H12503

NOAA Form 76-35A

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

DESCRIPTIVE REPORT

Type of Survey:	Navigable Area
Registry Number:	H12503

LOCALITY

State:	Virginia
General Locality:	Approaches to Chesapeake Bay, VA
Sub-locality:	25 NM East of Cape Henry, VA

2012

CHIEF OF PARTY
LCDR Benjamin K. Evans, NOAA

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Date:

NOAA FORM 77-28 (11-72)	U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	REGISTRY NUMBER:

HYDROGRAPHIC TITLE SHEET

H12503

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:	**Virginia**
General Locality:	**Approaches to Chesapeake Bay, VA**
Sub-Locality:	**25 NM East of Cape Henry, VA**
Scale:	**40000**
Dates of Survey:	**09/23/2012 to 12/13/2012**
Instructions Dated:	**03/02/2012**
Project Number:	**OPR-D304-FH-12**
Field Unit:	**NOAA Ship *Ferdinand R. Hassler***
Chief of Party:	**LCDR Benjamin K. Evans, NOAA**
Soundings by:	**Multibeam Echo Sounder**
Imagery by:	**Side Scan Sonar, Multibeam Echo Sounder Backscatter**
Verification by:	**Atlantic Hydrographic Branch**
Soundings Acquired in:	**meters at Mean Lower Low Water**

Remarks:

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/.

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Descriptive Report to Accompany Survey H12503

Project: OPR-D304-FH-12

Locality: Approaches to Chesapeake Bay, VA

Sublocality: 25 NM East of Cape Henry, VA

Scale: 1:40000

September 2012 - December 2012

NOAA Ship *Ferdinand R. Hassler*

Chief of Party: LCDR Benjamin K. Evans, NOAA

A. Area Surveyed

A.1 Survey Limits

Data was acquired within the following survey limits:

Northeast Limit	Southwest Limit
36.9339166667 N 75.3016638889 W	36.7845305556 N 75.5026277778 W

Table 1: Survey Limits

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

A.2 Survey Purpose

The primary purpose of this project is to support safe navigation through the acquisition and processing of hydrographic data for updating the National Ocean Service's (NOS) nautical charting products.

A.3 Survey Quality

The entire survey is adequate to supersede previous data.

A.4 Survey Coverage

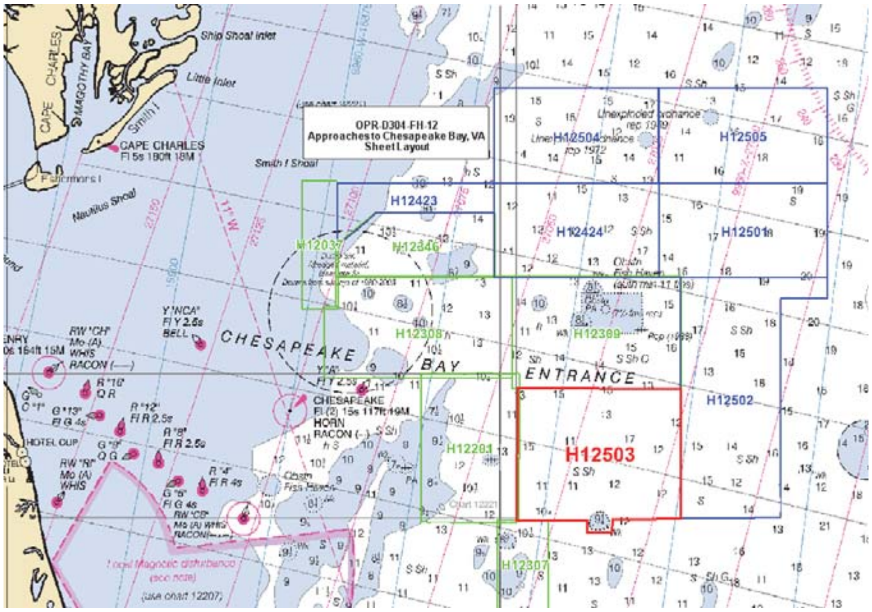


Figure 1: Survey layout for OPR-D304-FH-12 plotted over raster chart 12200_1.

100% Object Detection multibeam was used as the primary method for satisfying the coverage requirement with the exception of the following discrepancies;

There are a few small coverage holidays located throughout sheet H12503. These holidays are the result of either no collected data or poor quality data being rejected by the hydrographer.

The along track density of the 0.50-meter resolution grid has several low density areas because the range scale of the Reson was not adjusted during acquisition. Some areas of the 0.50 meter surface do not meet object detection data density requirements. However, the absence of significant features in areas of the 0.50 meter surface where density requirements were fully satisfied, suggest a very low probability of undetected or unrecognized significant features in those areas where data density was the threshold.

200% Side Scan was also acquired in the vicinity of the charted wreck (AWOIS #14919) at the southern extent of this sheet.

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	857.36	857.36
	Lidar Mainscheme	0	0
	SSS Mainscheme	0	0
	SBES/MBES Combo Mainscheme	0	0
	SBES/SSS Combo Mainscheme	0	0
	MBES/SSS Combo Mainscheme	9.01	9.01
	SBES/MBES Combo Crosslines	38.63	38.63
	Lidar Crosslines	0	0
Number of Bottom Samples			8
Number of DPs			0
Number of Items Items Investigated by Dive Ops			0
Total Number of SNM			53.53

Table 2: Hydrographic Survey Statistics

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

Survey Dates
09/24/2012
09/25/2012
09/26/2012
09/27/2012
09/28/2012
09/29/2012
10/10/2012
10/15/2012
12/13/2012

Table 3: Dates of Hydrography

Survey lines were run with a dual-head multibeam echo sounder. LNM for the dual-head system was calculated using statistics from the starboard head. Development lines were considered to be mainscheme lines.

A.6 Shoreline

The survey area is offshore and no shoreline investigation was required in the project instructions.

A.7 Bottom Samples

Bottom samples were taken to adequately sample the different bottom types apparent in the backscatter mosaic. Eight bottom samples were taken within the limits of sheet H12503. All bottom samples received S-57 attribution and are included in the submitted final feature file (FFF).

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. 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	3.85 meters

Table 4: Vessels Used

NOAA ship FERDINAND R. HASSLER (S250) acquired all data within the limits of H12503.

B.1.2 Equipment

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

Manufacturer	Model	Type
Sea Bird	MicroTSG 45	Sound Speed System
Klein	5000V2	SSS
Brooke Ocean	MVP-30	Sound Speed System
Hemisphere	MBX-4	Positioning System
Applanix	POS M/V 320 V4	Positioning and Attitude System
Reson	7125	MBES
AML	MicroCTD	Conductivity, Temperature and Depth Sensor
AML	Smart SV & P	Sound Speed System

Table 5: Major Systems Used

B.2 Quality Control

B.2.1 Crosslines

A geographic plot of crosslines is shown in Figure 2. 38.63 nautical miles of crosslines were acquired. This accounts for 4.46% of mainscheme distance which satisfies NOS Specifications and Deliverables (2012). Crosslines were filtered to remove soundings greater than 45 degrees from nadir. To evaluate crossline agreement, two 1 meter surfaces were created: one from the cross line 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 cross line surfaces are shown in Figure 3. The average difference between the surfaces is 0.01 meters; 95% of all differences were less than 0.11 meters.

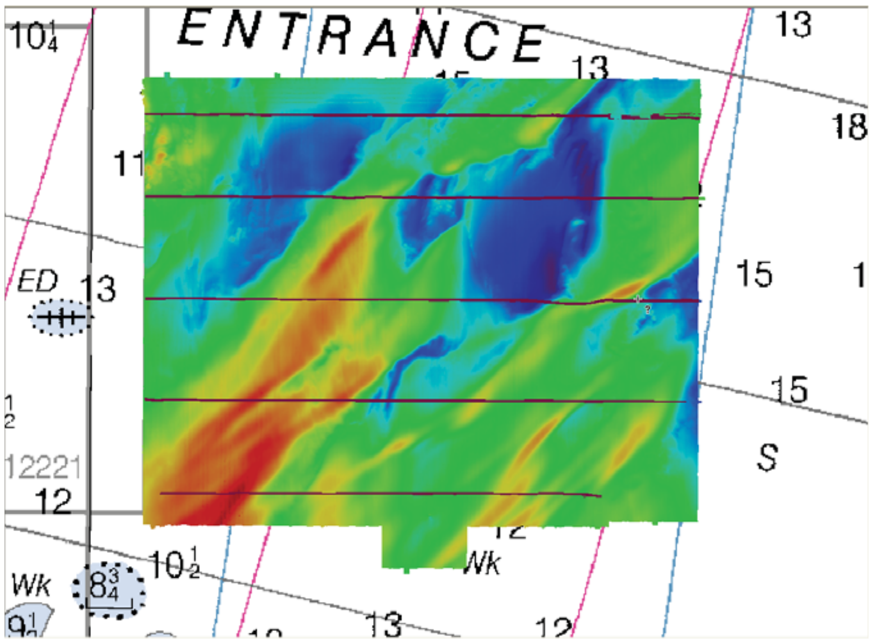


Figure 2: Difference surface between mainscheme and crosslines (magenta lines) overlaid onto the 1-meter MBES surface.

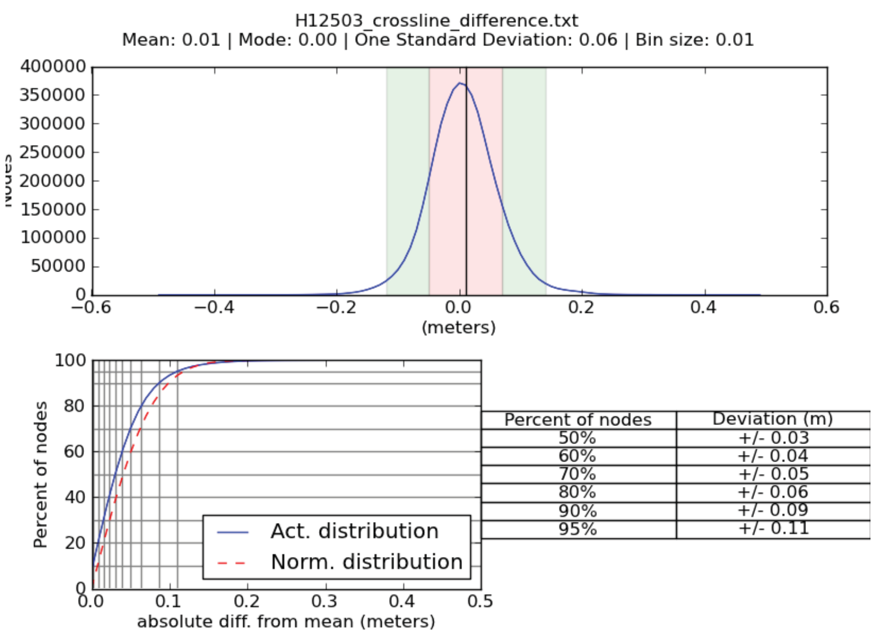


Figure 3: Statistical analysis of the mainscheme and crossline difference surface.

B.2.2 Uncertainty

The following survey specific parameters were used for this survey:

Measured	Zoning
0.01meters	0.081meters

Table 6: Survey Specific Tide TPU Values

Hull ID	Measured - CTD	Measured - MVP	Surface
S250	1.0meters/second	1.0meters/second	0.5meters/second

Table 7: Survey Specific Sound Speed TPU Values

The zoning value used was based upon VDatum uncertainty in the area was and provided in the project instructions.

In the finalized bathymetry surfaces, the uncertainty of the node is estimated as the higher of either the standard deviation or propagated uncertainty of the node. Using the create custom layer tool in CARIS HIPS, this estimated survey uncertainty was compared to the allowed total vertical uncertainty (TVU) defined in section 5.1.3 of the HSSD for each grid node. For both the 0.5 meter and 1-meter surfaces, 100% of all nodes had estimated uncertainty within the allowable TVU. For more detail, see the H12503_Standards_Compliance report submitted in Appendix II of this report. Due to the limitations of the analysis script, the 1-meter surface was split into six sections.

B.2.3 Junctions

The areas of overlap between sheet H12503 and its junction sheets were reviewed in CARIS Subset Editor. The junctioning surfaces were subtracted from the surface of H12503 to assess sounding consistency.

The following junctions were made with this survey:

Registry Number	Scale	Year	Field Unit	Relative Location
H12502	1:40000	2012	NOAA Ship FERDINAND R. HASSLER	E
H12201	1:40000	2011	NOAA Ship THOMAS JEFFERSON	NE
H12307	1:40000	2011	NOAA Ship THOMAS JEFFERSON	S
H12309	1:40000	2011	NOAA Ship THOMAS JEFFERSON	W

Table 8: Junctioning Surveys

H12502

This survey is from project OPR-D304-FH-12. The location is shown in Figure 4. H12503 and H12502 had minimal overlapping nodes due to poor planning during acquisition on sheet H12502. Of the overlapping nodes the average difference is -0.01 meters with a standard deviation of 0.06 meters. 95% of all differences were less than +/- 0.12 meters, as shown in Figure 5.

