W00206

NOAA FORM 76-35A

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

DESCRIPTIVE REPORT

Type of Survey **Hydrographic**

Registry No.

LOCALITY

State **New Hampshire**

General Locality **Isle of Shoals**

Sub-locality *White Island to Smuttynose Island*

2009

CHIEF OF PARTY
UNH/CCOM Summer Hydro 2009

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NOAA FORM 77-28U.S. DEPARTMENT OF COMMERCE (11-72)NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION **HYDROGRAPHIC TITLE SHEET**	REGISTRY NUMBER: **W00206**
INSTRUCTIONS:The Hydrographic Sheet should be accompanied b	FIELD NUMBER: N/A

State/Territory: **New Hampshire**

General Locality: **Isle of Shoals**

Sub-Locality: **White Island to Smuttynose Island**

Scale: 1:10,000 Date of Survey: 11 June 2009 – 20 June 2009

Instructions Dated: June 2009 Project Number:

Vessel: **R/V Coastal Surveyor**

Chief of Party: **UNH**

Surveyed by: **UNH/CCOM Summer Hydrography Course 2009**

Soundings by: **Multibeam Echosounder**

Graphic record scaled by: **N/A**

Graphic record checked by: **N/A**

Protracted by: **N/A** Automated Plot: **N/A**

Verification by: ***Atlantic Hydrographic Branch***

Soundings in: **Meters at MLLW**

Remarks:

1) All Times are UTC.

2) This is a basic Hydrographic Survey under the Navigable Area Concept.

3) Projection is UTM Zone 19.

Bold italic red notes in the Descriptive Report were made during office processing.

Table of Contents

Appendices

I. Danger to Navigation (DTON) Reports

II. Aids to Navigation (ATON) Reports

III. Vessel Description and Offsets

IV. Equipment Description

V. Supplemental Survey Records
   a. Survey Planning
   b. Patch Test Procedure
   c. Backscatter Mosaic

VII. AWOIS

Separates

I. Acquisition and Processing Logs

A. Patch Test

B. Daily Line Logs

List of Tables and Figures

Tables

Figures

A. Introduction

This descriptive report pertains to hydrographic survey data acquired using a multibeam echosounder in the vicinity of the Isles of Shoals, New Hampshire. The objectives of this document are to record and describe all aspects of acquiring and processing this mutlibeam data, which produced a final deliverable adhering to Order 1A survey specifications for the NOAA hydrographic office.

The survey took place as part of the 2009 Summer Hydrographic Field Course at the University of New Hampshire (UNH), Center for Coastal and Ocean Mapping-Joint Hydrographic Center (CCOM-JHC). Tables 1 and 2 give complete participant lists.

Table 1. Participant List

Anastasia Abramova
Felipe Barrios
Guillermo Diaz Pena
Samuel Greenaway
Kentaro Kaneda
Nicole Kuenzel
Christina Lacerda
Brian O'Donnell
Rachot Osiri
Rachel Soraruf
Per Steenstrup

Table 2. Supervising Faculty

Andrew Armstrong
Semme Dijkstra

B. Project

B1. Objectives

Prior surveys encompassing the survey area predate modern survey methods. Many charted depths derive from lead-line surveys from the turn of the century. The Isles of Shoals and surrounding Portsmouth Harbor area is designated a Priority 1 survey area as established by the 2008 edition of the NOAA Hydrographic Survey Priorities document. In addition, the NOAA ship Ferdinand R. Hassler is slated to be based out of New Castle, NH. The objectives of this survey are to ensure the safety of navigation for vessels transiting in the vicinity of Isle of Shoals.

This survey also addresses all items from the 2005 Lidar survey H11296 that fall within the survey area.

The data were acquired and processed in accordance with the National Ocean Service (NOS) Hydrographic Survey Specifications and Deliverables (HSSD) (April 2009). This survey achieves complete multibeam coverage as defined in that specification. ***Concur.***

B2. Area Surveyed

The survey area is bounded by the approximate coordinates listed in Table 3, which encompasses the southern region of the Isles of Shoals from White Island to the eastern end of Smuttynose Island. The survey area, shown in Figure 1, covers approximately 2.86 square nautical miles. Hydrographic data collection began on 11 June, 2009 and ended 20 June, 2009. Data was acquired on June 11, 12, 15, 16, 18, and 20. Total linear nautical miles run were 98.3 nautical miles of main scheme multibeam lines and 6.8 nautical miles of crosslines. No bottom samples were taken and no features were investigated. ***Concur.***

Table 3. The coordinate extents of the survey area in latitude and longitude.

Sheet Limits Sheet A Scale 1:10,000		
Point Location	Positions on NAD83	
	Degrees Latitude (N)	Degrees Longitude (W)
NW corner	42° 58’ 46.60’’	70° 39’ 01.40’’
SW corner	42° 57’ 38.22’’	70° 39’ 01.40’’
SE corner	42° 57’ 38.22’’	70° 35’ 27.70’’
NE corner	42° 59’ 10.62’’	70° 35’ 27.70’’

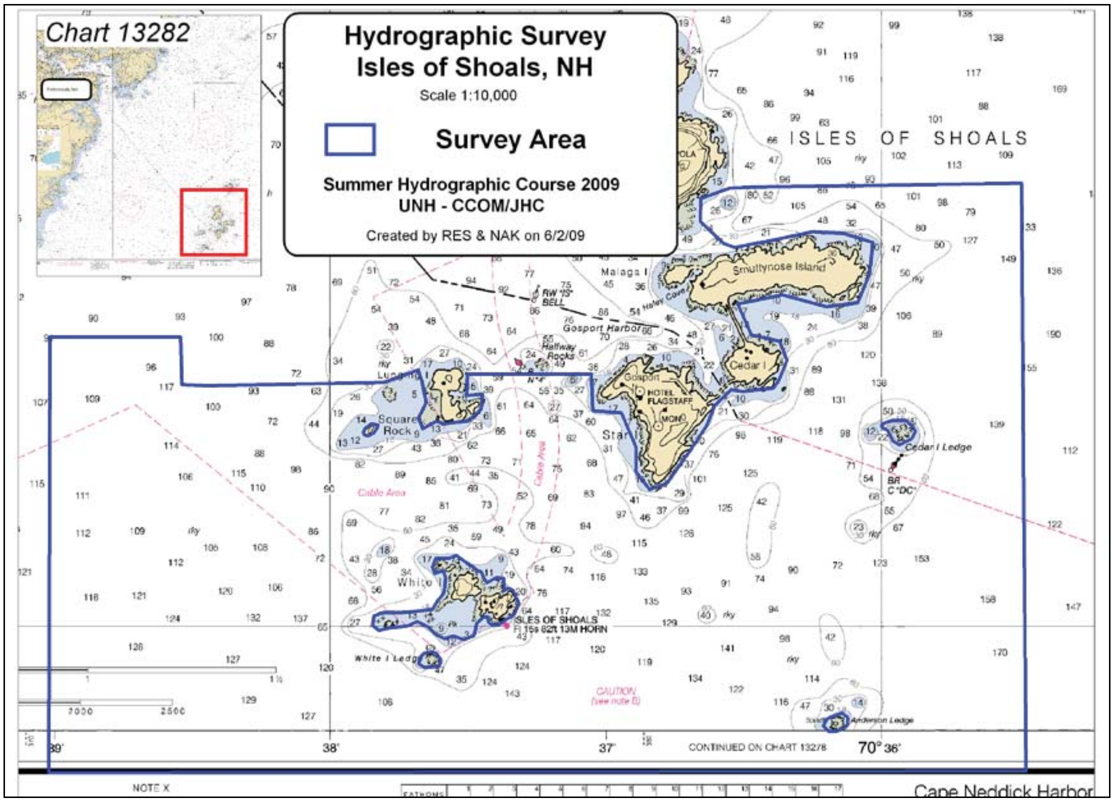

Figure 1. Survey area in the vicinity of the Isles of Shoals, NH. Survey outline in blue at a 1:10,000 map scale. Chart inset indicates the locations of the Isles of Shoals (red box) relative to the Portsmouth Harbor coastline.

