCDR Marc S. Moser, NOAA	Chief of Party	07/31/2014	2014.07.31 15:34:44 -04'00'
LT Adam Reed, NOAA	Field Operations Officer	07/31/2014	Adam Reed 2014.07.31 19:29:05 Z
David T. Moehl	Senior Survey Technician	07/31/2014	

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
TPU	Total Porpagated 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

APPENDIX I

TIDES AND WATER LEVELS

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

PROVISIONAL TIDE NOTE FOR HYDROGRAPHIC SURVEY

DATE : June 12, 2014

HYDROGRAPHIC BRANCH: Atlantic
HYDROGRAPHIC PROJECT: OPR-A321-FH-2014
HYDROGRAPHIC SHEET: H12697
LOCALITY: Bibb Rock to Boon Island, Gulf of Maine, ME
TIME PERIOD: April 27 - May 29, 2014

TIDE STATION USED: 842-3898 Fort Point, NH
Lat. 43° 04.3'N Long. 70° 42.7' W
PLANE OF REFERENCE (MEAN LOWER LOW WATER): 0.000 meters
HEIGHT OF HIGH WATER ABOVE PLANE OF REFERENCE: 2.735 meters

REMARKS: RECOMMENDED ZONING Preliminary zoning is accepted as the final zoning for project OPR-A321-FH-2014, H12697, during the time period between April 27 - May 29,2014.

Please use the zoning file A321FH2014CORP submitted with the project instructions for OPR-A321-FH-2014. Zones NA157 and NA168 are the applicable zone for H12697.

Refer to attachments for zoning information.

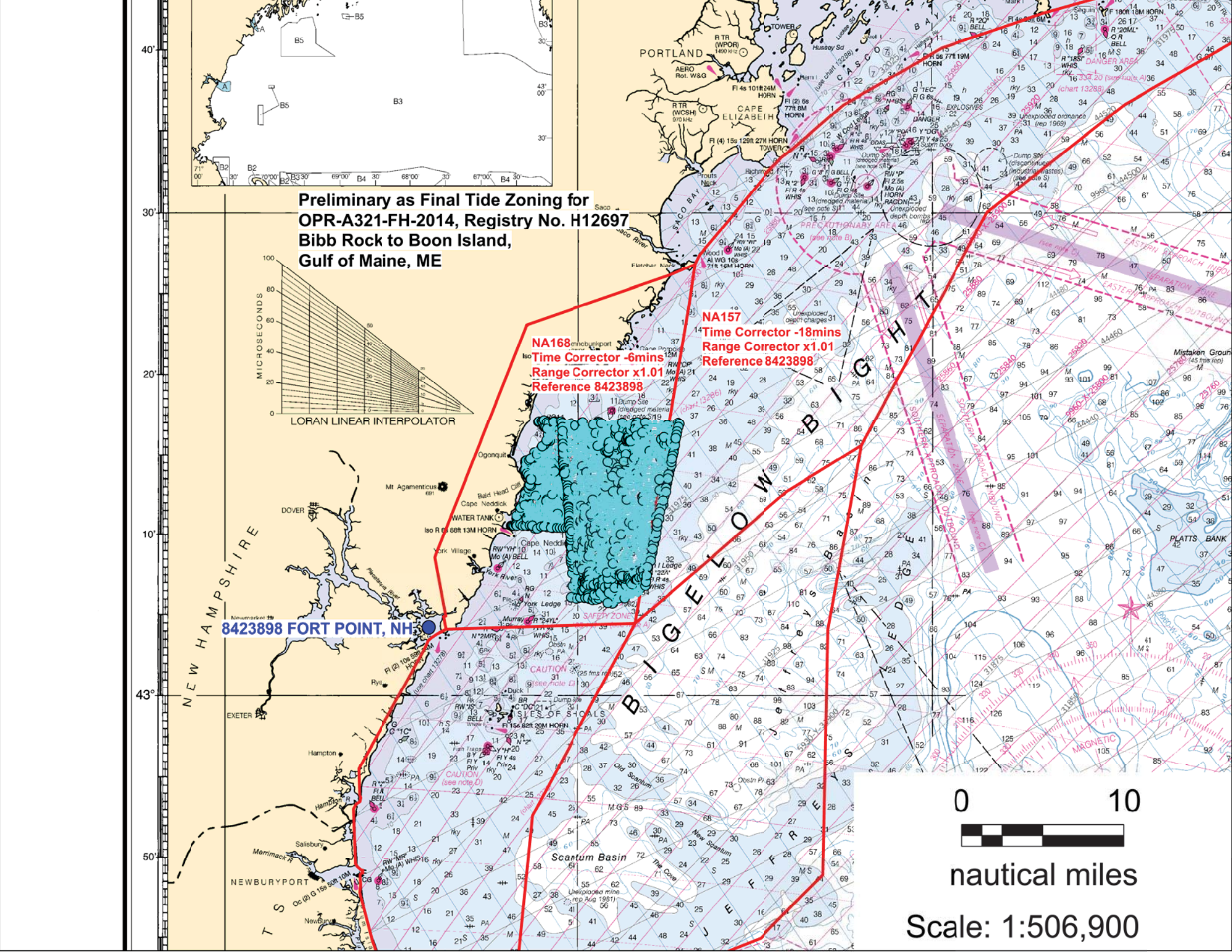
Note 1: Provided time series data are tabulated in metric units (meters), relative to MLLW and on Greenwich Mean Time on the 1983-2001 National Tidal Datum Epoch (NTDE).