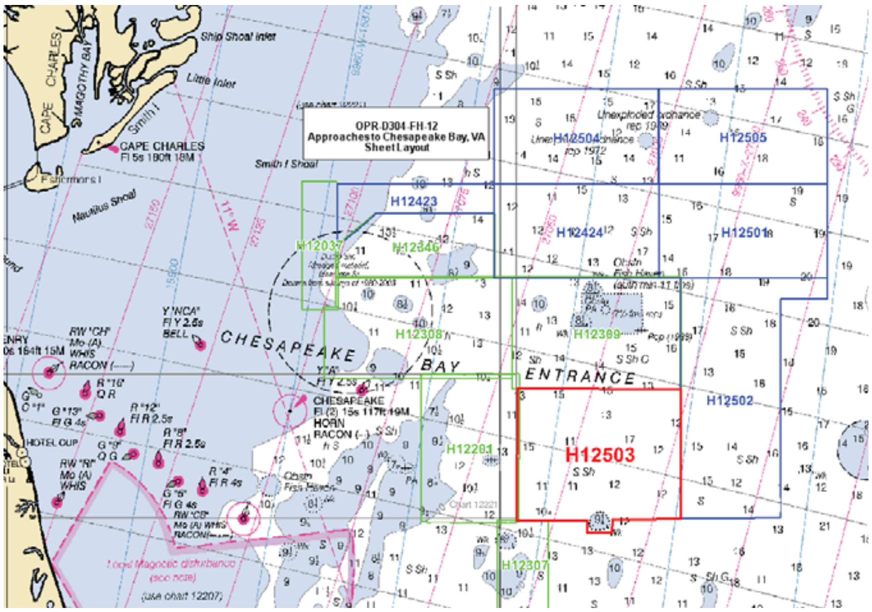
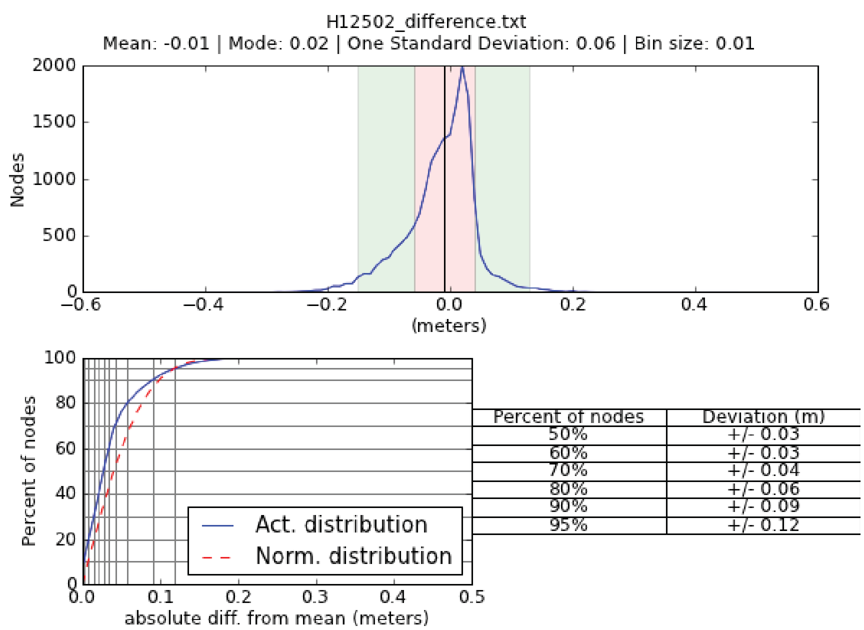


Figure 4: H12503 Junctions.



Percent of nodes	Deviation (m)
50%	+/- 0.03
60%	+/- 0.03
70%	+/- 0.04
80%	+/- 0.06
90%	+/- 0.09
95%	+/- 0.12

Figure 5: Difference surface statistics computed for the difference surface of H12503 minus H12502.

H12201

This survey is from project OPR-D304-TJ-10. The location is shown in Figure 4. The average difference is -0.08 meters with a standard deviation of 0.08 meters. 95% of all differences were less than +/- 0.15 meters, as shown in Figure 6.

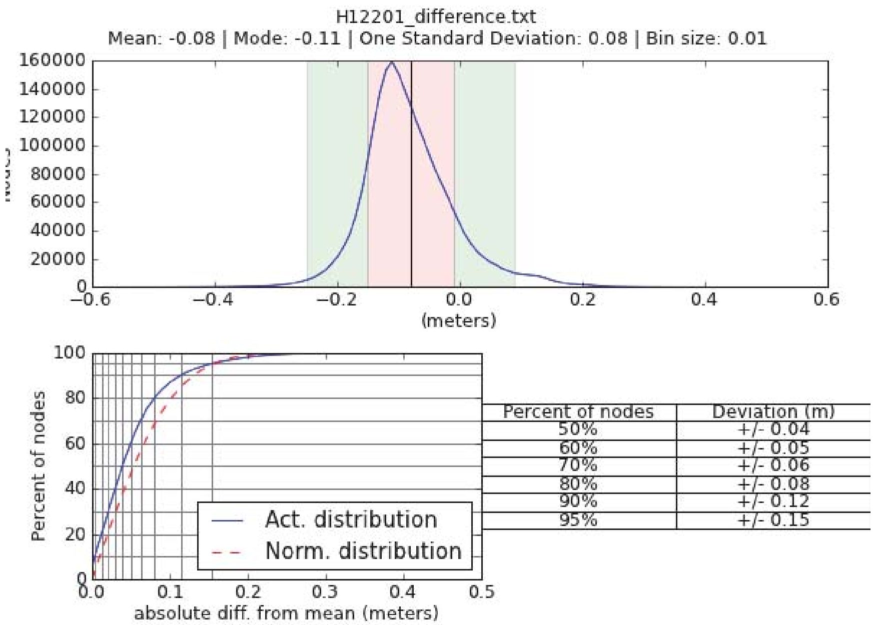


Figure 6: Difference surface statistics computed for the difference surface of H12503 minus H12201.

H12307

This survey is from project OPR-D304-TJ-11. The location of is shown in Figure 4. The average difference is -0.05 meters with a standard deviation of 0.10 meters. 95% of all differences were less than +/- 0.21 meters, as shown in Figure 7.

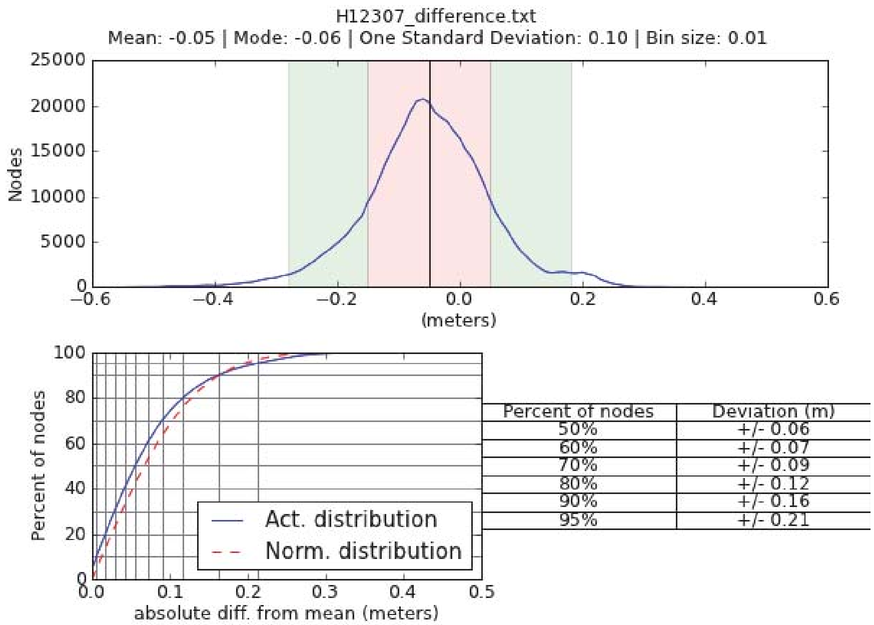


Figure 7: Difference surface statistics computed for the difference surface of H12503 minus H12307.

H12309

This survey is from project OPR-D304-TJ-11. At the time of this report, H12309 was in the survey acceptance process at Atlantic Hydrographic Branch and was not available for comparison.

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

B.2.5.1Outer Beam Errors

In sheet H12503, to free the acquisition watchstander for processing, the range scale of the multibeam was set to 75 meters for most of the sheet. In deeper areas this lead to the outer beams being truncated before the sea floor. In these areas the soundings from the outer beams arc up from the sea floor. The data from these outer beams is consistently shallower than nadir depth values (Figure 8). Outer beam artifacts seen in the grid were edited out manually using CARIS Subset Editor, and do not have a significant effect on the soundings in the final grids. This error is particularly evident when viewing the standard deviation layer. Figure 9 shows the high standard deviation at outer beams. These errors are more apparent in the deeper areas in the northern section of the sheet (Figure 10).

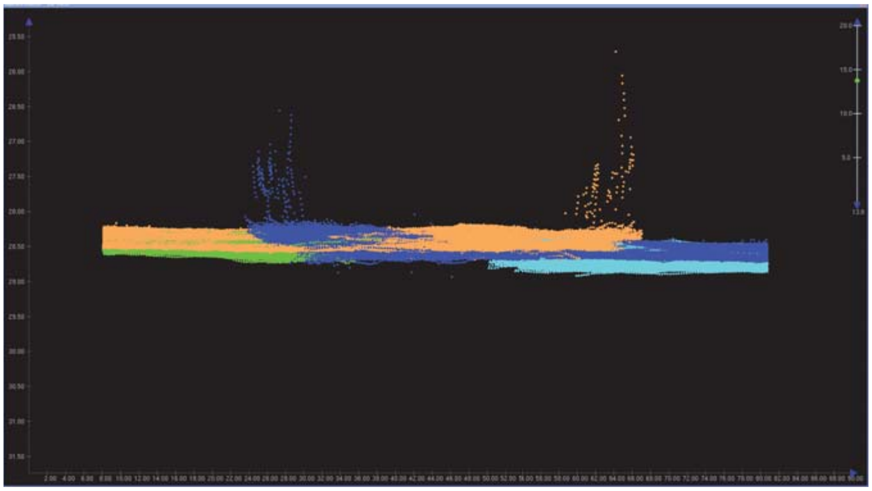


Figure 8: An example of the outer beam errors in CARIS Subset Editor.

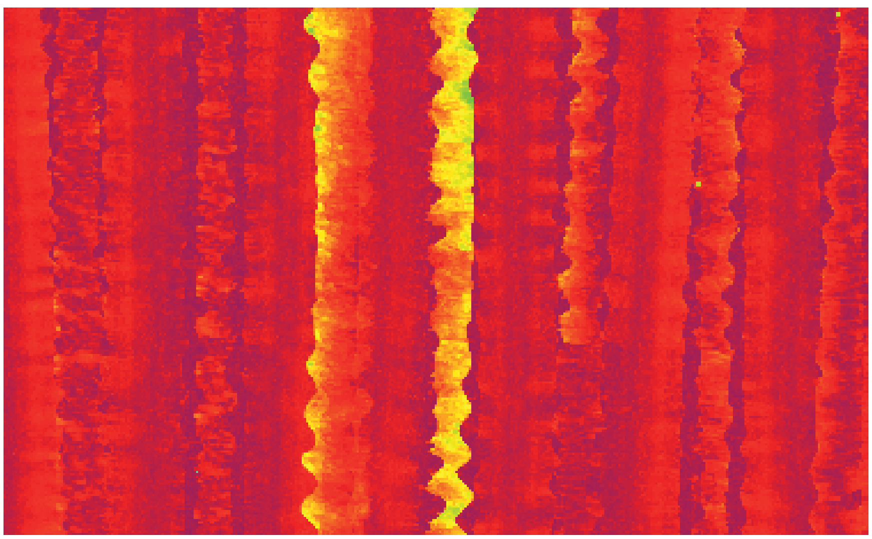


Figure 9: An example of high standard deviation at outer beams of survey H12503.

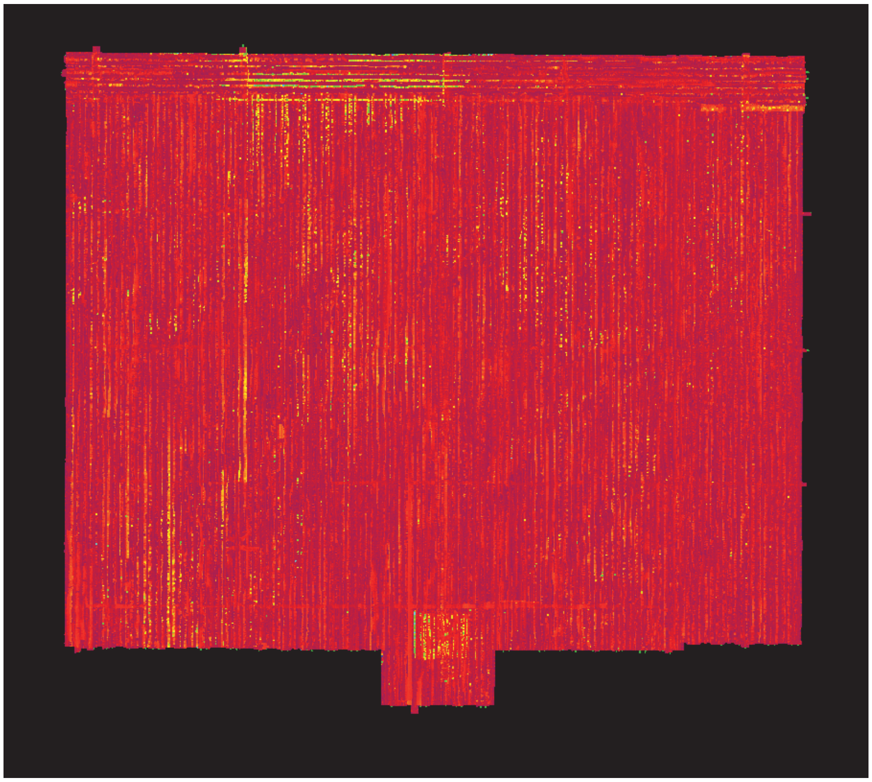


Figure 10: Overview of the standard deviation layer of the 1-meter CUBE surface of H12503. A high standard deviation can be seen in the Northern section of the grid.