B3. Affected Charts

The affected charts in this survey area range from large scale (1:20,000) to small scale (1:500,000) charts. (Charts of scales smaller than 1:500,000 are not discussed in this section.) Figure 2 indicates the charts affected based on the geographic positioning of the survey area. Chart 13283 (1:20,000) was the primary chart utilized in the planning and execution of this hydrographic survey. Table 4 indicates the affected raster and corresponding electronic navigational charts (ENC), scale, and edition number with subsequent date. ***Concur.***

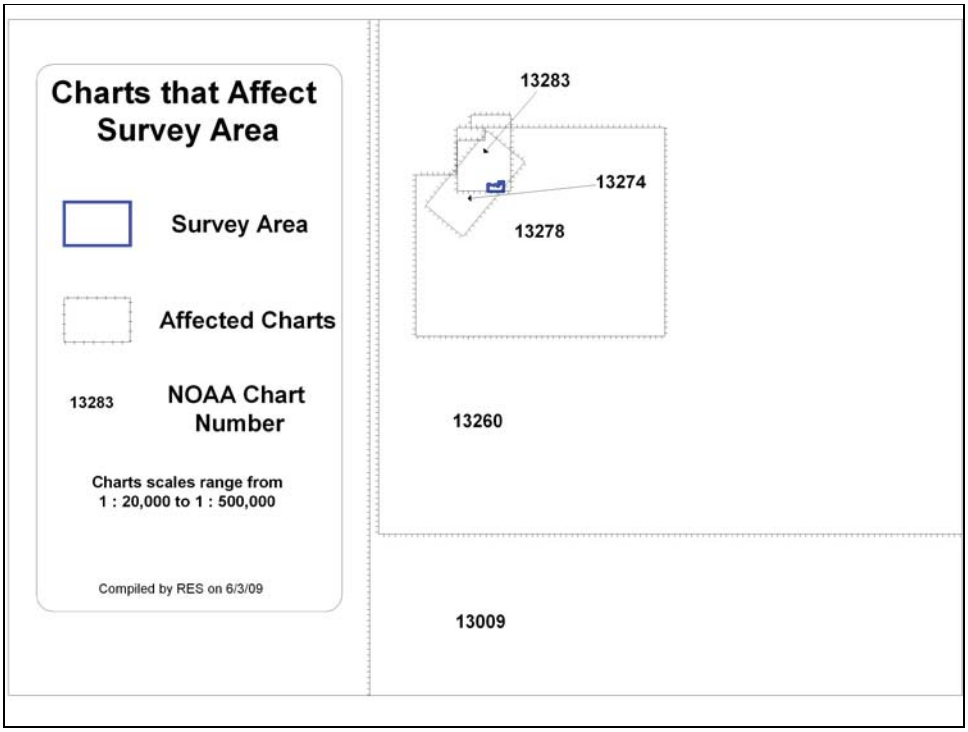

Figure 2. Charts affected by survey limits (blue). Chart scales range from 1:20,000 (large scale) to 1:500,000 (small scale).

Table 4. Affected chart comparisons for Isles of Shoals survey area.

Electronic (ENC)	Raster (RNC)	Scale	Edition Number	Issue Date
US5NH02M	13283	1: 20,000	20	10/2007
N/A	13274	1: 40,000	27	06/2007
US4MA04M	13278	1: 80,000	26	06/2005
US3EC10M	13260	1: 378,838	40	05/2007
US3EC05M	13009	1: 500,000	34	04/2009

C. Data Acquisition and Processing

C1. Equipment

C1.1 Survey Vessel

The R/V Coastal Surveyor was used as the multibeam data acquisition platform. The vessel is 40' (12.19m) in length, 12' (3.66m) in width, and has a draft of 5.5' (1.8m). The vessel is equipped with a mechanical ram-mount on the bow for sonar/instrument mounting. Refer to *Appendix III* (Vessel Description and Offsets)* for complete specifications for the R/V Coastal Surveyor. ***Appended to this report***

C1.2 Hydrographic Survey Equipment

Primary systems and equipment utilized on the R/V Coastal Surveyor are listed in Table 5. For further documentation and information on equipment see *Appendix IV* (Equipment Description)*.

Table 5. Description of major systems used on the R/V Coastal Surveyor.

Vessel R/V Coastal Surveyor LOA: 12.19m BEAM: 3.66m DRAFT (1.8m)		
	Equipment	Manufacturer & Model
Echo Sounding	Multibeam Echosounder	Kongsberg EM 3002 dual head
	Operator Station	Kongsberg HWS 10 WS
	Processing Unit	Kongsberg EM 3002 PU
Attitude/ Positioning	Position Compute System (PCS)	Applanix 320 V.4 POS/MV
	Inertial Motion Unit (IMU)	Applanix IMU-200 POS/MV
	GPS Primary Antenna (Port)	Trimble/Zephyr
	GPS Secondary Antenna (Starboard)	Trimble/Zephyr
Horizontal Positioning	GPS Base Station Reciever	Trimble 5700
	2 Radio Modems	Trimble Trimark 3
Water Levels	Pressure andTemperature Sensor	Aanderaa Instruments 051 NOAA Water Level Station #8423898
Sound Velocity	Surface Sound Speed	Odom Digibar Pro
		AML SV & T Probe
	Sound Velocity Profile	AML SV Plus Profiler
		Seabird 19
	Moving Vessel Profiler (MVP)	AML Singaround Sound Velocimeter

C1.3 Sounding Equipment

The Kongsberg EM 3002 dual head multibeam echosounder was used for bathymetric and acoustic backscatter data acquisition. Refer to Table 6 for system specifications. The sounder was operated in the 508 beam equidistant mode at all times. The angular sector of the sonar was typically restricted to 65 degrees on either side of nadir. For the most inshore lines, the inshore coverage was extended to 104 degrees from nadir. This allowed for greater inshore coverage while maintaining a safe distance from hazards.

Table 6. Specifications for the Kongsberg EM 3002 dual head multibeam echosounder.

EM 3002D Specifications	
Frequencies	293/307
Maximum Ping Rate	40 Hz
Number of beams per ping and sonar head	160
Measurements per ping	254
Beamwidth	1.5 x 1.5
Coverage sector	130
Depth resolution	1 cm
Pulse length	150 µs
Nearfield dynamic focusing	yes
Pitch compensation	yes
Roll stabilization	yes
Beam spacing	Equiangular/ Equidistant or Combination

C1.4 Position and Attitude Sensors

Horizontal positions and vessel attitude were acquired using an Applanix POS/MV 320 v.4. This system incorporate two GPS receivers tightly coupled with an inertial motion sensor to derive a position and attitude solution. A GPS base station was established at Ordione Point, NH which broadcasted real time kinematic (RTK) corrections for position by a Trimble TrimMark 3 radio modem broadcasting corrections using the Trimble cmr+ protocol. The corrections were received by another modem on the R/V Coastal Surveyor which allowed for horizontal position accuracy to the centimeter level. The distance from the base station to the survey vessel was no greater than 14 km (7.5 nm).

C1.5 Sound Velocity Profilers

The primary means of obtaining sound velocity profile measurements was an AML sound velocity and temperature probe. The SmartTalk software system provided by Kongsberg was utilized to convert sound speed profile files to synchronize with the Seafloor Information System (SIS) software used for data acquisition. An AML Smart SV Probe was mounted at the face of the transducer and interfaced directly to the EM3002 for beam steering.

C2. Data Acquisition Software

C2.1 HYPACK

The HYPACK 2008 software system product version 8.0 was used for pre-survey line planning. In addition to maintaining on-line control, on-the-fly updates to the line plan were also created using the HYPACK software suite during survey operations.

C2.2 Seafloor Information System (SIS)

Acquisition for the multibeam data for this survey was conducted using the Seafloor Information System (SIS) software suite version 3.6.4 provided by Kongsberg, which is designed to be the user interface and real time processing system for Kongsberg Maritime instruments.

C3. Settlement and Squat

C3.1 Static Draft

Static draft was measured daily while the vessel was moored to the New Castle pier. The height of the IMU reference point above the waterline was measured with a tape using a draft tube located adjacent to the IMU. This draft correction was entered into SIS as "waterline" and was corrected for during acquisition. See Table 7 for daily draft measurements.

Table 7. Daily draft measurements.

DN	Date	Draft (m)
162	06.11.2009	0.491
163	06.12.2009	0.510
166	06.15.2009	0.516
167	06.16.2009	0.482
169	06.18.2009	0.530
171	06.20.2009	0.530*

* On DN171 the draft was measured as 0.533, but was not updated in SIS. The difference is negligible.

Daily measurements of the sonar mount confirmed that the sonar head did not move with respect to the vessel reference frame throughout the project.