Note 2: Annual leveling for Fort Point, NH (8423898) was not completed in FY13. A review of the verified leveling records from October 2002 - 2012 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-A321-FH-2014, H12697. 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.

BURKE.PATRICK.B.1365830335

Digitally signed by BURKE.PATRICK.B.1365830335
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=OTHER, cn=BURKE.PATRICK.B.1365830335
Date: 2014.06.16 13:08:27 -04'00'

ACTING CHIEF, OCEANOGRAPHIC DIVISION


Preliminary as Final Tide Zoning for
OPR-A321-FH-2014, Registry No. H12697
Bibb Rock to Boon Island,
Gulf of Maine, ME
NA168
Time Corrector -6mins
Range Corrector x1.01
Reference 8423898
NA157
Time Corrector -18mins
Range Corrector x1.01
Reference 8423898
8423898 FORT POINT, NH
LORAN LINEAR INTERPOLATOR
MICROSECONDS
BIGELOW BIGHT
NEW HAMPSHIRE
PORTLAND
CAPE ELIZABETH
DOVER
EXETER
NEWBURYPORT
Scantum Basin
PLATTS BANK
0
10
nautical miles
Scale: 1:506,900

APPENDIX II

SUPPLEMENTAL SURVEY RECORDS AND CORRESPONDENCE

Subject: Re: LNM Announcements for 2014 Projects
From: FOO <ops.ferdinand.hassler@noaa.gov>
Date: 3/27/2014 11:54 AM
To: Brent Pounds - NOAA Federal <brent.pounds@noaa.gov>
CC: "CO.Ferdinand Hassler - NOAA Service Account" <CO.Ferdinand.Hassler@noaa.gov>

Brent,

Thanks for putting the LNM together. These look good to me.

V/R,
Adam

On 3/27/2014 4:28 AM, Brent Pounds - NOAA Federal wrote:

> All,
>
> See attached for the LNM announcements I put together for the 2014 projects. If you could please look them over and provide any corrections or comments, I would appreciate it. I want to get these running in the LNM and forwarded to the lobstermen's associations soon.
>
> V/R,
> -Brent
> ---
> LCDR Brent Pounds, NOAA
> Navigation Manager, Northeast Region
> Office of Coast Survey
> Navigation Services Division
> 28 Tarzwell Drive
> Narragansett, RI 02882
> Tel: 401-782-3252
> Cel: 401-545-0174
> Fax: 401-782-3292
> nauticalcharts.noaa.gov

--
Field Operations Officer, NOAA Ship Ferdinand R. Hassler
29 Wentworth Road
New Castle, NH, 03854

OPS.Ferdinand Hassler - NOAA Service Account <ops.ferdinand.hassler@noaa.gov>

Hassler trackline request for August/September 2013

Meghan McGovern - NOAA Federal <meghan.mcgovern@noaa.gov> Wed, Jun 11, 2014 at 7:32 PM
To: "OPS.Ferdinand Hassler - NOAA Service Account" <ops.ferdinand.hassler@noaa.gov>
Cc: Brent Pounds - NOAA Federal <brent.pounds@noaa.gov>, John Kidd - NOAA Federal <john.kidd@noaa.gov>

Adam,

As part of the ongoing lobster gear loss issue, I will need the ship's trackline from the beginning of your 2013 'Approaches to Portsmouth' project through 9/14/2013. Basically from the date you started surveying in that location through 9/14. The trackline file from Coastal Explorer should suffice. Thank you.