B.2.5.1Cast-by-Cast Field Calibration of MVP Sound Speed Sensor

Before the start of acquisition on H12503, the MVP sound velocity sensor (SN: 5466) was examined and found to be in need of repair. The base of the three rods supporting the sound speed chamber of the sing-around system were rusted and two of the three screws holding the reflector to the rods were loose. The assembly was dissembled, cleaned of rust, and reassembled with new screws and thread-lock compound.

On Dn270 the sound speed sensor was again loose, and the sensor was disassembled, cleaned and reassembled.

While these in-house repairs improved the stability of the sensor, the length of the rod was changed, and unknown. The sensitivity of the instrument is such that a difference in length of less than 0.10 mm could cause a sound speed change of over 1m/s. Therefore, the instrument was considered out of calibration.

The repaired sensor was used for acquisition on all days except for Dn289 and Dn348 and verified against the ship's hull-mounted thermosalinograph (TSG) for each cast. A correction coefficient was calculated by dividing the average sound speed value computed from one minute of TSG data at the time of each MVP cast by the average value of the MVP sound speed sensor within 1m of the TSG intake. The full MVP cast was multiplied by the correction coefficient to correct for any length change in the sound speed chamber.

The Python scripts used for this analysis and a table of the correction coefficient for each cast are included in Separates II. The sound speed values used for this field calibration are shown in Figure 11 and the correction coefficient is shown in Figure 12. SV data on this sheet was within specification once corrections were applied.

A replacement AML Smart SV&P sensor (SN:5466) was installed before acquisition on Dn285. This sensor was confirmed to be within specification by a comparison cast with the SeaBird 19+ CTD. No other corrections were made to the sound speed.

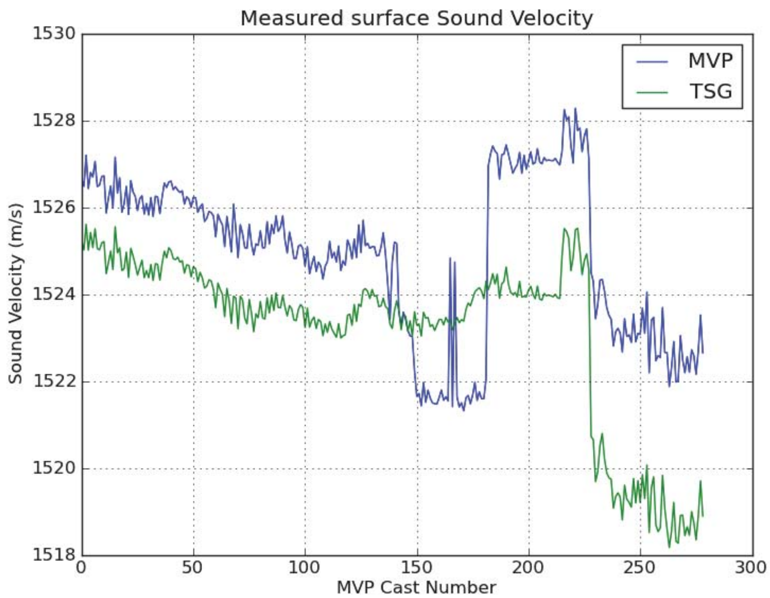


Figure 11: Sound speed at 4 meters depth from MVP and TSG at each MVP cast. The sensor was dissembled, cleaned and reassembled at cast 225.

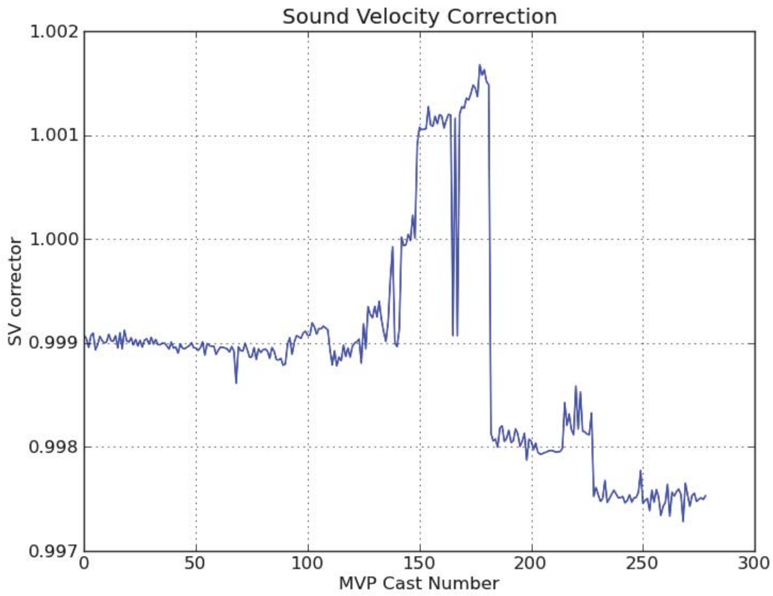


Figure 12: Correction coefficient calculated from the ratio of TSG sound speed to MVP sound speed. The MVP data for each cast was multiplied by this coefficient.

B.2.5.1Applanix Trueheave dropouts

The Ethernet logged POS file used for Trueheave had gaps in the IMU data for three lines. Because CARIS linearly interpolates across a gap in the data record, these data gaps resulted in large heave errors in the corrected soundings. An example of this interpolation across a data gap and the bathymetric effect is show in Figure 13 and Figure 14. These data gaps occurred during the following lines:

Port-
Dn284_063428

Starboard-
Dn 267_190804
Dn269_025333

The data gaps were corrected by application of the concurrently logged internal POS file. The internal POS file is submitted under the survey's RAW data in addition to the Ethernet logged files in these cases. Following these corrections, the large heave artifacts caused by these data gap are completely eliminated.

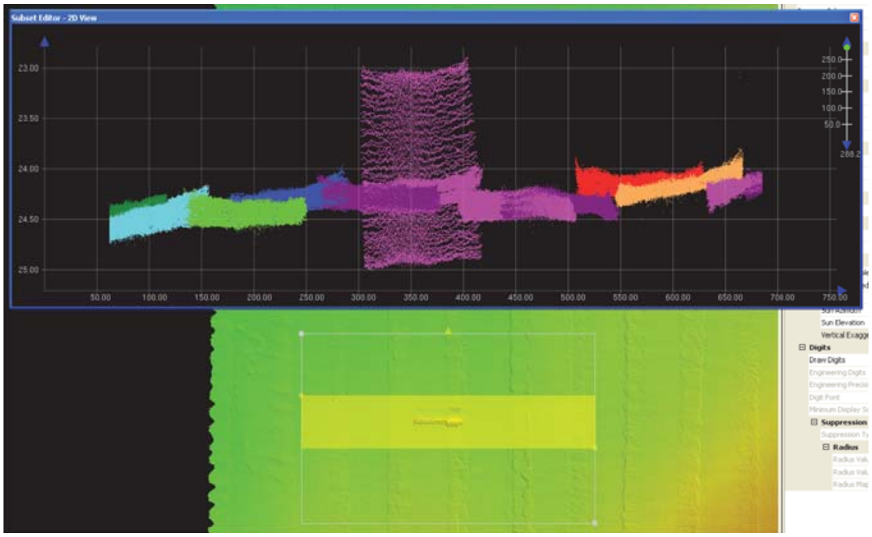


Figure 13: Trueheave gaps in H12503.

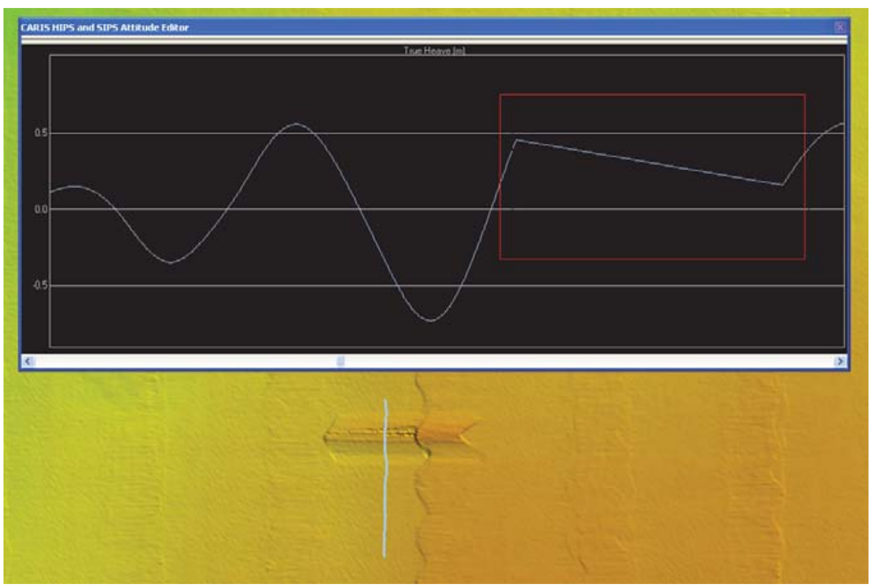


Figure 14: Trueheave gaps found in H12503 before correction. The red box indicates the interpolated section.

B.2.6 Factors Affecting Soundings

B.2.6.1 None Exist

There were no other factors that affected corrections to soundings.

B.2.7 Sound Speed Methods

Sound Speed Cast Frequency: Casts were taken approximately every 20 minutes. Casts were taken more often due to more frequent changes in water density.

The sound speed correction method of nearest in distance within time of one hour was used for all days of the survey except for Dn270_204050 and Dn284_19373 which used nearest in distance within time of two hours. The area within sheet H12503 has a complex sound velocity regime. MVP casts were taken more frequently than every 20 minutes with the assumption that more SV casts would give a more accurate estimation of the overall sound velocity profile. Once these casts were viewed in Fledermaus it was clear that a steep gradient in sound speed existed near the seabed, and that some casts were not taken deep enough to intersect that gradient. This resulted in sound speed errors to soundings when viewed in CARIS Subset Editor. A script was written to analyze the sound velocity casts and eliminate those that did not reach the gradient. These casts were rejected and are not included with the concatenated file or in either the submitted raw or processed sound speed profiles.

B.2.8 Coverage Equipment and Methods

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

B.2.9 Interpolation of GPS Tide Errors Using SBETs

In limited areas throughout the survey, errors in the GPS-derived vertical position solution led to vertical errors in the associated soundings. These altitude errors were located by examining the surface for areas of high standard deviation. Figure 15 shows an area of high standard deviation caused by altitude errors before correction. CARIS Subset editor and Attitude editor were used to isolate the error in these cases to a GPS height error.

These errors are most apparent in the “GPS Tide” record generated in CARIS. This record is calculated during the “Calculate GPS Tide” process by removing the inertial generated heave record (TrueHeave) from the post-processed GPS height solution (from the applied SBET) and applying the datum-ellipsoid transformation model. The resultant record should contain both the tidal signal and any loading or dynamic draft effects. In cases where there was both an apparent vertical error in the corrected soundings and the GPS Tide record had physically unreasonable jumps or anomalies, the GPS Tide anomalies were rejected in CARIS attitude editor and the resultant gap linearly interpolated. For short duration anomalies contained wholly within the line, this rejection and interpolation could be done simply in altitude editor. Sections of the following lines were handled in this way:

Port:
Dn268 131439
Dn267 050830

Starboard:
Dn268 131439

Dn268 041818
Dn269 161909
Dn269 181746

For lines with GPS tide anomalies extended beyond the end of the line, this simple interpolation approach was not feasible because the heave record, and thus the derived GPS height record, does not extend beyond the end of the line. In these cases, the SBET was reapplied with a ten minute buffer beyond each end of the line. The GPS height was smoothed through application of a 60 second moving average (effectively removing heave without reliance on the inertial data) and the GPS height re-calculated with the smoothed GPS-height. These extended GPS Tide records were then interpolated in a similar fashion as described above. The following lines were corrected in this way:
Starboard:
Dn268 120524 and 152117
Port:
Dn268 131439
Dn269 142919.
Following correction of the GPS Tide record, the lines were remerged. In all cases the vertical error in the soundings was substantially reduced or eliminated.