C3.2 Dynamic Draft

The dynamic draft characteristics of the R/V Coastal Surveyor were determined in a RTK experiment conducted in 2006. The full experiment report is included in the separates (*Separate IV* Squat and Settlement Measurements for the R/V Coastal Surveyor*). The dynamic draft corrections were entered into the vessel configuration file in Caris and corrected during processing. Positive dynamic draft indicates that the vessel is lower in the water than at rest. This dynamic draft measurement is added to the observed depth during the Caris Merge process.

The dynamic draft corrections that were entered into Caris are found in Table 8. Typical survey speeds were approximately 3m/s (6 knots). At this speed the dynamic draft correction is less than 2 cm. ***Submitted with original field records***

Table 8. Dynamic draft correction.

Speed (m/s)	Dynamic Draft (m)
0.000	0.000
0.514	-0.025
1.029	-0.040
1.543	-0.043
2.058	-0.035
2.572	-0.017
3.087	0.012
3.601	0.053
4.116	0.104
4.630	0.166
5.144	0.239

C3.3 Heave

Heave was measured by the Applanix POS/MV 320 v.4, output to the sonar system and corrected for on acquisition. No additional heave corrections were applied in Caris.

C4. Quality Control

C4.1 Survey Planning

Line spacing was set to achieve desired multibeam echosounding coverage, in accordance with NOAA complete multibeam coverage specifications. Pre-survey planning was carried out in HYPACK using the UTM zone 19 projection and WGS 84 ellipsoid. The final plan used a line spacing of 4 times the water depth (Fig. 3) as verified by a CARIS HIPS TPE test, which was achieved using 3 x 3 gridlines run during the patch test. The line plan includes 170 lines with total length of 189.503 km. The total estimated survey time at 6 knots ranged from 20-30 hours, including survey lines, transit time, and sound velocity cast intervals of four hours. The survey area was divided into 9 sub areas in accordance with variations in depth. The initial line plans produced in HYPACK are seen in Figure 3. For full pre-planning documentation see *Appendix V.A** *(Supplemental Survey Records-Survey Planning)*. ***Appended to this document***

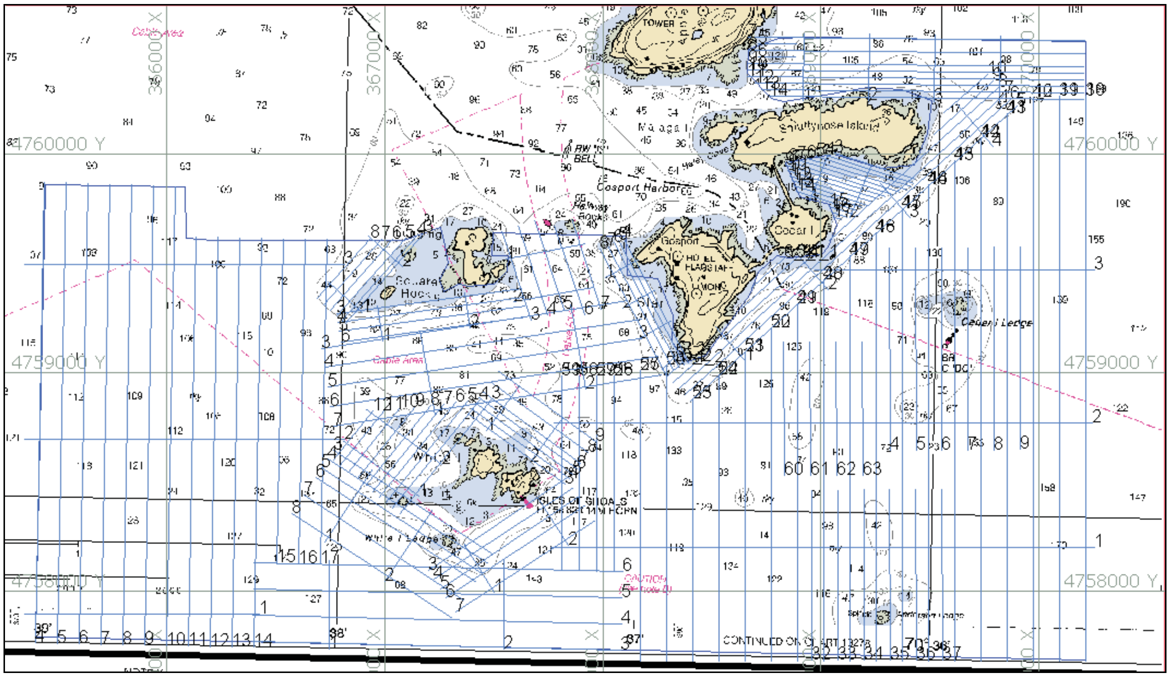

Figure 3. Final line plan utilizing a line spacing of 4 times the water depth.

C4.2 Patch Test

The patch test was carried out on 9 June 2009 utilizing the EM3002D multibeam echosounder, with independent verification conducted on 10 June 2009 by a second team of surveyors on the same vessel. High-resolution multibeam data, collected for the Shallow Water Mutlibeam Conference 2007, in the Portsmouth area was utilized to determine a patch test location that consisted of a prominent feature with an adjacent flat seafloor (Fig. 4). The timing, pitch and heading biases were determined by running a series of lines at different speeds and directions over the feature and determining calibration offsets to resolve any discrepancies in the resulting multibeam data; the flat bottom region was used to determine any roll bias. A gridded reference surface was also obtained during the patch test to verify that the planned line spacing was appropriate. The offsets obtained during the patch test are shown in Table 9; complete guidelines for the patch test procedure can be found in *Appendix V.B* (Supplemental Survey Records – Patch Test Procedure)*. ****Appended to this report***

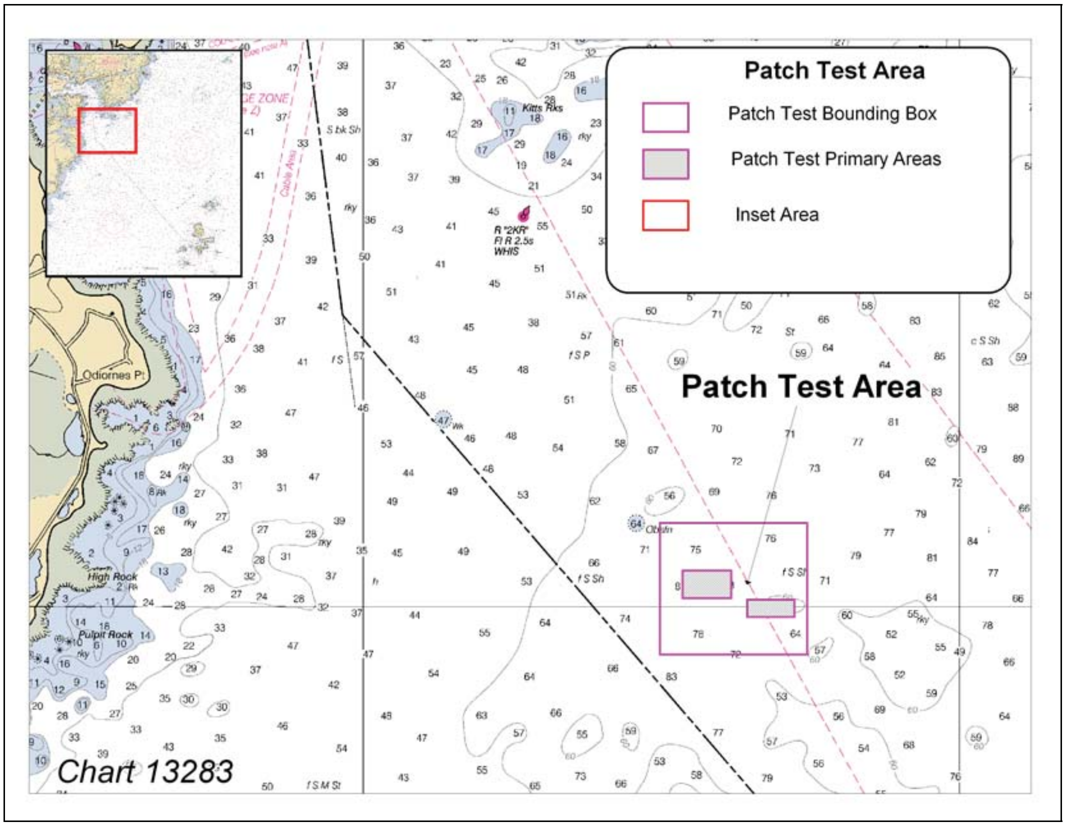

Figure 4. Patch test regions are within the vicinity of an area previously surveyed with a high-resolution multibeam echosounder. Primary patch test areas of interest within pink bounding box are designated by hatched boxes. Area of interest is designated by the red box located on inset of Chart 13283, approaches to Portsmouth Harbor.