r,
Meghan

--

Meghan McGovern, LT/NOAA
Office of Coast Survey
Navigation Services Division
28 Tarzwell Drive
Narragansett, RI 02882
Tel: 401-782-3252
Fax: 401-782-3292
nauticalcharts.noaa.gov

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
Office of Coast Survey
Silver Spring, Maryland 20910-3282

July 25, 2014

MEMORANDUM FOR: LCDR Marc S. Moser, NOAA
Commanding Officer, NOAA Ship *Ferdinand Hassler*

FROM: Jeffrey Ferguson
Chief, Hydrographic Surveys Division

SUBJECT: Vertical Datum Transformation Technique,
OPR-A321-FH-14, Approaches to Portsmouth, NH

Hydrographic surveys H12696, H12697 & H12698 are approved for vertical reduction to chart datum, Mean Lower Low Water (MLLW), using the NOAA Vertical Datum Transformation (VDatum) (http://vdatum.noaa.gov) derived separation (SEP) model..

Approval of VDatum, in lieu of the NOAA Center for Operational Oceanographic Products and Services (CO-OPS) discrete zoning package as per the Project Instructions, is based on your recommendation and the review of comparison results you included in your attached email from June 19, 2014.

The results of the data analysis show that ellipsoidally referenced survey (ERS) techniques with VDatum used as the vertical datum reducer meet or exceed horizontal and vertical specifications for hydrographic surveys.

The comparison techniques are in line with the procedures outlined in the NOS Hydrographic Surveys Specifications and Deliverables document.

You shall include a description of your ERS processing procedures and the comparisons you conducted between ERS and traditional tides or prior survey data in the appropriate Descriptive Report (DR), Horizontal and Vertical Control Report and/or Data Acquisition and Processing Report. As appropriate in the DR, document specific vessel day(s) or line(s) that have not been processed using VDatum as the vertical reducer to MLLW where discrete zoning provides better results and/or where vertical uncertainties of your post processed vertical positional data are inaccurate.

Include this memo in the supplemental correspondence Appendix of the DR.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Office of Marine and Aviation Operations
NOAA Ship *Ferdinand R. Hassler* (S-250)
Box 638, New Castle, NH 03854

June 19, 2014

MEMORANDUM FOR: Jeffrey Ferguson
Chief, Hydrographic Survey Branch

FROM: LCDR Marc S. Moser, NOAA
Commanding Officer

TITLE: OPR-A321-FH-14 VDatum Evaluation and Deliverable Recommendation

Ferdinand R. Hassler personnel conducted a comparison of VDatum based Ellipsoid Referenced Survey (ERS) versus discrete tidal zoning vertical transformation techniques using crossline data per the Hydrographic Survey Project Instructions (PI). In addition we conducted comparisons using the difference between crosslines and mainscheme to give a better recommendation on internal consistency. While there are differences between the two data reduction methods, there is no justification to disprove or suspect the VDatum separation model. Results and analysis of the comparison are in the attached report.

When successful, ERS methods generally result in a more internally consistent sounding set. However, we experienced some problems in reliably processing the vessel trajectory relative to the ellipsoid. From our findings documented in this report we recommend that all surveys be reduced to MLLW via VDatum with the occasional line containing a poor GPS height solution being corrected by verified discrete tides.

It is understood that upon review of this report, a determination will be made for the final vertical transformation technique to be used to create the final deliverables.

Attachment

Table of Contents

List of Figures

List of Tables

1.0 Introduction

This document is an interim report describing methods and results of the vertical datum analysis component of the vertical control requirements stated in Hydrographic Survey Project Instructions OPR-A321-FH-14 Approaches to New Hampshire (April 30, 2014). The project is located in the vicinity of the Gulf of Maine and includes hydrographic surveys H12696, H12697, and H12698. The Project Instructions require the field unit to recommend the final vertical transformation technique after analyzing crossline data. The recommendations and supporting data included in this report are intended for use by the Hydrographic Surveys Division (HSD) to support the final decision on the use of ellipsoidal-referenced survey (ERS) methods in lieu of traditional tides for final water level correctors for the OPR-A321-FH-14 project.

The basis of this analysis is a comparison of discrete tidal zoning and Vertical Datum Transformation (VDatum) as methods for vertical control. Because discrete tidal zoning is the conventional and accepted method, it is regarded as a baseline for this evaluation.

2.0 Procedure

The VDatum evaluation was conducted according to the instructions in Appendix 1 of the project instructions. Additional guidance, found in the Pydro distribution (Pydro\Lib\site-packages\HSTP\Pydro\PostAcqTools_CompareTSeries.docx), was followed for the direct comparison of data.