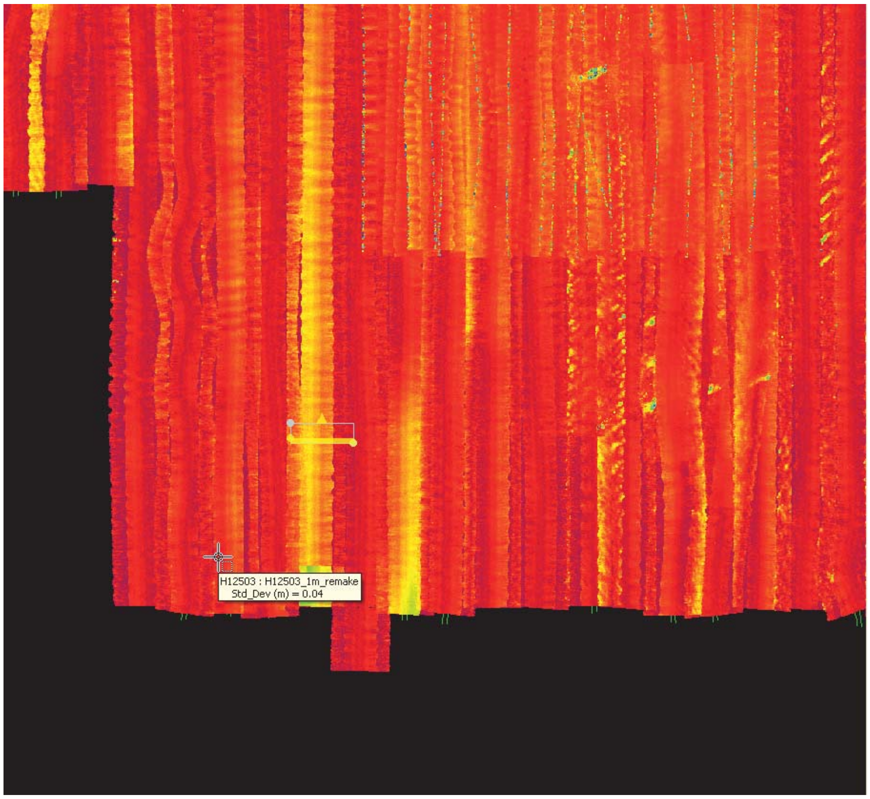


Figure 15: Area of high standard deviation caused by incorrect GPS altitude before correction.

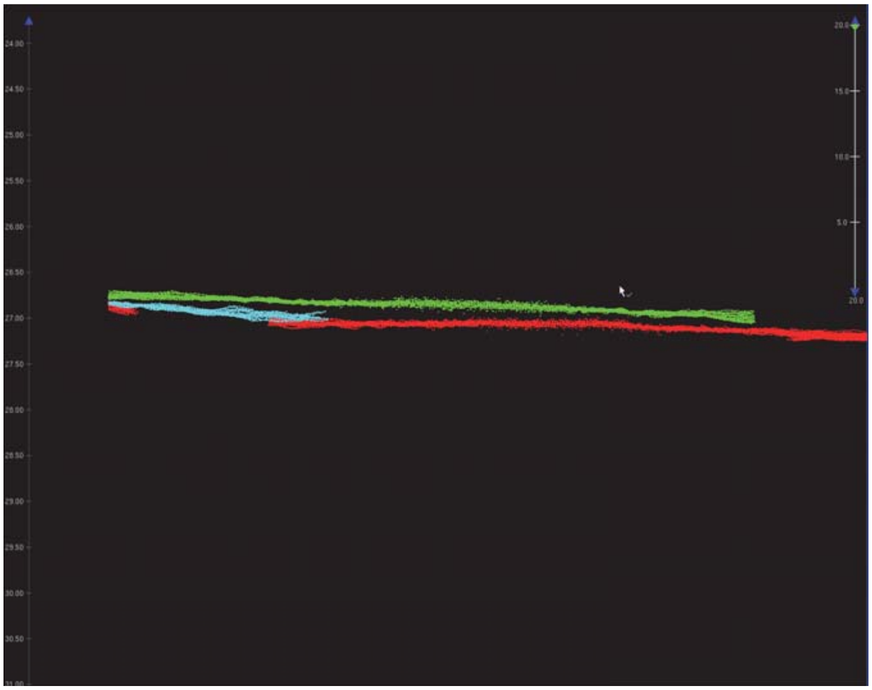


Figure 16: CARIS Subset Editor image. Green line represents a line with a vertical offset before correction.

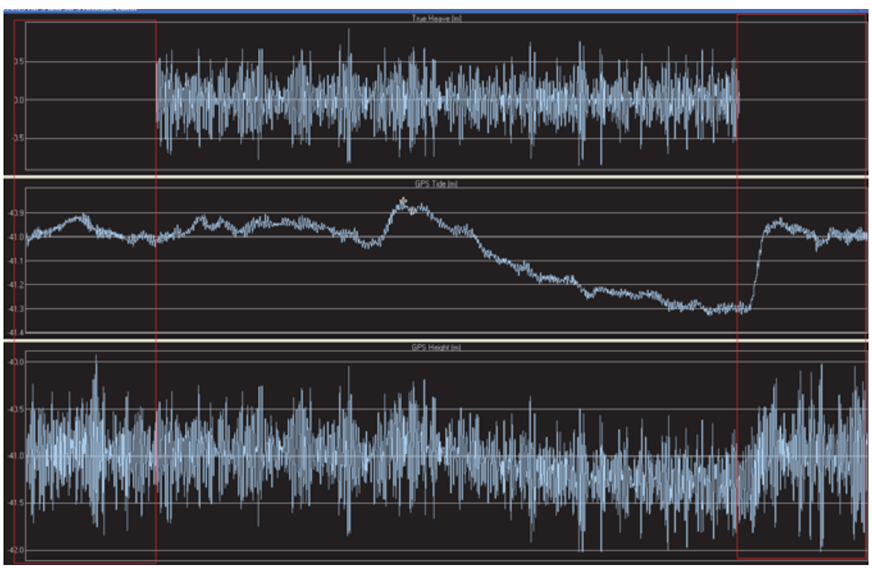


Figure 17: GPS tide (middle box) of line Dn268 131439 before interpolation was made from SBETs. SBET data is indicated by red boxes. Top box is true heave and bottom box is GPS Height which are both used to calculate GPS tide.

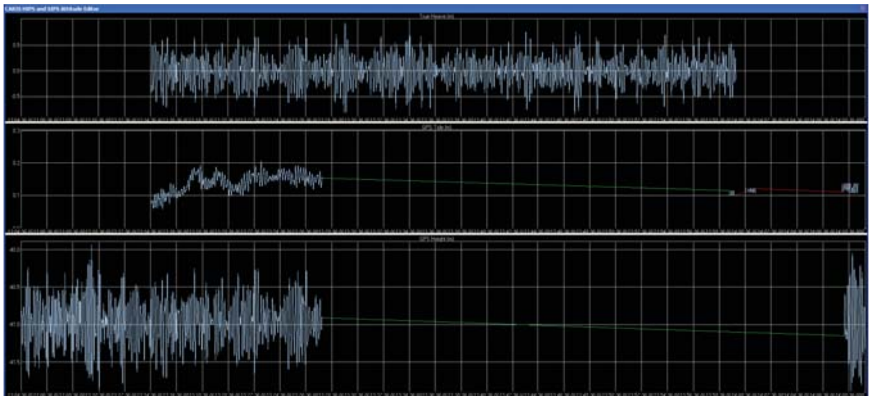


Figure 18: An example of an interpolated GPS Tide line using SBETs.Top box is true heave, bottom box is GPS height and middle box is GPS tide.

B.2.10 Filtering of port line Dn267 123329

Dn267 line 123329 has a number of apparent surface sound speed anomalies at the northern edge of the sheet (Figure 20). These anomalies may have been the result of high sea state during acquisition. In this section, the outer port beams (Beams 1-200) were filtered from this line (Figures 21 and 22). Additional editing was performed in CARIS subset editor to remove the remaining erroneous soundings (Figure 23). Since these sounding edits were made on the far northern edge of the survey, the northern extent of coverage was slightly reduced but no coverage gaps were created.

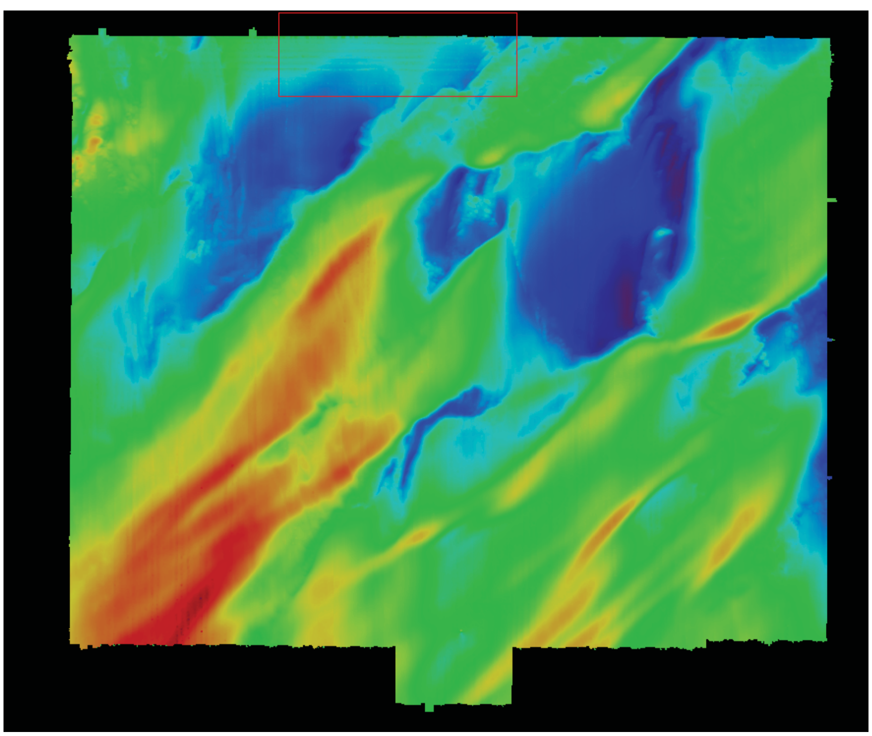


Figure 20: Errors seen at the edge of sheet H12503 seemingly due to a surface sound speed dropout. The problem area is indicated by the red box.

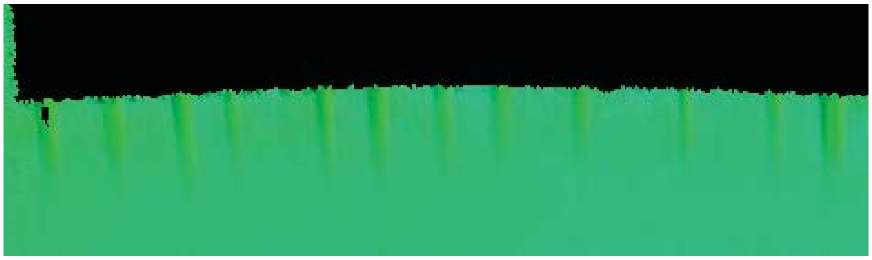


Figure 21: Zoomed in image of 1-meter surface in Figure 20 showing the surface sound speed error before filtering of beams 1-200.

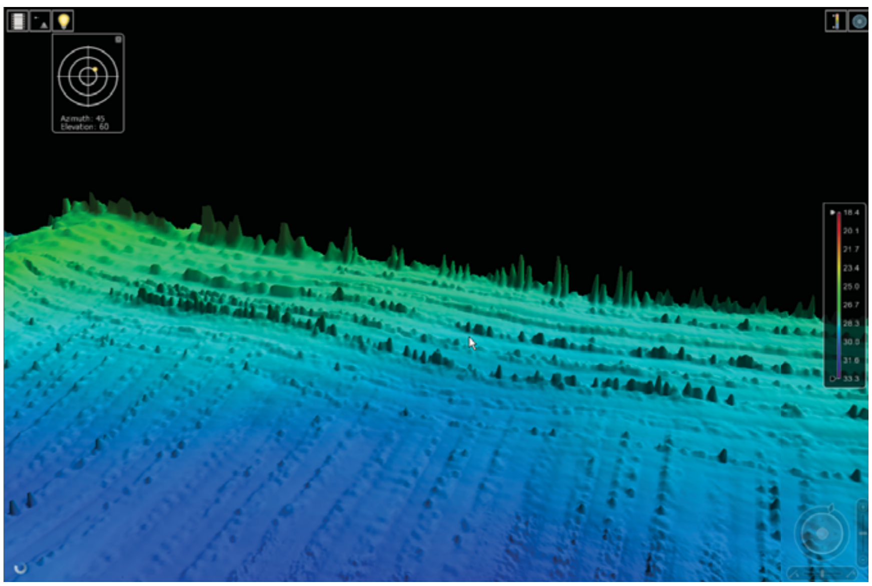


Figure 22: Errors at the Northern edge of sheet H12503 seen in CARIS 3D view mode with a 100 meter exaggeration before filtering of beams 1-200.

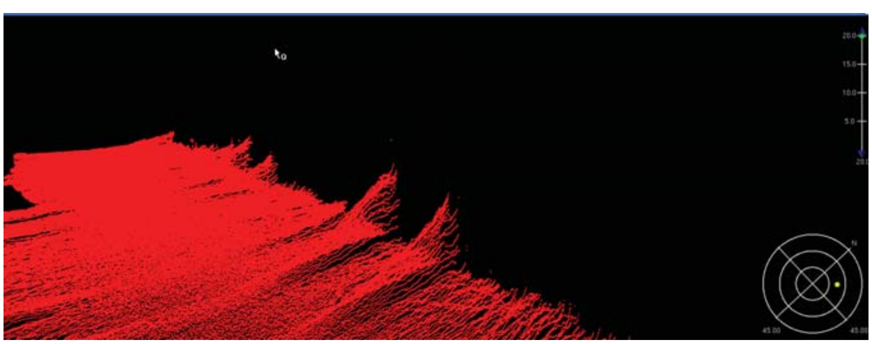


Figure 23: CARIS Subset Editor image at the Northern edge of sheet H12503 before filtering of beams 1-200.

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 H12503. The files were paired with the CARIS HDCS data, imported and processed using Fledermaus Geocoder Toolbox, version 7.3.2b-beta, build 406, 64-bit version.