The offset values obtained during the patch test were entered directly into the SIS software for real time full bottom coverage during data acquisition (see Table 9 for offset values). After the patch test calibration values were entered into SIS, a second independent patch test was run on 10 June, 2009 and processed using the Caris Calibration tool. This test confirmed that any remaining offsets were not significantly different than zero. No additional offset corrections were applied during processing. The standard deviation from multiple tests of the Caris Calibration tool for each parameter was used to update the Total Propagated Error (TPE) section of the Caris HVF file.

Real time bottom coverage was displayed on the vessel during acquisition to aid in achieving coverage to specifications.

Table 9. Patch test offsets for the R/V Coastal Surveyor obtained on 9 June 2009

	June 9 Patch Test		June 10 Residual Patch Test			
Offset	Port Head	Starboard Head	Port Head	±	Starboard Head	±
Time	0	0	0	0	0	0
Pitch	2.1°	2.2°	-0.2	0.1	-0.1	0.1
Roll	39.35°	-41.45°	-0.2	0.1	0.1	0.05
Heading	0°	359.4°	0.4	0.3	0.6	1.2

C4.3 Lead Line Comparisons

A set of comparisons of sonar to lead line were conducted at the start and end of the project to ensure that all vertical vessel offsets had been correctly accounted for in the survey. The tests were conducted while the survey vessel was moored alongside the pier at Newcastle, NH. The depth from the surface of the water to the seafloor was measured with a lead line adjacent to the sonar head. The lead line was marked, removed from the water, and measured with a survey tape. Simultaneously, the corrected depth output from the sonar system was recorded. The results are shown in Table 10. In addition, survey lines were logged during the end of project comparison. These lines were processed through Caris using the normal workflow with the exception that a zero tide file was applied. The processed lines agreed with the multibeam depths noted on acquisition. The lead line comparisons confirm that all static vertical vessel offsets were appropriately corrected for and did not change during the survey.

Table 10. Lead line comparison to echosounder at beginning and end of survey

DN 162 Start of Project Lead Line Comparison — **All depth are in meters**

trial	Multibeam Depth	Lead Line Depth	difference	Comment
1	4.26	4.334	-0.07	forward of transducer
2	4.27	4.220	0.05	aft of transducer
3	4.27	4.238	0.03	port of transducer
		average difference	0.00	

DN 171 End of Project Lead Line Comparison

trial	Multibeam Depth	Lead Line Depth	difference	Comment
1	4.88	4.938	-0.06	forward of transducer
2	4.82	4.790	0.03	aft of transducer
3	4.81	4.828	-0.02	starboard of transducer
4	4.78	4.818	-0.04	port of transducer
		average difference	-0.02	

C4.4 Crosslines

Cross line comparisons were carried out to verify and validate the accuracy of the sounding measurements. The total length of crosslines was 6.8 nautical miles or 7% of the main scheme lines. Consistency was established through comparison of cross lines within subset editor mode of the Caris HIPS 6.1 software. The crossing lines were examined to determine whether the lines have approximately the same depth sounding value at the same point. It was concluded that all intersecting track lines show consistent depth values. Difference between crosslines and main scheme lines were typically less than 0.20 m. ***Concur.***

C4.5 Data Density

According to section 5.1.2.2 of the NOS Hydrographic Surveys Specifications and Deliverables document (April, 2009), complete coverage multibeam requires that at least 95% of all nodes on the surface are populated with at least five soundings. To verify that the survey density meets these specifications, analysis of data density was conducted utilizing Matlab. The density layer of the final CUBE surface was exported as an ASCII file. This file was loaded into Matlab and all nodes with five or more soundings were tallied. 98.1% of all nodes had at least five soundings. This survey meets the density specification.

Areas where the sounding density is lower than five soundings per node are clustered on the edge of the survey coverage, particularly the inshore edge. See Figure 5 for a depiction of this distribution. These areas were surveyed with the sonar operated with a large opening angle facing inshore as discussed in section C1.3. This area also is well covered by the data from the inshore LIDAR survey H11296. This density should be taken into account when combining the LIDAR data with this survey data during the compilation process. This area at the inshore extent of the sonar coverage was also found to have the highest difference from the LIDAR data. This is discussed further in section C4.5 *Survey Junctions*. In some inshore areas of less than 5 soundings per node, it may be appropriate to favor the LIDAR survey depths over this survey. The hydrographic team recommends that the data from this survey supersede the LIDAR data in areas where the five sounding requirement has been satisfied.

In addition, there are no holidays over the tops of potentially significant features and all other requirements stated in section 5.1.2.2 have been met. ***Concur.***

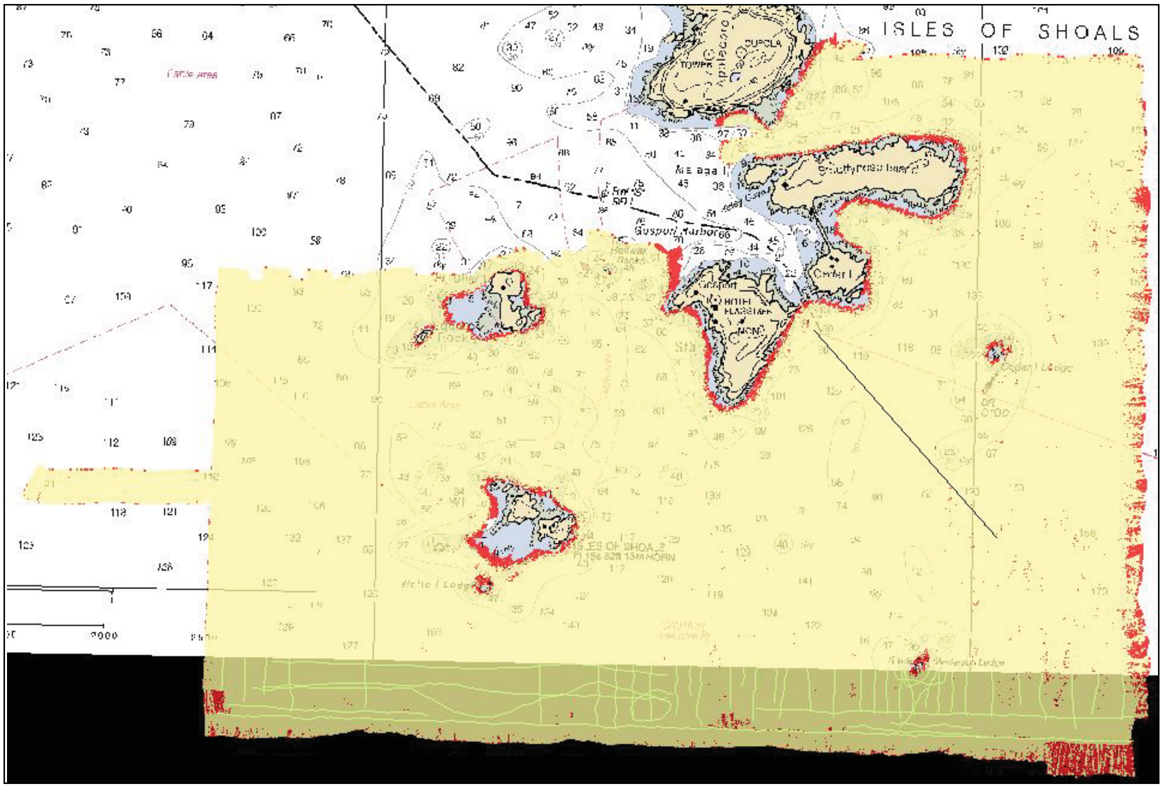

Figure 5. Density plot of survey area - yellow areas indicate regions where sounding data density is equal to or exceeds 5 soundings per meter while red areas indicate regions where data density is less than 5 soundings per meter.