Project crossline data were reduced to Mean Lower Low Water (MLLW) via conventional discrete tidal zoning. A second set of crossline data were reduced using VDatum. Time series data for the nadir depth were extracted from both data sets and differenced using the Pydro Post Acquisition Tool.

In addition, CARIS surfaces of crossline and mainscheme data were analyzed using both discrete zoning and VDatum methods. This analysis was used to evaluate the internal consistency of data and detect any spatial trends in the difference that may suggest inconsistencies in the VDatum model.

Survey limits for the areas used in this assessment are shown in Figure 1. The ship acquired data within the limits of H12696, H12697, and H12698.

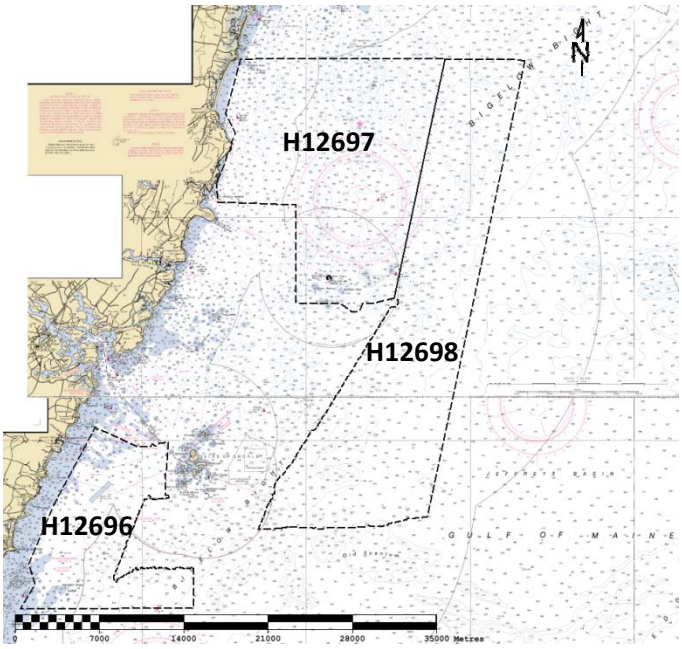


Figure 1: Sheet layout for OPR-A321-FH-14. Sheets H12696, H12697, and H12698 were surveyed by *Ferdinand R. Hassler.*

3.0 Results and Discussion

This report will answer three questions:

- Is the VDatum model correct in the geographic location of this project?
- Is the internal consistency of the data improved by ERS methods?
- What method of vertical control is appropriate for specific surveys?

3.1 VDatum Model Accuracies

To analyze the VDatum model, the separation model .csar file provided by HSD Operations was checked in CARIS BDB. This was examined to assess the overall slope of the model within the survey area. The surface was also inspected for errors that could be the result of inconsistencies within the VDatum model. This surface is shown in Figure 2.