The GSF files containing the extracted backscatter are submitted with the data in this survey. The processed mosaic is saved as both a geoTiff and a scalar attached to the bathymetric Fledermaus .sd file and is 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: 5.2

CARIS HDCS lines were processed using CARIS HIPS and SIPS 7.1 Service Pack 2.

B.5.2 Surfaces

The following CARIS surfaces were submitted to the Processing Branch:

Surface Name	Surface Type	Resolution	Depth Range	Surface Parameter	Purpose
H12503_50cm_100	SSS Mosaic	0.50 meters	-	N/A	100% SSS
H12503_50cm_200	SSS Mosaic	0.50 meters	-	N/A	200% SSS
H12503_1m	CUBE	1 meters	18.92 meters - 33.28 meters	NOAA_1m	Object Detection
H12503_50cm	CUBE	0.50 meters	18.40 meters - 33.26 meters	NOAA_0.5m	Object Detection
H12503_1m_Final_19plus	CUBE	1 meters	19.0 meters - 33.28 meters	NOAA_1m	Object Detection
H12503_50cm_Final_0to20	CUBE	0.50 meters	18.40 meters - 20 meters	NOAA_0.5m	Object Detection

Table 9: CARIS Surfaces

B.5.3 Missing raw files

Raw BOT file number 29 for Dn270 cannot be located. The processed master concatenated SVP file contains the processed sound velocity information from this file.

C. Vertical and Horizontal Control

Additional information regarding the vertical and 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.

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
Duck, NC	8651370

Table 10: NWLON Tide Stations

File Name	Status
8651370.tid	Verified Observed

Table 11: Water Level Files (.tid)

File Name	Status
D304FH2012CORP.zdf	Final

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

A request for final approved tides was sent to N/OPS1 on 12/19/2012. The final tide note was received on 01/14/2013.

Preliminary zoning is accepted as the final zoning for project OPR-D304-FH-12, H12503, during the entire time period of survey operations.

Non-Standard Vertical Control Methods Used:

VDatum

Ellipsoid to Chart Datum Separation File:

2012_D304_VDatum_Ellip_MLLW.xyz

All soundings being submitted as H12503 are referenced to MLLW reduced by Ellipsoidal methods using the aforementioned Ellipsoid to Chart Datum separation file.

C.2 Horizontal Control

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

The following PPK methods were used for horizontal control:

Smart Base

The following CORS Stations were used for horizontal control:

HVCR Site ID	Base Station ID
Chesapeake Light	COVX
Driver 5	DRV5
Driver 6	DRV6
Loyola	LSO3
Moriches 5	MOR5
Buxton	NCBX
Elizabeth City	NCEL
Cedar Island	NCCI
Duck 3	NCDU
Middle Township	NJCM
Riverhead	NYRH
Gloucester Pt	VAGP

Table 13: CORS Base Stations

DGPS was used for real time positioning.

The following DGPS Stations were used for horizontal control:

DGPS Stations
Driver, Virginia (289kHz)

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
12200	1:419706	50	07/2011	06/28/2011	07/09/2011
12221	1:180000	81	04/2011	04/05/2011	04/09/2011

Table 15: Largest Scale Raster Charts

12200

Survey soundings from H12503 agree with charted depths of raster chart 12200 in all areas except for depths corresponding with the AWOIS item in the Southern portion of the sheet.

12221

H12503 overlaps chart 12201 insignificantly and no chart comparison was performed.

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?
US3DE01M	1:419716	12	10/06/2011	12/15/2011	NO

Table 16: Largest Scale ENCs

US3DE01M

The soundings of survey H12503 are between 0 to 2 meters deeper than the charted depths. As discussed in the AWOIS section below, the depths and location of the AWOIS item do not match the ENC.

D.1.3 AWOIS Items

Number of AWOIS Items Addressed: 1
Number of AWOIS Items Not Addressed: 0

AWOIS item number 14919, the wreck of FRANCIS E. POWELL (Figure 24), is charted in survey area H12503. The POWELL, an American steam tanker, was torpedoed by a German U-boat on January 27th, 1942. Contemporary reports indicate that the ship broke in pieces before sinking. and suggest that this wreck may be a portion which was towed away from the attack site in an unsuccessful salvage attempt.

This wreck was found with MBES, approximately 200m from its charted position, as shown in Figure 25. In addition, 200% Side Scan was acquired in the vicinity of this wreck to look for debris fields or small features protruding from the wreck. None were found.

A sounding was designated to hold the least depth and position of this wreck for charting. The selection of this sounding was guided by a 0.5-meter cube surface in the area. The selected sounding is representative of the most likely 0.5-meter CUBE hypothesis. Soundings from seven lines acquired over three days are consistent with this depth hypothesis. The shallowest sounding over this wreck is from the outer beams line 183728 of Dn284. These outer beam soundings have higher uncertainty and are unsupported by any of additional passes over this feature. Because they do not influence the 1-meter surface in this area, they have not been flagged as rejected.

The hydrographer recommends that the position and depth of this wreck be updated on the affected nautical charts and AWOIS database with the data from the current survey reported in the Final Feature File.

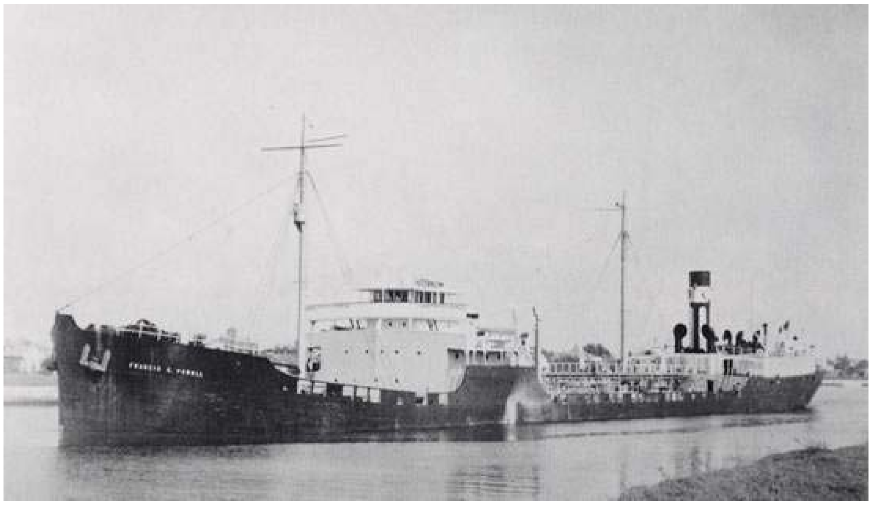


Figure 24: Historical image of AWOIS item 14919, FRANCIS E. POWELL (photo courtesy of the Peabody and Essex Museum, Salem MA).

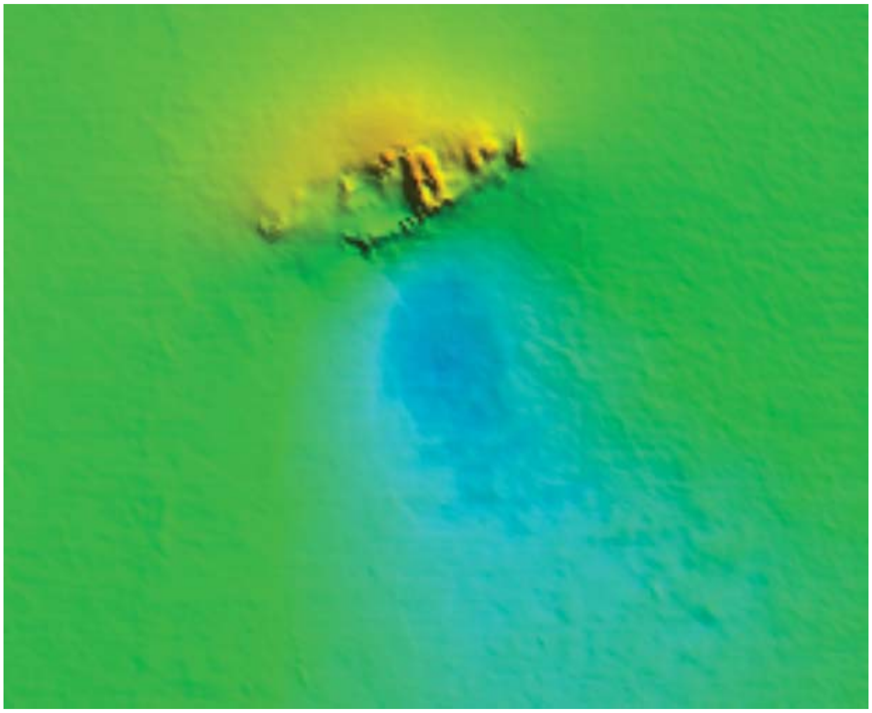


Figure 25: MBES image of AWOIS item 14919 in the 1-meter resolution surface at a 5-times vertical exaggeration.

Figure 26: SSS mosaic in vicinity of AWOIS item 14919.

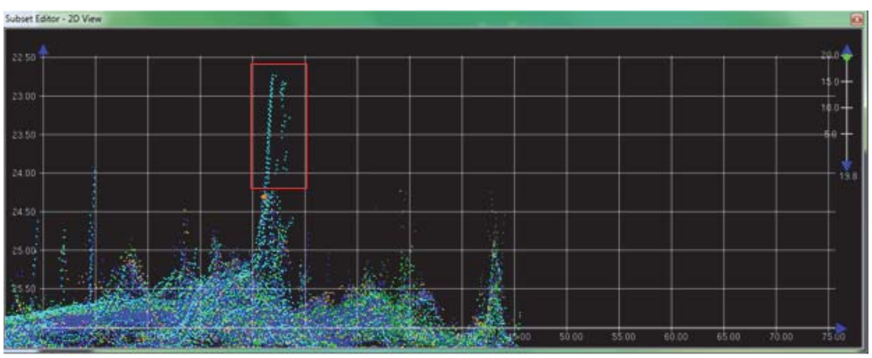


Figure 27: The designated sounding chosen for AWOIS item 14919 shown as orange point. Outer-beam soundings above the designated least depth are indicated with a red box.

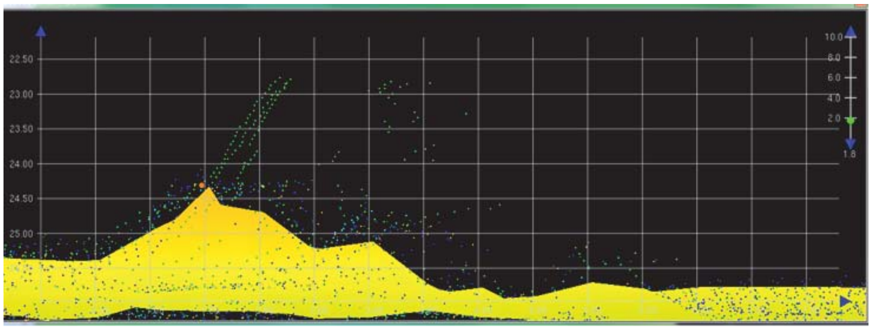


Figure 28: Subset image of shoalest point of wreck with the 0.50-meter reference surface (yellow).

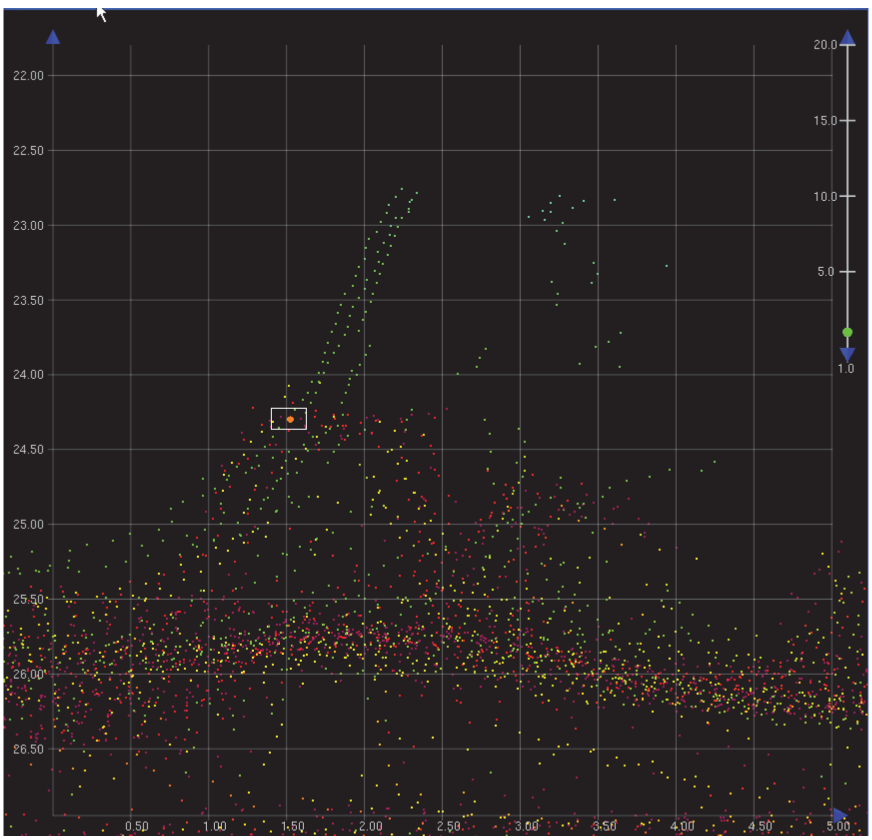


Figure 29: Subset image of shoalest point of wreck with the data points colored by uncertainty. The designated sounding is indicated by the white box.

D.1.4 Charted Features

One charted feature exists for this survey and is discussed above in the previous section.