C4.6 Uncertainty

Caris was used to compute the Total Propagated Uncertainty (TPU) for each sounding. The measured tide uncertainty parameter was set to 0.08 m and the zoning to 0.1 m. The measured sound speed parameter was set to 0.5 m/s and the surface sound speed to 0.2 m/s. Final uncertainty was taken as the greater of the propagated uncertainty or the 95% scaled standard deviation. Areas of high uncertainty are in regions with steep slopes. The final uncertainty is within IHO Order 1 tolerances. ***Concur.***

C4.7 Survey Junctions

This survey has junctions with two other multibeam surveys to the North and East (Table 11 and Figure 6). The inshore areas of the Isles of Shoals were also surveyed in by the 2005 LIDAR survey H11296.

Table 11. Contemporary survey junctions.

Survey	Scale	Date	Junction Side
H10771	1:10,000	1997	Southeastern
H11296 (Lidar)	1:10,000	2005	Inshore
Summer Hydro	Unknown	2005	Northwestern

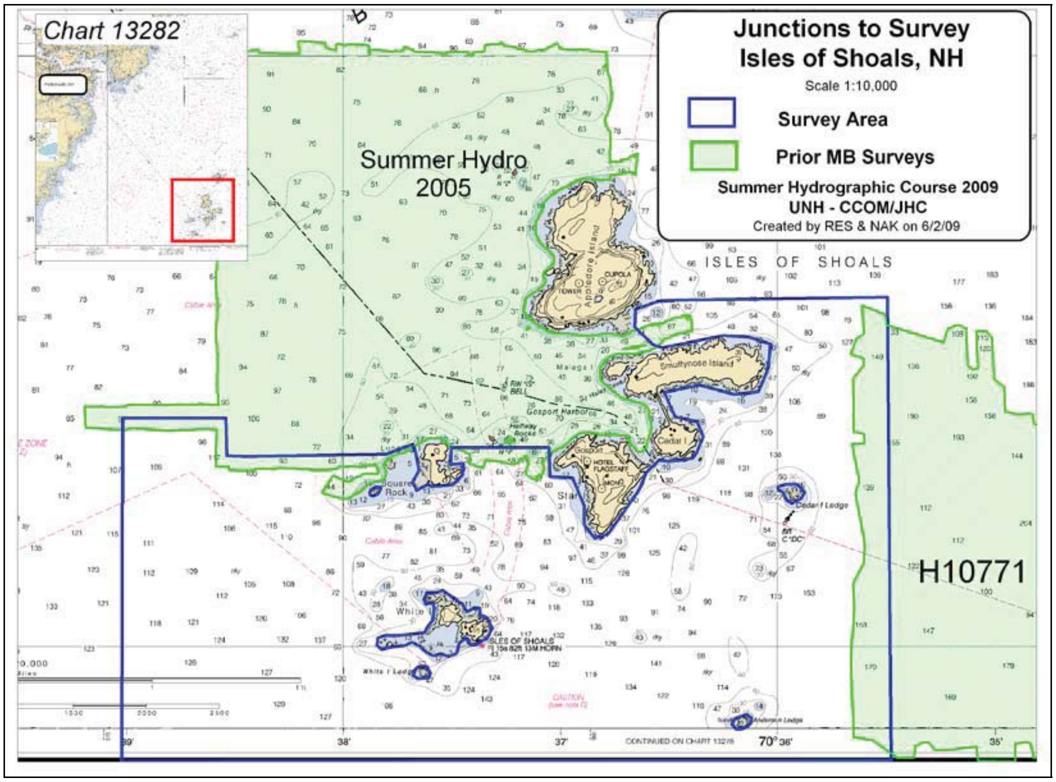

Figure 6. Prior multibeam surveys (green) junctioned with field sheet (blue). Chart inset indicates the locations of the Isles of Shoals (red box) relative to the Portsmouth Harbor coastline.

2005 Summer Hydro Junction

The data from the 2005 Summer Hydro class survey was acquired with the same vessel and sonar system used for this survey. The data from 2005 has not yet been submitted to NOAA. The processed 1 meter CUBE surfaces from the 2005 survey and this survey were compared by creating a difference surface using IVS Fledermaus. The 2009 survey is on average 0.160m deeper than the 2005 data. The differences between the data sets are generally consistent, with higher differences on the edges of each surveys coverage areas. The hydrographic team suspects that the difference arises from errors in the sonar offset measurements used for the 2005 survey and recommends that in the overlaying areas that depths from this survey be favored. The differences are within the allowable error tolerance for this survey.

Additional Junctions

The results from this survey were also compared with two surveys that have been previously accepted by NOAA. These surveys are the 2005 LIDAR H11296 and the 1997 survey H10771 by the NOAA Ship Rude.

The binary LIDAR data (S-57 format) was converted into GeoJSON format utilizing FWTools ver.2.3.0 to extract coordinates and depth data. The data was extracted and formatted to an xyz file; longitude and latitude are in degrees and water depth is in meters below the sea surface (designated by a negative number). This is the same data format of the H10771 data. Both the hydrographic and LIDAR data were converted into pixel node registration grid data (NetCDF format) utilizing the xyz2grd command of Generic Mapping Tools (GMT) ver.4.3.1. The grid size was set to 1 m x 1 m to express the depth of specific points, since these xyz data were not equally spaced.

The 1 meter xyz data of our measurements were exported from Caris HIPS ver.6.1 and also converted to pixel node grid data. The depth difference between this survey and the junction surveys the overlapping areas was calculated by subtraction; a "grdmath OR" command of GMT was applied for limiting the range of the junction area, and the "grdmath SUB" command was used for creating the grid data of the depth difference.

The results are shown in Figures 7 and 8, which show the distribution of overlapping points as compared with the previous data and indicate the magnitude of the depth difference. The dark gray area designates the 2009 hydrographic survey data, with the greenish gray and bluish gray areas corresponding to the H10771 bathymetric data and the H11296 LIDAR data, respectively. The percentages of the depth difference are shown in Table 12. The points that range from -0.5 to 0.5 m in depth difference account for 65.5 % of all data points. The percentages of points that are more than 1 m and less than 1 m in difference are 12.9 % and 0.9 %, respectively. Points showing the largest differences are frequently concentrated where the relief is steeper, which is typically located around the islands.

The hydrographic team recommends that depths from this survey supersede depths from both H10771 and H11296 owing to the superior resolution and density and improved technology inherent in this survey. ***Concur.***

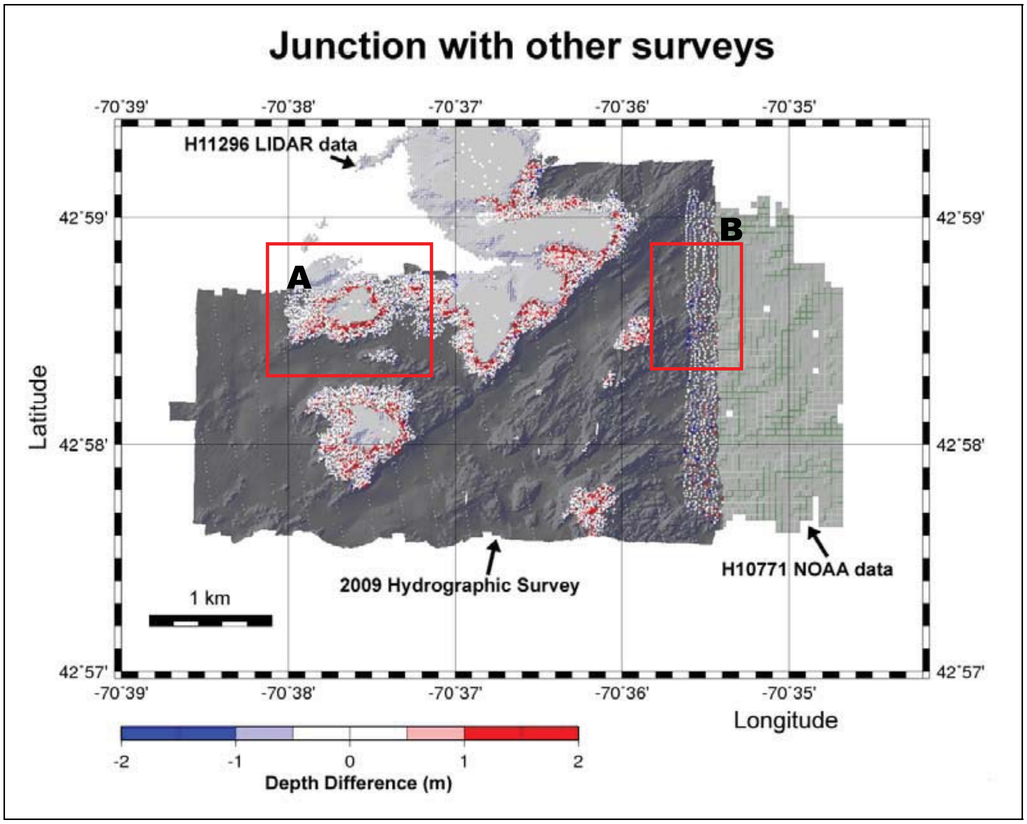

Figure 7. Depth differences between this 2009 hydrographic survey (dark gray area) and previous data (H11296 LIDAR survey: bluish gray, H10771 hydrographic survey: greenish gray) are plotted as colored dots (blue, white and red) on the topographic map. Red and blue dots indicate where the previous data are shallower or deeper than the 2009 data, respectively.