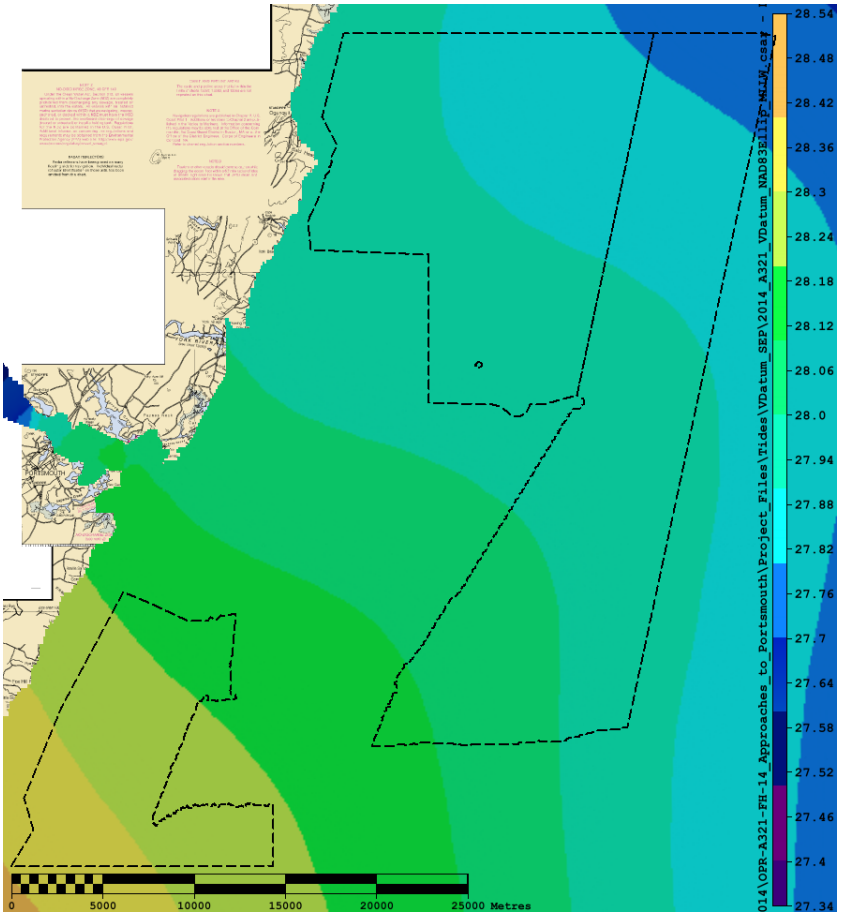


Figure 2: 2014_A321_VDatum_NAD83Ellip_MLLW.csar separation model overlaid with H12696, H12697, and H12698 survey areas. Colored bands correspond to 10 cm intervals.

As illustrated in Figure 2, the separation model is free of gaps and anomalies within the survey limits acquired for OPR-A321-FH-14 (black dashed outline). Overall, the model appears adequate for use within the limits of project OPR-A321-FH-14.

In accordance with Appendix I of the Project Instructions, Pydro's Post Acquisition Tool utility was used to compare the nadir depths from data corrected with VDatum and discrete zoned tides. As shown in Table 1, the average differences range from 0.016 to 0.070 meters. These differences may arise from many different sources including: poor vertical GPS solutions, poor zoning or separation models, errors in dynamic draft values, and loading errors.

XL Discrete - VDatum (PostAcq Tools)		
H12696		
Sonar	**Mean (m)**	**St Dev (m)**
Port 7125	0.061	0.080
Starboard 7125	0.070	0.073
H12697		
Port 7125	0.023	0.063
Starboard 7125	0.016	0.064
H12698		
Starboard 7125	0.022	0.140

Table 1: Results of Pydro Post Acquisition Tool script run on OPR-A321-FH-14.

Water depths within the boundaries of this comparison range from 4 to 160 meters. The total allowable vertical uncertainty in this depth range is between +/- 0.50 and 3.81 meters. Of this total uncertainty, approximately 0.21 meters is budgeted for water level corrections. H12698 has an agreeable mean value but large standard deviation that exceeds the uncertainty budgeted for water level corrections. However, this sheet has the deepest depths of any for project OPR-A321-FH-14 and the larger than normal standard deviation is still well within the total allowable uncertainty.

Additional statistical analyses were performed with a difference surface (discrete tides minus VDatum). This surface was created to examine spatial trends in the data. No discernible trends were observed. Figures 3-5 display the statistical analyses of the differenced surface. 95% of differences for all sheets are less than +/-0.24 meters. Again, H12698 exceeds the budgeted water level uncertainty value, but due to the depths of this survey 95% of nodes are well within IHO total vertical uncertainty values. The differenced surface for H12697 exhibits a bi-modal distribution with a mean value of 0.01 meters (Figure 4). For the purposes of this VDatum evaluation, the bi-modal distribution is not investigated further.

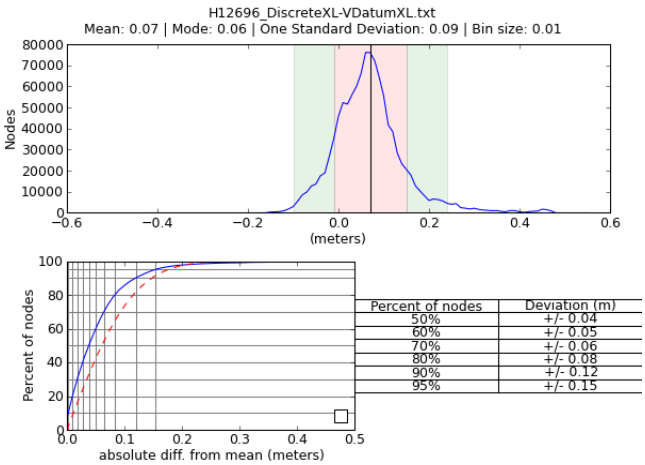


Figure 3: Statistics of the discrete zoned tide crossline surface minus the VDatum crossline surface for H12696.