D.1.5 Uncharted Features

No uncharted features exist for this survey.

D.1.6 Dangers to Navigation

No Danger to Navigation Reports were submitted for this survey.

D.1.7 Shoal and Hazardous Features

No shoals or potentially hazardous features exist for this survey.

D.1.8 Channels

No channels exist for this survey. There are no designated anchorages, precautionary areas, safety fairways, traffic separation schemes, pilot boarding areas, or channel and range lines within the survey limits.

D.2 Additional Results

D.2.1 Shoreline

Shoreline was not assigned in the Hydrographic Survey Project Instructions or Statement of Work.

D.2.2 Prior Surveys

Prior survey comparisons exist for this survey, but were not investigated.

D.2.3 Aids to Navigation

Aids to navigation (ATONs) do not exist for this survey.

D.2.4 Overhead Features

Overhead features do not exist for this survey.

D.2.5 Submarine Features

Submarine features do not 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 Construction and Dredging

H12503 is part of an area planned for possible future wind energy development.

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, Standing and Letter Instructions, and all HSD Technical Directives with the exception of discrepencies noted in this report. These data are adequate to supersede charted data in their common areas. This survey is complete and no additional work is required.

Report Name	Report Date Sent
Data Acquisition and Processing Report	2013-03-04

Approver Name	Approver Title	Approval Date	Signature
LCDR Benjamin K. Evans, NOAA	Chief of Party	03/01/2013	Benjamin K. Evans 2013.03.05 18:52:23 -05'00'
LT Samuel F. Greenaway, NOAA	Field Operations Officer	03/04/2013	
David T. Moehl	Senior Survey Technician	03/04/2013	Digitally signed by David Moehl Date: 2013.03.05 09:29:54 -05'00'
Jennifer K. Kist, ERT	Sheet Manager	03/04/2013	2013.03.06 11:12:30 -05'00'

F. Table of Acronyms

Acronym	Definition
AFF	Assigned Features File
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
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
HSSDM	Hydrographic Survey Specifications and Deliverables Manual

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	Exectutive 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

TIDE NOTE FOR HYDROGRAPHIC SURVEY

DATE : January 8, 2013

HYDROGRAPHIC BRANCH: Atlantic
HYDROGRAPHIC PROJECT: OPR-D304-FH-2012
HYDROGRAPHIC SHEET: H12503Rev

LOCALITY: 25 NM East of Cape Henry, Approaches to Chesapeake Bay, VA
TIME PERIOD: September 23 - December 13, 2012

TIDE STATION USED: 8651370 Duck, NC
Lat. 36° 11.0'N Long. 75° 44.8' W
PLANE OF REFERENCE (MEAN LOWER LOW WATER): 0.000 meters
HEIGHT OF HIGH WATER ABOVE PLANE OF REFERENCE: 1.026 meters

REMARKS: RECOMMENDED ZONING

Preliminary zoning is accepted as the final zoning for project OPR-D304-FH-2012, H12503Rev, during the time period between September 23 to December 13, 2012.

Please use the zoning file D304FH2012CORP submitted with the project instructions for OPR-D304-FH-2012. Zone SA46 is the applicable zone for H12503Rev.

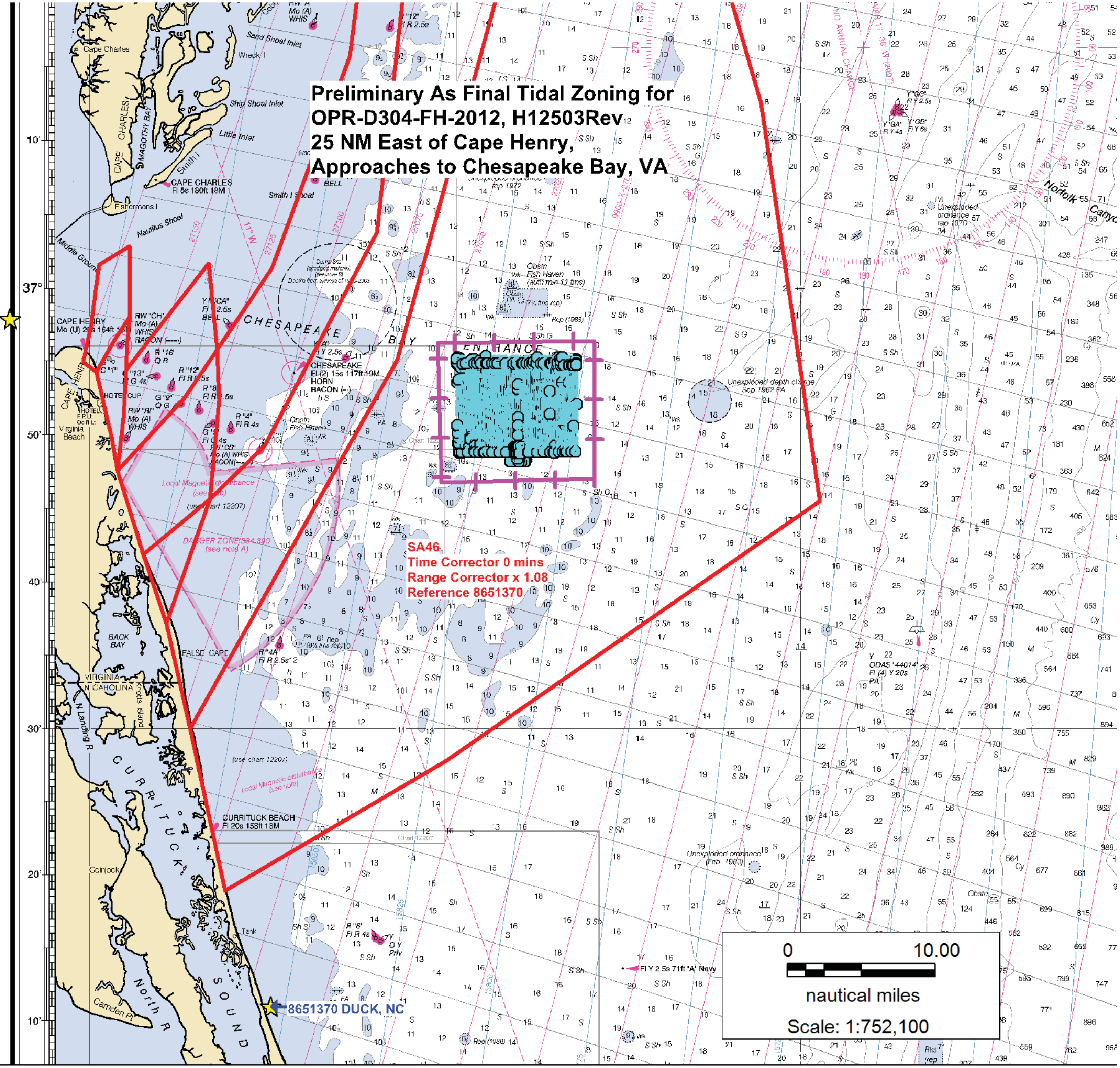
Refer to attachments for zoning information.

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).

HOVIS.GERALD.THOMAS.1365860250

Digitally signed by HOVIS.GERALD.THOMAS.1365860250
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=OTHER, cn=HOVIS.GERALD.THOMAS.1365860250
Date: 2013.01.14 12:47:42 -05'00'

CHIEF, PRODUCTS AND SERVICES BRANCH


Preliminary As Final Tidal Zoning for
OPR-D304-FH-2012, H12503Rev
25 NM East of Cape Henry,
Approaches to Chesapeake Bay, VA
SA46
Time Corrector 0 mins
Range Corrector x 1.08
Reference 8651370
8651370 DUCK, NC
0
10.00
nautical miles
Scale: 1:752,100

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NOAA Ship FERDINAND R. HASSLER (MOA-FH)
29 Wentworth Road
New Castle, NH 03854

December 19, 2012

MEMORANDUM FOR: Gerald Hovis, Chief, Products and Services Branch, N/OPS3

FROM: LCDR Benjamin K. Evans, NOAA, NOAA Ship FERDINAND R. HASSLER (MOA-FH)

SUBJECT: Request for Approved Tides/Water Levels

Please provide the following data:

1. Tide Note
2. Final zoning in MapInfo and .MIX format
3. Six Minute Water Level data (Co-ops web site)

Transmit data to the following:

Atlantic Hydrographic Branch (N/CS33)
439 West York St
Norfolk, VA 23510

NOAA Ship Ferdinand R. Hassler
439 West York St
Norfolk, VA 23510
ATTN: Operations Officer

These data are required for the processing of the following hydrographic survey:

Project No.:	OPR-D304-FH-12
Registry No.:	H12503
State:	Virginia
Locality:	Approaches to Chesapeake Bay, VA
Sublocality:	25 NM East of Cape Henry, VA

Attachments containing:

1) an Abstract of Times of Hydrography,
2) digital MID MIF files of the track lines from Pydro

cc: N/CS33

Generated by Pydro v12.9(r3965) on Wed Dec 19 16:00:10 2012 [UTC]

Year_DOY	Min Time	Max Time
2012_267	03:01:26	23:50:00
2012_268	00:05:07	23:58:28
2012_269	00:17:44	23:48:38
2012_270	00:12:45	23:59:58
2012_271	00:00:03	07:50:54
2012_272	01:29:09	06:19:38
2012_283	22:17:36	23:59:58
2012_284	00:00:03	23:03:40
2012_289	12:36:46	16:44:18
2012_348	12:27:42	12:36:23

APPENDIX II

SUPPLEMENTAL SURVEY RECORDS AND CORRESPONDENCE

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

February 25, 2013

MEMORANDUM FOR: LCDR Benjamin K. Evans, NOAA
Commanding Officer, NOAA Ship *Ferdinand Hassler*

FROM: Jeffrey Ferguson
Chief, Hydrographic Surveys Division

SUBJECT: Vertical Datum Transformation Technique,
OPR-D304-FH-12, Long Island Sound, NY

Hydrographic surveys H12502, H12503, and H12504 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 provided on the project CD/DVD.

Approval of VDatum, in lieu of the NOAA Center for Operational Oceanographic Products and Services (CO-OPS) TCARI package as per the Project Instructions, is based on your recommendation and the review of comparison results you included in your memos from January 4, 2013, Subject “OPR-D304-FH-12 VDatum Evaluation”.

The results of the data analysis show that ellipsoidally referenced survey (ERS) techniques with VDatum used as the vertical datum reducer to MLLW in this area indicate a better internal consistency of the survey data and produces final sounding values that meet or exceed horizontal and vertical specifications for hydrographic surveys.

The comparison techniques are in line with the procedures that were developed and approved as part of the CSDL Ellipsoidally Referenced Survey (ERS) project. These procedures and deliverables were added to the April 2012 edition of the NOS Hydrographic Surveys Specifications and Deliverables Manual and Field Procedures Manual documents.

You shall include a description of your ERS processing procedures and the comparisons you conducted between ERS and traditional tides in the appropriate Descriptive Report (DR), Horizontal and Vertical Control Report and/or Data Acquisition and Processing Report.

This memo and your memo, shall be included in the supplemental correspondence Appendix of the DR.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NOAA Marine and Aviation Operations
NOAA Ship *Ferdinand R. Hassler* S-250
326 West York Street
Norfolk, VA 23510

January 4, 2013

MEMORANDUM FOR: Jeffrey Ferguson
Chief, Hydrographic Survey Branch

FROM: LCDR Benjamin K. Evans, NOAA
Commanding Officer

TITLE: OPR-D304-FH-12 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 a number of problems in reliably processing the vessel trajectory relative to the ellipsoid. Due to these difficulties rather than any suspicion of the VDatum mode, we recommend that some sheets be submitted with zoned water level correctors and others with ERS. The sheet by sheet recommendation is tabulated below.

Sheet	Recommended Method	Reason
H12423	zoned	FM related vertical offsets
H12424	zoned	FM related vertical offsets
H12501	zoned	Data gaps, may be too far from network
H12502	ERS	No solution for three lines. Many small issues, but should be solvable
H12503	ERS	Good solutions. A few small issues
H12504	ERS	Good solutions. A few small issues
H12505	To be determined	May be too far from network.

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 in the vertical control requirements of the Hydrographic Survey Project Instructions for *OPR-D304-FH-12 Approaches to Chesapeake Bay* (March 2, 2012). The project is located in the vicinity of the Approaches to Chesapeake Bay, Virginia and encompasses hydrographic surveys H12423, H12424, H12501, H12502, H12503, H12504 and H12505. According to the Project Instructions the field unit is to provide a recommendation on the vertical transformation technique after an analysis using crossline data. This interim report and supporting data constitutes the recommendation and will be used by Hydrographic Survey Division (HSD) to support a decision on whether to use Ellipsoidally-Referenced Survey (ERS) methods in lieu of traditional tides for final water level correctors for the OPR-D304-FH-12 surveys.

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 12.9 distribution (Pydro\Lib\site-packages\HSTP\Pydro\ PostAcqTools_CompareTSeries.docx) was followed for the direct comparison of data.

Project crossline data was reduced to Mean Lower Low Water (MLLW) via conventional discrete tidal zoning and also via VDatum. Time series data for the nadir depth was extracted from both data sets and differenced using the Pydro PostAcq toolset.

In addition, CARIS surfaces of crosslines and mainscheme were analyzed in both discrete zoning and VDatum methods to evaluate the internal consistency of data as well as look for any spatial patterns in the difference that may have suggested problems with the VDatum model.