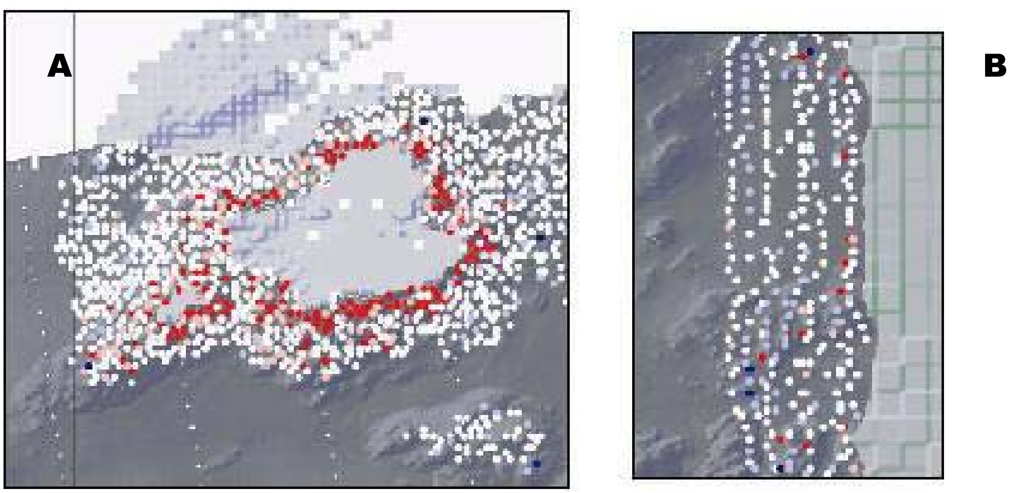

Figure 8. Close-up view of area A and area B from Figure 7. Depth differences between this 2009 hydrographic survey (dark gray area) and previous data (H11296 LIDAR survey: bluish gray, H10771 hydrographic survey: greenish gray) are plotted as colored dots (blue, white and red) on the topographic map. Red and blue dots indicate where the previous data are shallower or deeper than the 2009 data, respectively.

Table 12. Distribution of depth difference ranges pertaining to Figures 7 and 8.

Depth difference	H10771	H11296	Total	Color
< -1.0 m	2.4 %	0.6 %	0.9 %	
-1.0 m ~ -0.5 m	20.7 %	3.5 %	5.8 %	
-0.5 m ~ 0.5 m	64.7 %	65.6 %	65.5 %	
0.5 m ~ 1.0 m	6.4 %	16.3 %	15.0 %	
> 1.0 m	5.9 %	14.0 %	12.9 %	

C5. Corrections to Echosounding

Vessel offsets were measured prior to the survey. The survey mark on the top of the IMU was taken to be the reference point of the vessel. Angular offsets were determined from the patch test described in C.4.2. All offsets were entered into SIS and were corrected for on acquisition with the exception of dynamic draft, which was corrected for in post-processing using Caris HIPS. Table 13 shows all offsets entered into SIS. For more detail on the offset measurements see *Appendix III* (Vessel Description and Offsets).* ****Appended to this report***

Table 13. Vessel offsets aboard the R/V Coastal Surveyor configured with the Kongsberg 3002D multibeam echosounder.

All dimensions are in meters	X (forward is positive)	Y (starboard is positive)	Z (down is positive)	Comment
IMU	0.000	0.000	0.000	IMU is reference point
Transducer 1	9.007	-0.226	1.093	Port transducer
Transducer 2	9.007	0.226	1.093	Starboard transducer
Primary GPS antenna	-0.052	-1.103	-3.570	Entered in POS

SVP

Sound velocity casts were taken using the AML SV Plus Profiler with a maximum sampling interval of four hours during data acquisition. The sound velocity profiles were loaded into SIS and were applied on acquisition. For further information and documention see *Separates II* (Sound Velocity Profile Data and Calibration Files)*. ****Submitted with original field records***

Tide

Water level correctors were applied in Caris to reduce the data to MLLW. Correctors were based on the permanent NOAA water level gauge at Ft. Point, NH (Station 8423898). (See D1. Vertical Control for more information on water level correctors.)

C6. Data Processing

The data were acquired between June 11 and June 20, 2009 (DN 162-171). The results were examined informally each day, and preliminary base surfaces to review data quality and aid in planning. The final processing was carried out from June 22 to June 26, 2009.

Data processing was performed using Caris HIPS software and the final depth information for this survey is submitted as a Caris Base surface which best represented the seafloor at the time of the 2009 survey. All possible measures were taken to ensure the data was correctly processed and represented the least depth of significant contacts, which were retained in the finalized surfaces.

A Combined Uncertainty and Bathymetry Estimator (CUBE) surface was created with a resolution of 1.0 m throughout the survey area. The individual sounding data and the CUBE surface was inspected using subset editor in Caris HIPS. Obvious data outliers were manually flagged as rejected.

Quality control checks were conducted to ensure that the lines were imported correctly and projected in the appropriate coordinate system. The finalized base surface was also inspected for any arrant blunders and inconsistencies and to ensure least depth over significant features were appropriately represented.

D. Vertical and Horizontal Control

D1. Vertical Control

All sounding data were initially reduced to Mean Lower Low Water (MLLW) using predicted water levels from the NOAA tide station located at Fort Point, NH, station number: 8423898 (Table 14), using the zone corrector NA169 (Table 15). Data were then corrected with preliminary and then verified observed water levels as the data became available on the NOAA Tides and Currents website. The zone corrector was applied to using Microsoft Excel and transformed to a Caris .tid file. The resultant tide file “Ft_Point_zoned_vrfy.tid” has been applied to this survey.

Verified water levels have been applied to this survey.

Table 14. Tidal gauge information.

Gauge	Model	Gauge Type	Location	Latitude	Longitude	Operational
8423898	NOAA Primary	Acoustic	Fort Point, NH	43° 4.3' N	70° 42.7' W	permanent

Table 15. Tide Zone from Fort Point, NH.

Zone	Site	Station number	Time	Range Ratio
NA169	Fort Point	8423898	-6 min	1.00

A secondary water level gauge was also installed on the Star Island pier. This gauge was operational throughout the survey, but data gaps, time stamping issues for a portion of the data, and lack of sufficient observation duration precluded the use of this gauge for datum determination. The water level data from this gauge has not been used to correct depths measured in this survey, but the data does confirm the appropriateness of the tide zoning that has been applied. The difference between the zoned water levels from Ft. Point and the Star Island gauge are shown in Figure 9. To compensate for the distance the Star Island gauge is below MLLW, the mean of the difference between the Star Island and the zoned Ft. Point data has been subtracted from the Star Island data. This mean difference of 0.44m is the approximate distance that the Star Island gauge was below MLLW.