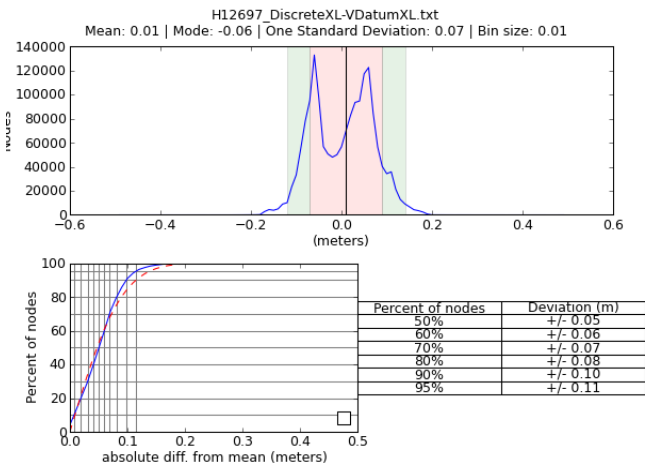


Figure 4: Statistics of the discrete zoned tide crossline surface minus the VDatum crossline surface for H12697.

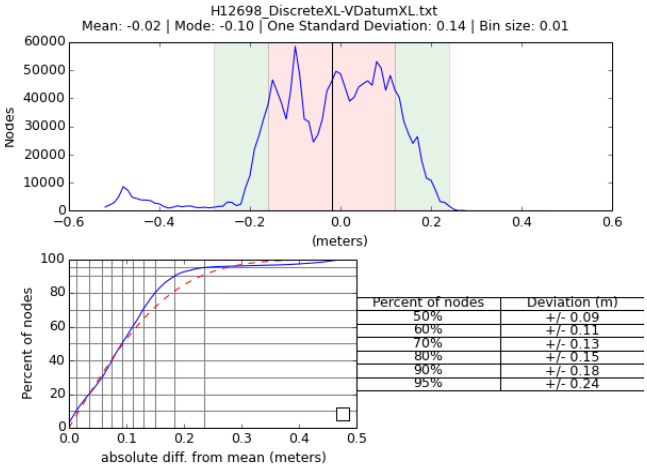
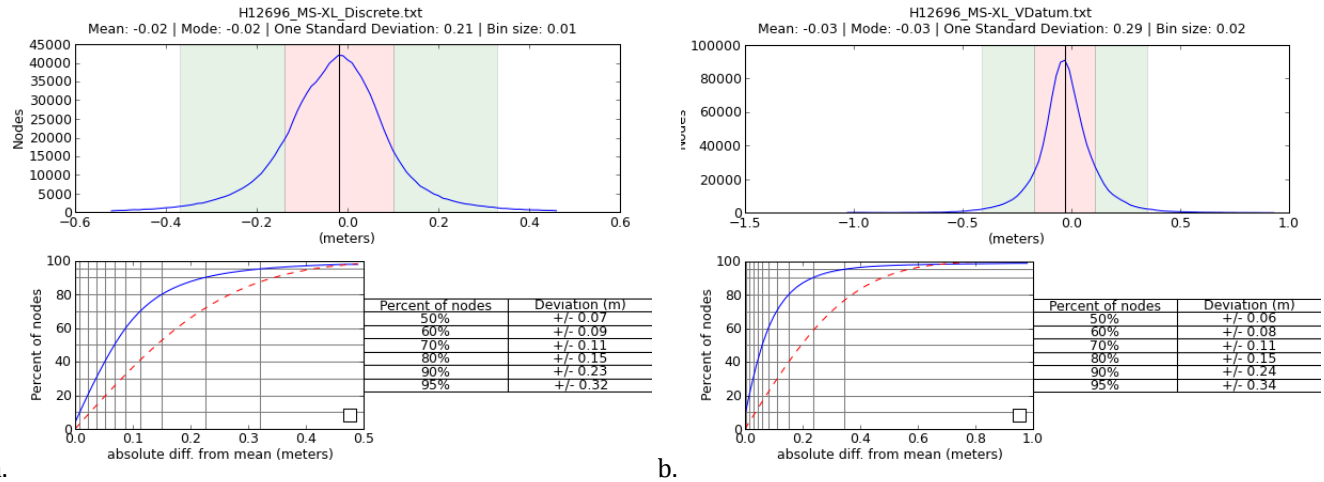


Figure 3: Statistics of the discrete zoned tide crossline surface minus the VDatum crossline surface for H12698.

These results suggest that the VDatum model is accurate for the survey areas conducted during OPR-A321-FH-14.