Sheets H12501, H12502, H12503 and H12504 were chosen for evaluation because these sheets contained higher quality POSPac solutions. In addition, these sheets span project OPR-D304-FH-12, as shown in Figure 1 below.

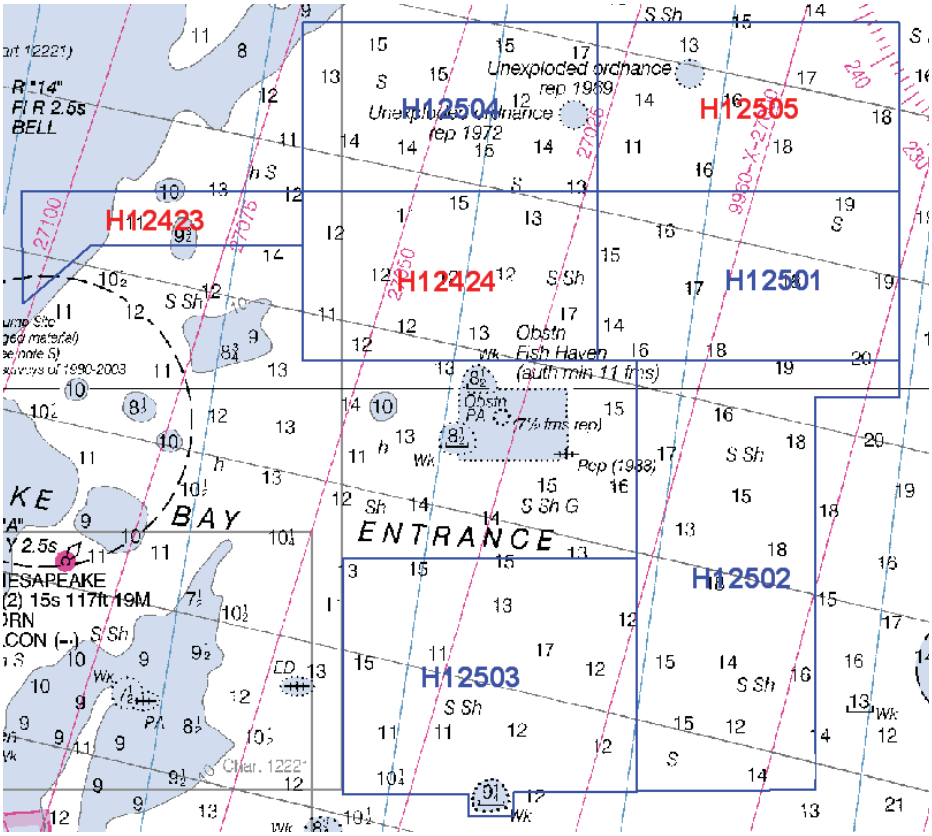


Figure 1: D304 sheets where VDatum Evaluation was performed shown in blue, sheets not evaluated shown in red.

3.0 Results and Discussion

This report addresses two questions:

1) Is the VDatum model correct in the geographic location of this project?
2) Is the internal consistency of the data improved from the use of ERS methods?

The following discussion will attempt to answer these questions.

3.1 VDatum Model Accuracies

To analyze the VDatum model, an approximately 100 meter surface was created using the ellipsoid to MLLW .xyz separation file provided by HSD Operations. The resulting surface was analyzed by looking for blunders in the model as well as an overall assessment of the change expected in the separation between MLLW and the ellipsoid. This surface is represented below in Figure 2.

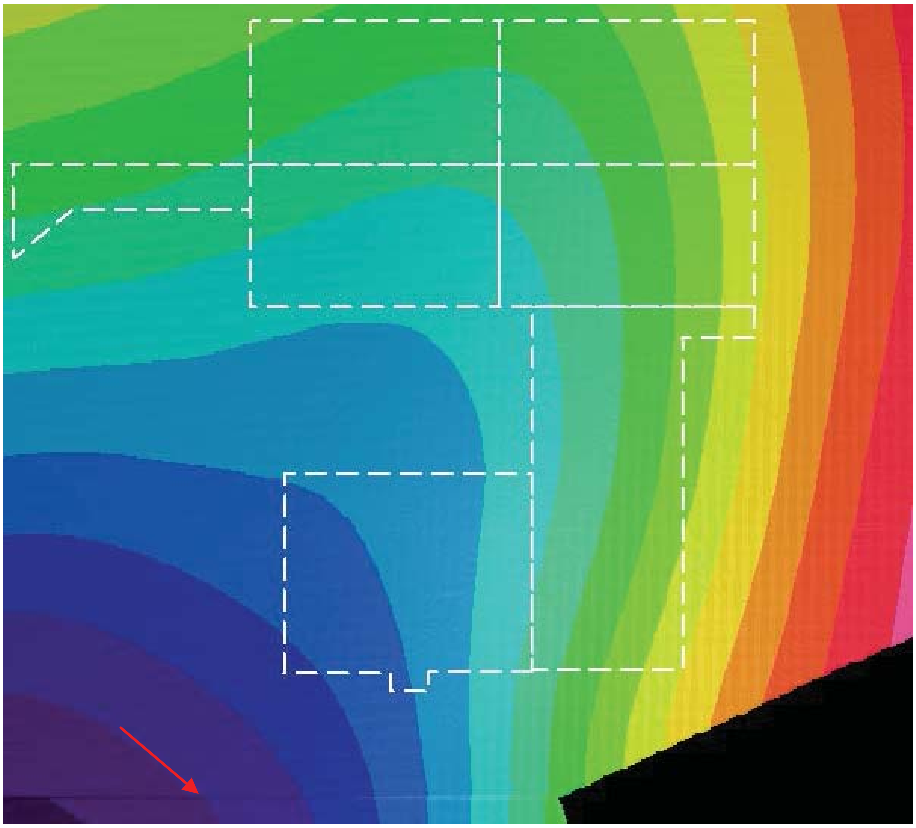


Figure 2: D304 sheets shown with gridded 2012_D304_VDatum_Ellip_MLLW_rev1.xyz VDatum Separation Model (colored bands correspond to 10 cm interval) NOTE: arrow pointing to model artifact outside of project area

As the above figure shows, the grid is absent of obvious blunders. One 0.01 meter discontinuity artifact in the VDatum model is apparent south of the project area which does not affect these results. There is a significant slope in the VDatum model across the project extents at approximately 1 meter overall. This is thought to be driven by close proximity of the continental shelf and the geoid slope that accompanies this geographic feature.

In accordance with Appendix I of the Project Instructions, Pydro was used to compare the nadir depths using both vertical models. As shown in Table 1, there are significant differences between zoned tides and VDatum, with values ranging from 0.02 to -0.23. These differences may arise from many different sources including: poor vertical GPS solutions, poor zoning model, errors in dynamic draft values and loading errors.

XL Discrete-Vdatum (Pydro)			
Sheet	**Head**	**Mean (m)**	**StDev (m)**
H12501	Port	0.02	0.05
H12502	Port	-0.07	0.07
	Starboard	0.01	0.14
H12503	Port	0.00	0.13
	Starboard	0.05	0.11
H12504	Port	-0.23	0.07
	Starboard	-0.22	0.07

Table 1: Results of D304 VDatum Evaluation (Pydro analysis)

Sheets H12501, H12502 and H12503 show average differences within the VDatum uncertainty of 0.08 meters. However, H12504 contains average differences in the twenty centimeter range, which exceeds the uncertainty model.

From these results (using Pydro as was recommended in Appendix I) it is difficult to form a recommendation for H12504. There is clearly a large difference between ERS and zoned tides for this sheet, but the nadir analysis alone is insufficient to understand why.

Comparison of the CARIS crossline difference surfaces referenced to discrete zoning or VDatum, rather than statistical analysis of just the nadir depths, was performed in order to see spatial trends in the data.

For the crossline surface comparisons, crossline surfaces contained data from both heads: the crosslines were not filtered, as is common practice amongst the fleet to eliminate erroneous outer beams. Before submission, the crosslines will be filtered, however for this evaluation SV errors on the outer beams would affect both discrete and VDatum equally and therefore cancel out. The results of the surface differences are shown in Table 2. As expected the average differences and standard deviation are similar to the Pydro nadir analysis shown in Table 1.

XL Discrete-Vdatum (CARIS)				
Sheet	Mean (m)	Mode (m)	StDev (m)	95% +/- (m)
H12501	0.02	0.00	0.05	0.08
H12502	-0.08	-0.05	0.12	0.22
H12503	0.02	0.11	0.12	0.23
H12504	-0.26	-0.31	0.08	0.15

Table 2: Additional results of D304 VDatum Evaluation (CARIS surface analysis)

In particular, H12504 shows the same large difference in the CARIS surfaces as the Pydro analysis. Figure 3 shows the Discrete – VDatum crossline surface over the separation model.

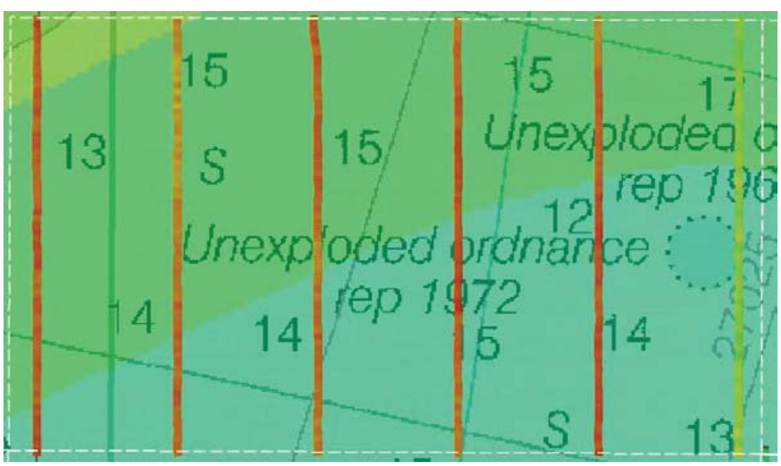


Figure 3: H12504 Discrete minus VDatum XL CUBE surface – average differences for green line on right are -0.14 m while average of red/orange lines are -0.31 m.

The tides were examined for the particular day of crosslines and are shown below in Figure 4. The dark green lines show the time period of the crosslines and the orange line marks the time period in between the first crossline (east line) and the subsequent lines. Take note of the high residual values recorded at the tide gauge. Because the gauge is 60 nautical miles from this sheet, water level residuals driven by local effects may not be well modeled in the zoned methods. The black dotted line represents when mainscheme acquisition was started.

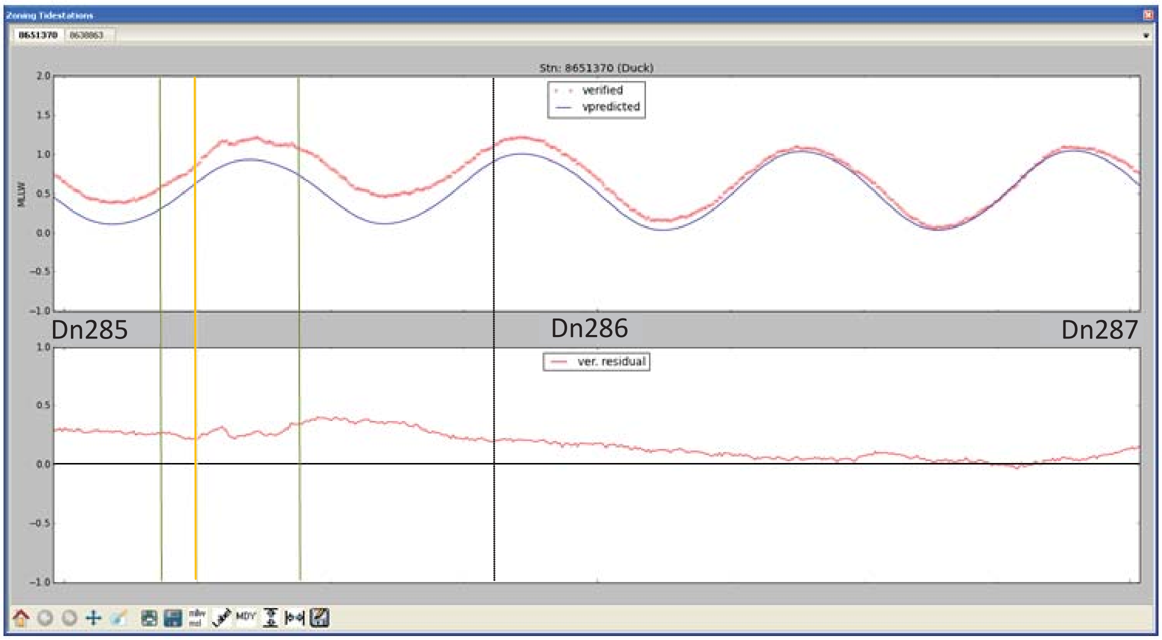


Figure 4: Verified tidal signature for Duck, NC and accompanying residual values.

Sheet H12504 was analyzed further to determine which vertical model is more likely to contain correct values. Results from this further analysis can be seen below in Table 3. A complete difference between an ERS and zoned approach was made with the mainscheme lines and again with the holiday and development lines, which were collected two months later. During the acquisition of multibeam, the water level residual at the controlling gauge varied from 0 to 0.25 meters. When waterline residuals were close to zero, ERS - zoned differences were approximately 0.15 meters. When waterline residuals were higher ERS - zoned differences were approximately 0.30 meters.

This result suggests that the large differences between ERS and zoned are the result of water level errors, not VDatum.