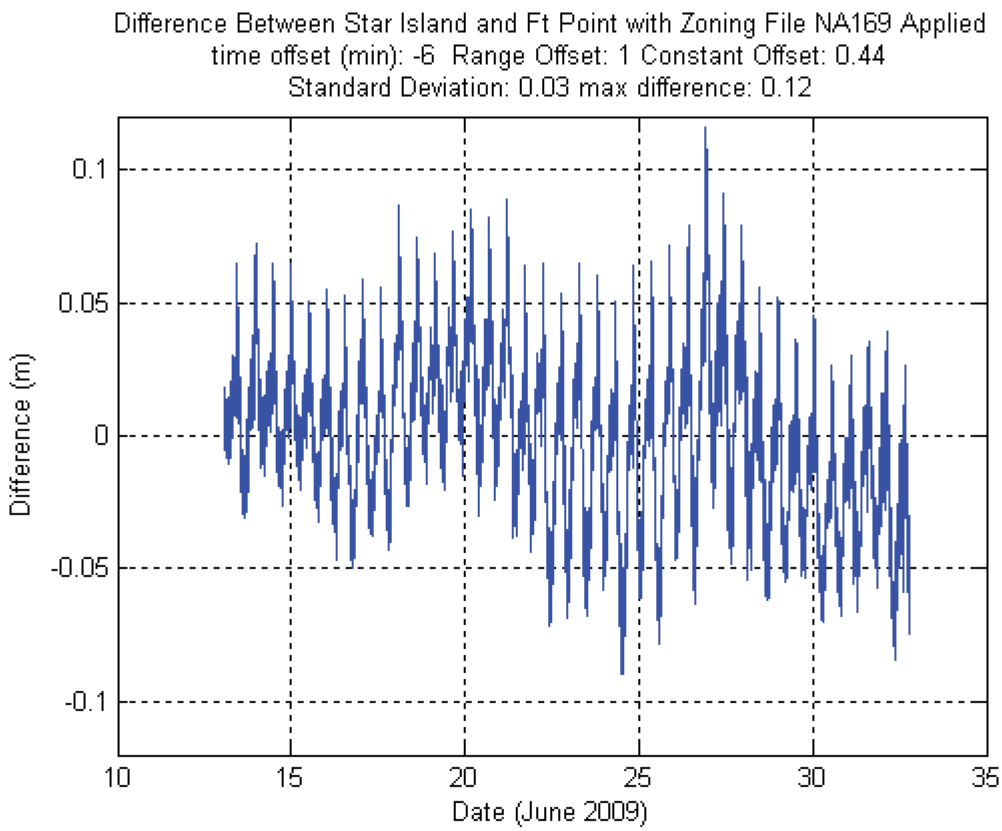

Figure 9. Difference between Star Island temporary gauge and zoned water levels based on the permanent NOAA gauge at Ft. Point. The mean difference of 0.44m has been removed from the data to approximate for the distance the Star Island gauge was below MLLW. Dates shown as June 31 and 32 correspond to July 1 and 2.

The standard deviation of the difference between the zoned water levels and those observed at the gauge is 0.03 m. The maximum observed difference is 0.12 m, though this was observed after data acquisition had ended. This comparison does not include data from the first day of survey operations on June 11 as time stamping issues corrupt that data. This analysis supports the reasonableness of the zoning that has been applied to the data. ***Concur.***

D2. Horizontal Control

The horizontal control datum used for this survey was the North American Datum of 1983 (NAD83). All raw positions were collected in WGS84 and transformed to NAD83 during post-processing in Caris HIPS.

E. Results and Recommendations

This survey, as shown in Figure 10, meets NOAA specifications and should be used to update the affected charts. ***Concur.***

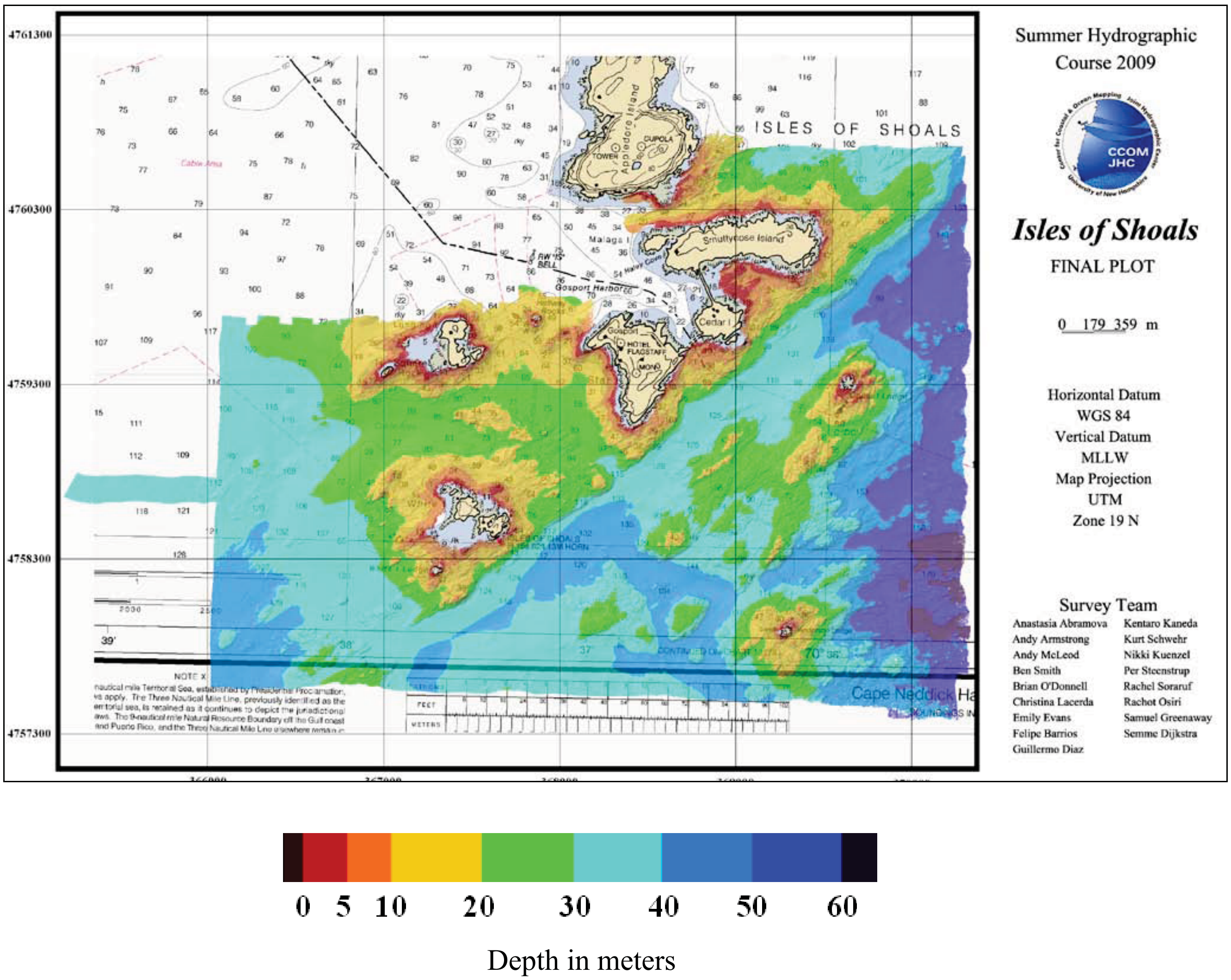

Figure 10. Plot of the survey area overlain on NOAA chart 13283. Associated color bar indicates corresponding depths in meters.

E1. Chart Comparisons

The final base surface (Figure 10) was compared with the largest scale chart for this area: 13283, 20th edition, October 2009, scale 1:20 000. An initial comparison of the survey data was performed highlighting shoal areas, named hazards, and locations of potential discrepancy between the survey dataset and the chart. All flagged discrepancies and dangers to navigation (DTONS) are reported in the following sections.

The following chart comparison is performed using color schemes based on contour intervals see in Table 16. The processed Caris base surface is overlain on raster chart 13283 for comparison. The chart comparison indicates that nearly all currently charted depth curves should be recompiled by cartographers in accordance with updated depth measurements obtained during this survey. Additionally, there are multiple shoal areas that were previously uncharted, where new depth curves should be added to the applicable nautical charts. Figure 11 illustrates one such example where charted soundings give no prior indication of the irregular nature of the seafloor in the vicinity of the Isles of Shoals. The least depth on the feature seen in Figure 11 is 65 ft, which is significantly shallower than the charted 119 ft sounding in the area. The hydrographic team recommends updates to soundings on the charts affected by this survey. ***Concur with clarification. Area shown in Figure 11 is in the vicinity of 42-57-45N 70-36-57W.***

Table 16. Contour color designations for chart comparison figures; the images all utilized contour intervals designated by different color schemes. Depth contours are designated by the following intervals: 0-6 ft (red), 6-12 ft (yellow), 12-18 ft (green), 18-30 ft (light blue), 30-60 ft (dark blue), and 60-246 ft (pale yellow).