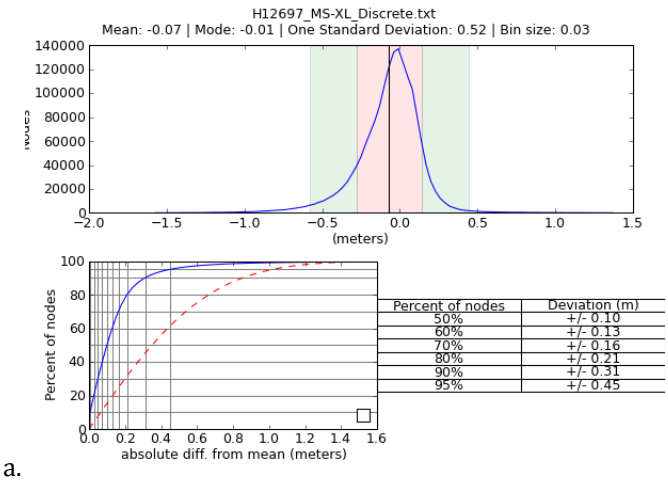
3.2 Data Internal Consistency

To analyze the internal consistency of ERS methods a crossline analysis was completed for all sheets using both discrete zoning and VDatum waterline correctors. The results of these differences are shown in Figures 6-8. At the time of writing this report, the data used for this analysis were not fully processed by the sheet managers. Crosslines were not filtered and all data were not fully cleaned of fliers, both common practice before final submittal of a survey. Each sheet's descriptive report (DR) will have final statistics that could differ greatly than those mentioned in this evaluation. It is likely that the standard deviation will be reduced after cleaning and filtering of crosslines takes place by the sheet managers.

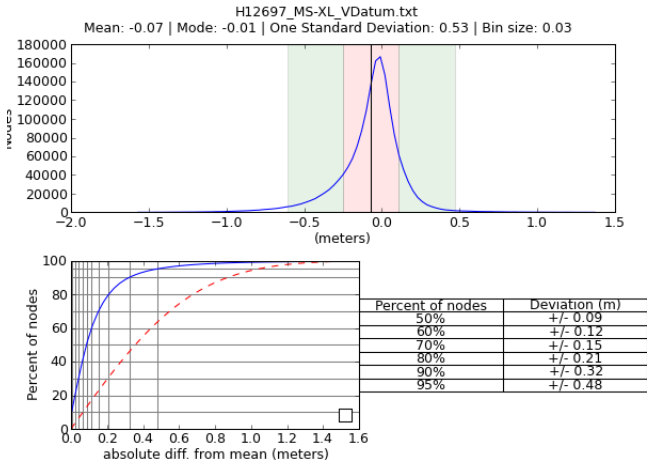


a. b.

Figure 6: Difference statistics for H12696 mainscheme/crossline analysis of data with discrete zoned tides applied (6a) and data with VDatum applied (6b).

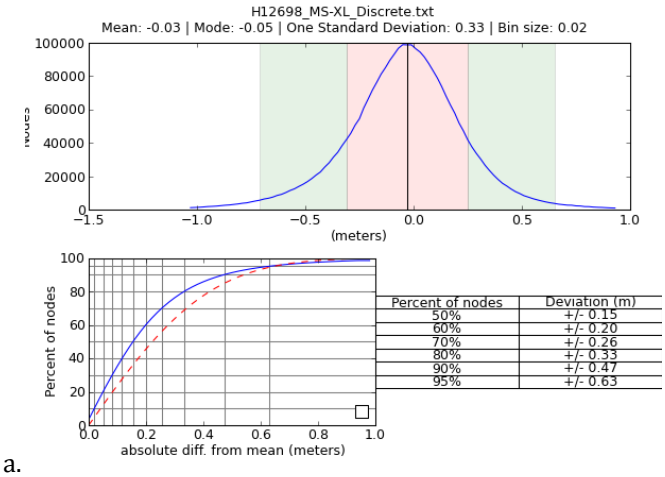


a.