H12504 Analysis				
	Mean (m)	Mode (m)	StDev (m)	95% +/- (m)
Mainscheme Dn285-288 (Discrete - VDatum)	-0.24		0.07	
Development Dn345-348 (Discrete - Vdatum)	-0.14	-0.16	0.10	0.19

Table 3: Additional H12504 Statistics

After careful examination of all data it is our belief that on average H12504 discrete zoning contains a separation from VDatum of around 15 cm. This is most likely the result of a poor zoning model and is not the result of an erroneous VDatum model.

3.2 Data Internal Consistency

To analyze the internal consistency of ERS methods a crossline analysis was completed over the entire sheet for both discrete zoning and VDatum. The results of these differences are shown in Table 4.

	Discrete MS-XL Differences				VDatum MS-XL Differences			
Sheet	Mean (m)	Mode (m)	StDev (m)	95% +/- (m)	Mean (m)	Mode (m)	StDev (m)	95% +/- (m)
H12501	-0.07	-0.07	0.11	0.21	unsucessful			
H12502	-0.04	-0.10	0.14	0.26	0.05	0.05	0.10	0.19
H12503	-0.14	-0.28	0.15	0.24	0.01	0.00	0.06	0.12
H12504	0.06	0.09	0.11	0.24	0.02	0.01	0.12	0.17

Table 4: D304 Internal Consistency Comparison from CARIS Difference Surfaces

The results show that ERS generally improves the internal consistency of the data. As can be seen in the result of sheet H12503, averaged differences of -0.14 with a standard deviation of 0.15 under discrete zoning went to an average of 0.01 with standard deviation 0.06 with VDatum. For sheets H12502, and H12503 the standard deviation of the differences was significantly lowered with VDatum compared to discrete zoning. As seen in Figure 5; with VDatum, the distribution of differences is generally Gaussian, while the zoned distribution often shows multiple peaks and other anomalies.

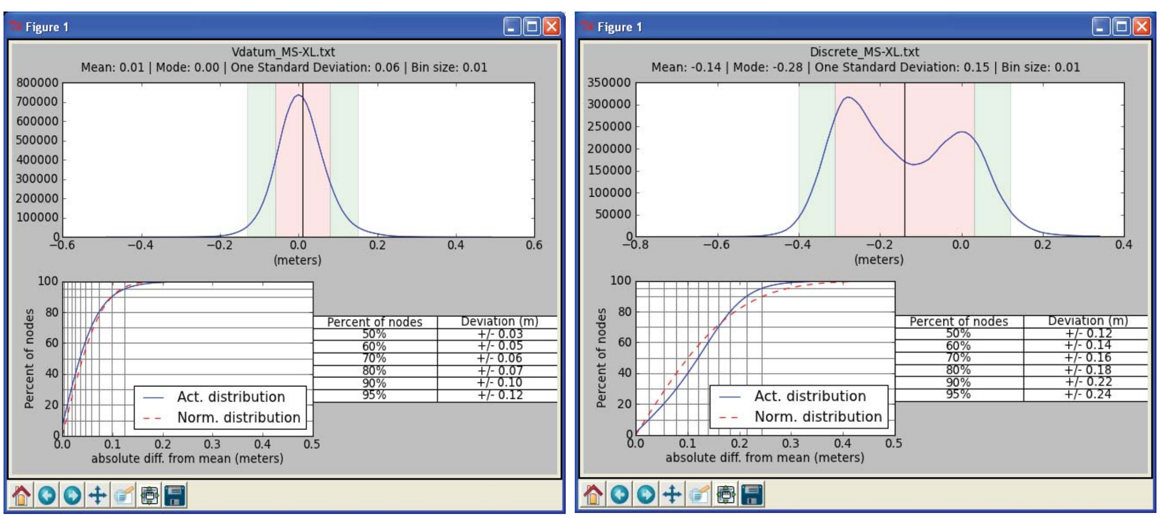


Figure 5: Surface Difference Distribution for Sheet H12503; VDatum on left and Discrete on right.

Sheet H12501 proved to be more troublesome. While the SBETs for the cross-lines were acceptable for this analysis, processing the SBETs for the main-scheme coverage was difficult, resulting in many split projects and incomplete SBETs for five lines. In addition to the troubles with processing, solutions derived in POSPac contained high RMS values as well as unexplainable vertical position jumps. This demonstrates the limits of an ERS approach; if poor or no vertical GPS solution exists, then there is an ERS holiday. To collect these holidays would take additional time at sea and therefore is not feasible in most cases.

4.0 Recommendation

ERS with VDatum is a tool to help us eliminate many vertical errors that can be attributed to traditional tide models and ship water line estimators. For D304, the difference between ERS and zoned were generally within the anticipated VDatum uncertainty. Where they were not (H12504) we have shown that this is likely the result of water level errors rather than an issue with VDatum. While this analysis does not rigorously verify the VDatum model, it gives us no reason to doubt it. Therefore, we believe the VDatum model is accurate in this area.

In addition, we have shown that ERS improves the internal consistency of the data when compared with traditional tide zoning methods, especially noticeable during times of increased wind and weather.

However, poor POSPac solutions can result in inferior data compared to the traditional methods and therefore should not be applied to all data on all sheets. It is our recommendation to use ERS on a sheet by sheet basis. We recommend an ERS approach when the majority of the sheet contains good solutions, i.e. free of data gaps and vertical jumps. Additionally H12423 and H12424 had vertical offsets related to newly implemented FM hardware that complicate application of ERS methods. This issue is discussed in detail in the Data Acquisition and Processing report submitted with this project. The sheet by sheet recommendation is tabulated below.

Sheet	Recommended Method	Reason
H12423	zoned	FM related vertical offsets
H12424	zoned	FM related vertical offsets
H12501	zoned	Data gaps, may be too far from network
H12502	ERS	No solution for three lines. Many small issues, but should be solvable
H12503	ERS	Good solutions. A few small issues
H12504	ERS	Good solutions. A few small issues
H12505	To be determined	May be too far from network.

In all cases the vertical data reduction method will be discussed in the individual sheet descriptive report and the D304 Horizontal and Vertical Control Report to avoid confusion in the quality control process that follows.

APPENDIX III

FEATURES REPORT

DTONS -- NONE

AWOIS -- ONE

WRECK -- NONE

MARITIME BOUNDARIES -- NONE

H12503 Feature Report

Registry Number: H12503

State: Virginia

Locality: Approaches to Chesapeake Bay, VA

Sub-locality: 25 NM East of Cape Henry, VA

Project Number: OPR-D304-FH-12

Survey Date: 12/13/2012

Charts Affected

Number	Edition	Date	Scale (RNC)	RNC Correction(s)*
12200	49th	06/01/2007	1:419,706 (12200_1)	[L]NTM: ?
13003	49th	04/01/2007	1:1,200,000 (13003_1)	[L]NTM: ?

* Correction(s) - *source: last correction applied (last correction reviewed--"cleared date")*

Features

No.	Name	Feature Type	Survey Depth	Survey Latitude	Survey Longitude	AWOIS Item
1.1	#14916 - Francis E. Powell	Wreck	24.04 m	36° 49' 03.3" N	075° 23' 50.1" W	14916

Generated by Pydro v13.2(r4249) on Wed Jul 03 14:12:30 2013 [UTC]

1 - AWOIS Features

1.1) #14916 - Francis E. Powell

Primary Feature for AWOIS Item #14916

Search Position:	36° 48' 52.3" N, 075° 23' 59.1" W
Historical Depth:	16.82 m
Search Radius:	1000
Search Technique:	sb, sss, mb
Technique Notes:	[None]

History Notes:

L-579(1948) - Wreck Francis E. Powell was located by the U.S. Coast and Geodetic Survey in the approximate position: 36/48/57.3 75/23/52.5 and cleared with wire drag to a depth of 55 ft. (currently charted as 9 1/4 fathoms). (PTT 5/16/2011)

Survey Summary

Survey Position:	36° 49' 03.3" N, 075° 23' 50.1" W
Least Depth:	24.04 m (= 78.86 ft = 13.143 fm = 13 fm 0.86 ft)
TPU (±1.96σ):	**THU (TPEh)** [None] ; **TVU (TPEv)** [None]
Timestamp:	2012-348.00:00:00.000 (12/13/2012)
Dataset:	H12503_Wreck.000
FOID:	0_ 0000045036 00001(FFFE0000AFEC0001)
Charts Affected:	12200_1, 13003_1

Remarks:

WRECKS/remrks: AWOIS #14919 Charted (12200) wreck repositioned with 100% MBES

Feature Correlation

Source	Feature	Range	Azimuth	Status
H12503_Wreck.000	0_ 0000045036 00001	0.00	000.0	Primary
OPR-D304-FH-12	AWOIS # 14916	406.04	033.2	Secondary (grouped)

Hydrographer Recommendations

Remove wire drag AWOIS item on chart (12200) and replace with surveyed location and depth. Verified item with 200% SSS and 100% MBES coverage superseding wire drug depth and location.

Cartographically-Rounded Depth (Affected Charts):

13fm (12200_1, 13003_1)

S-57 Data

Geo object 1:	Wreck (WRECKS)
Attributes:	CATWRK - 1:non-dangerous wreck
	QUASOU - 6:least depth known
	SORDAT - 20121213
	SORIND - US,US,graph,H12503
	TECSOU - 3,2:found by multi-beam,found by side scan sonar
	VALSOU - 24.036 m
	WATLEV - 3:always under water/submerged

Office Notes

SAR: Wreck verified with multibeam and 200% side scan sonar.

Compile: Add 13 fm Wreck

Feature Images

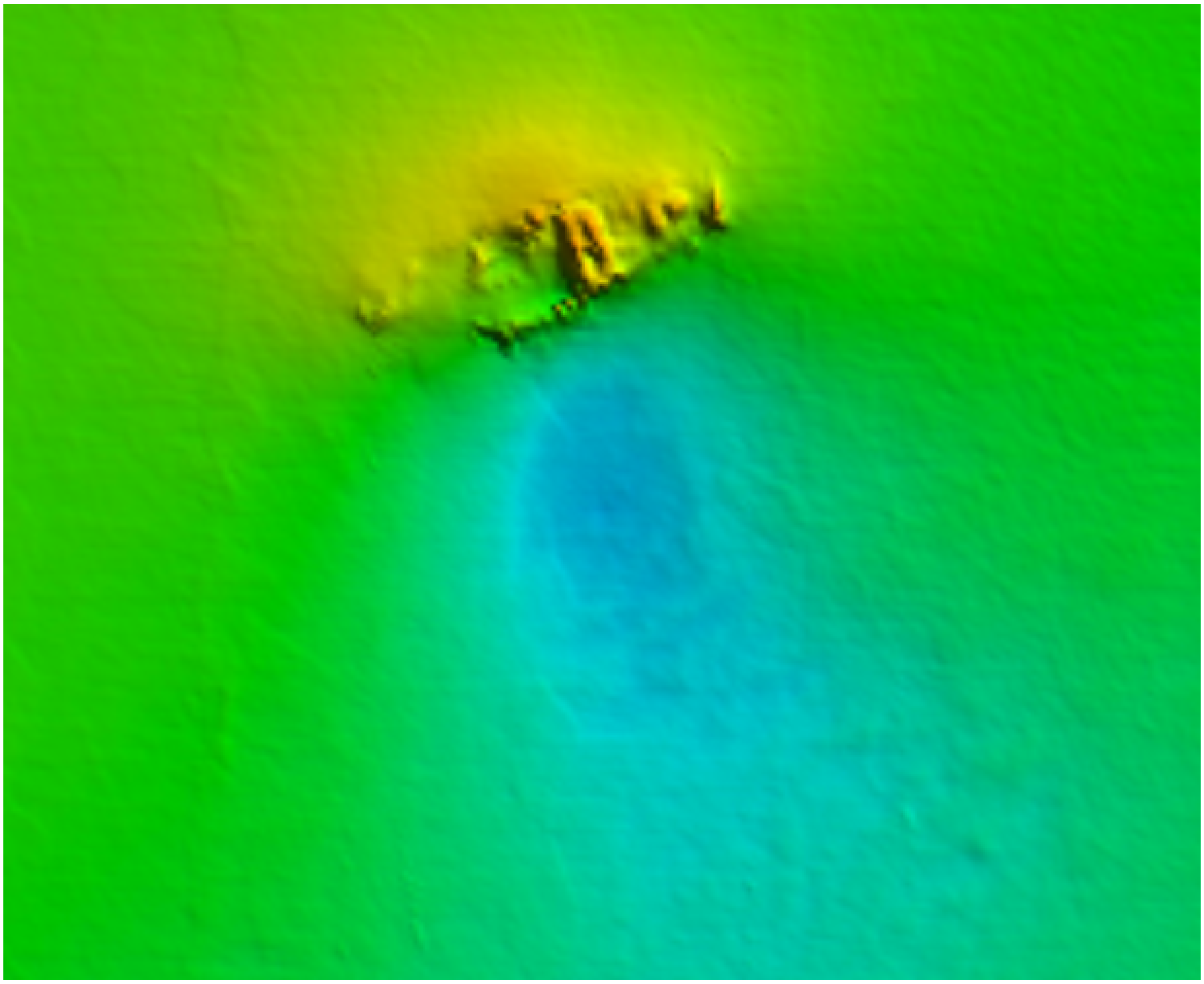


Figure 1.1.1

APPROVAL PAGE

H12503

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

- H12503_DR.pdf
- Collection of depth varied resolution BAGS
- Processed survey data and records
- H12503_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:________________________________ For: ________________

LT Abigail Higgins, NOAA
Chief, Atlantic Hydrographic Branch