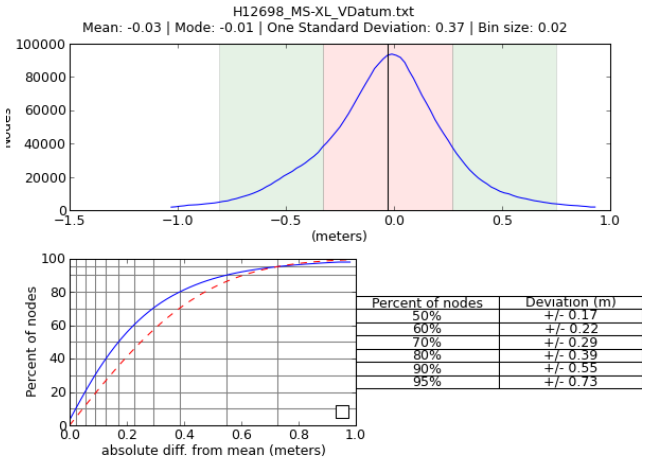


b.

Figure 7: Difference statistics for H12697 mainscheme/crossline analysis of data with discrete zoned tides applied (7a) and data with VDatum applied (7b).



a.



b.

Figure 8: Difference statistics for H12698 mainscheme/crossline analysis of data with discrete zoned tides applied (8a) and data with VDatum applied (8b).

The results show that discrete zoned tides have marginally better internal consistency of the data. As seen in Figures 6-8, mean values show a difference of up to 0.01 meters with a standard deviation of up to 0.08 meters between discrete zoned and VDatum reduced data. The largest differences were noticed on H12696, Figure 6.

A quick investigation of H12696 showed at least one large GPS height anomaly, shown in Figure 9. Errors in the calculated GPS Tide cause the standard deviation value to be larger than expected. The “ramping” illustrated in this example show a line that will likely need to be reduced using discrete zoned tides due to a poor GPS height solution.

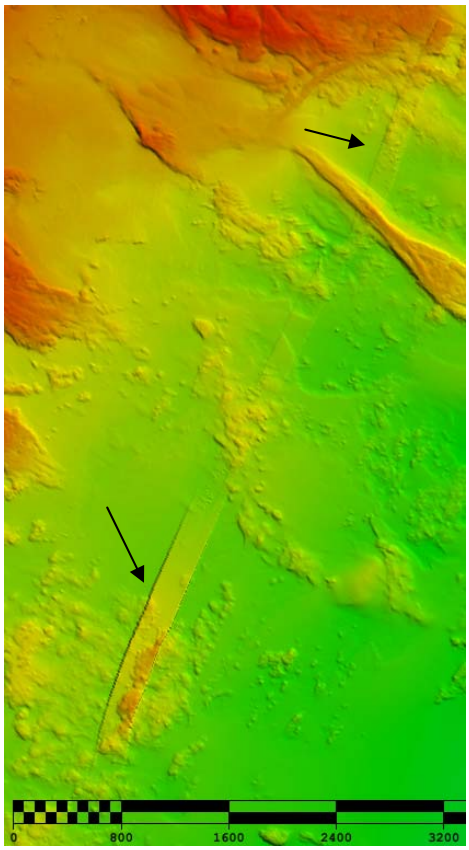


Figure 9: Vertical GPS height anomaly "ramping" seen in survey H12696.

4.0 Discussion

Comparison between discrete tides and VDatum indicate that the VDatum model for this area accurately reduces the data to mean lower low water (MLLW). In addition, the quality of internal consistency for VDatum is equivalent to discrete zoned tides. We believe the VDatum model for this area to be accurate.

Post-processed solutions were not consistently accurate for the entirety of OPR-A321-FH-14. After SBET application, some lines exhibited unrealistic vertical offsets during periods of low positional accuracy.

ERS reduced by VDatum eliminates several sources of vertical errors that can be attributed to traditional tide models and ship water line estimators, such as dynamic draft. An ERS approach is therefore desired when possible. However, ERS and VDatum require good position solutions to be effective. If individual lines contain poor post-processed position solutions, it will be necessary to reduce the line with discrete zoned tides. In all cases, this will thoroughly be discussed in the sheet's descriptive report.

5.0 Recommendation

For all surveys conducted during the course of OPR-A321-FH-14, the comparison between VDatum and discrete zoning is within the acceptable range of uncertainty. Isolated areas of poor post-processed position data will need to be corrected with discrete zoned tides. While internal consistency was better with data reduced by zoned tides, the differences are marginal and it is recommended to apply the VDatum model.

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

APPROVAL PAGE

H12697

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 NGDC for archive

- H12697_DR.pdf
- Collection of depth varied resolution BAGS
- Processed survey data and records
- H12697_GeoImage.pdf

The survey evaluation and verification has been conducted according current OCS Specifications, and the survey has been approved for dissemination and usage of updating NOAA's suite of nautical charts.

Approved:_____

Lieutenant Commander Matthew Jaskoski, NOAA
Chief, Atlantic Hydrographic Branch