Range of Contour Intervals in feet	Color
0-6	
6-12	
12-18	
18-30	
30-60	
60-250 (max depth)	

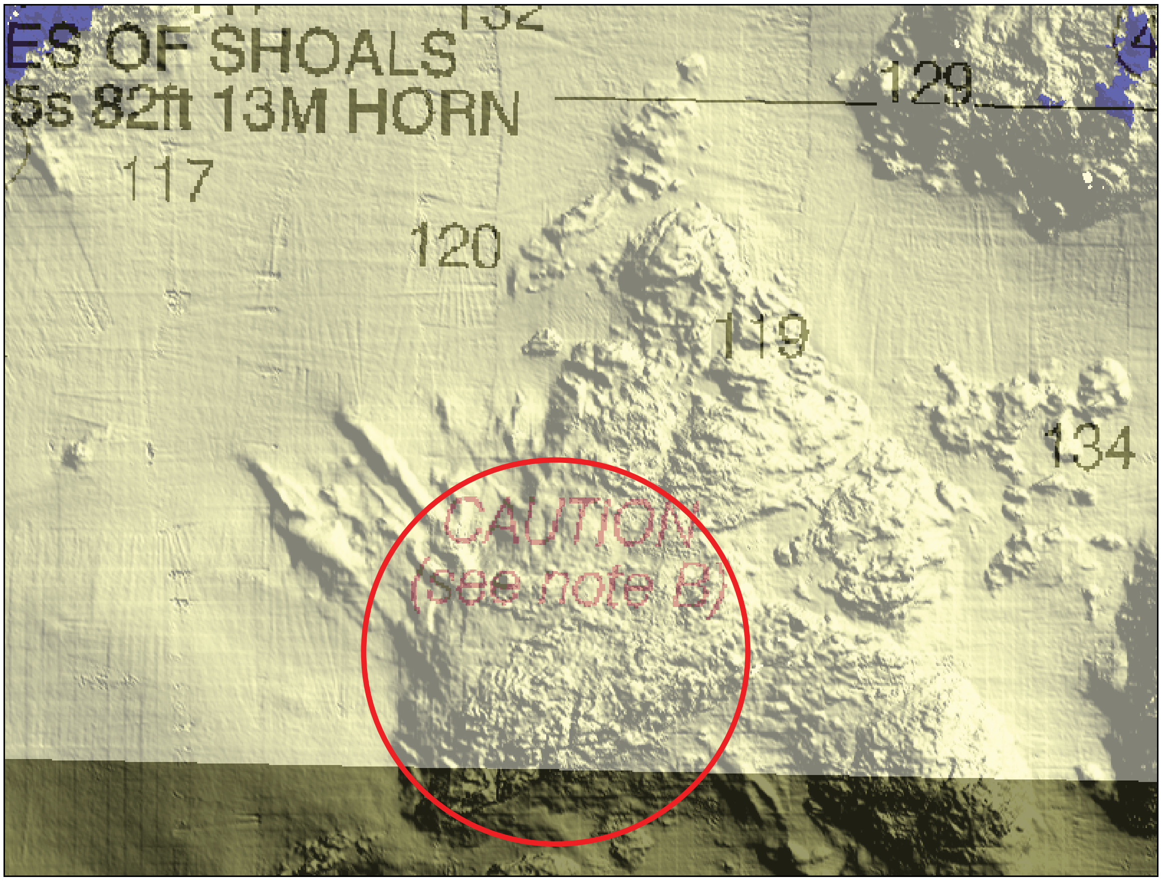

Figure 11. Irregular features and shoals located in formerly sparsely surveyed areas with Chart 13283 overlain on multibeam derived base surface. The least depth of this feature is 65 ft. Pale yellow color indicates that depths in this area exceed 60 ft depth (see Table 16 for contour intervals).

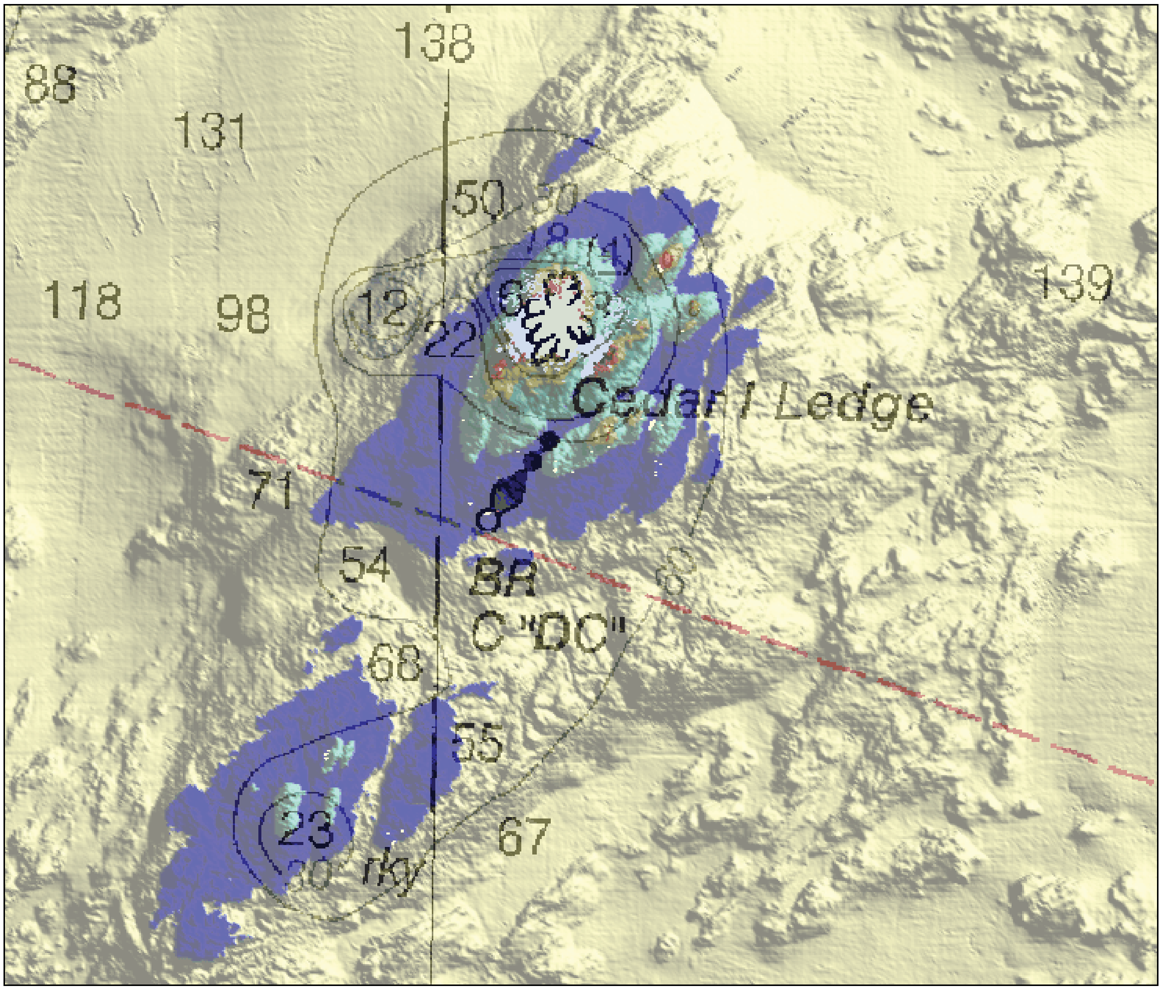

Figure 12. Cedar Island Ledge indicating feature shape, extents, and depth contours. Note 12 ft sounding to the west of Cedar Island Ledge is disproved by 100% multibeam coverage. Colored contour intervals are based on Table 16.

This survey found Cedar Island Ledge to be significantly different than charted. This ledge is presently charted as a directionally east-west running ledge. In actuality, the ledge expands in a southwest to northeast direction as seen in Figure 12. Figure 12 clearly illustrates the discrepancies between charted feature extents and what was obtained during this survey. The hydrographic team recommends re-charting Cedar Island Ledge to more accurately depict the feature shape, extents, and associated depth contours. In addition, the charted 12 ft sounding, on the western side of Cedar Island Ledge (see Figure 11), has been disproved with 100% multibeam coverage. The hydrographic team recommends removal of the charted sounding in conjunction with depth contour reconfiguration surrounding Cedar Island Ledge. This addresses item three of the recommended additional survey work from the "Atlantic Hydrographic Branch Evaluation Report to Accompany Survey H11296". ***Concur. Area shown in figure 12 is in the vicinity of 42-58-30N 70-35-55W.***

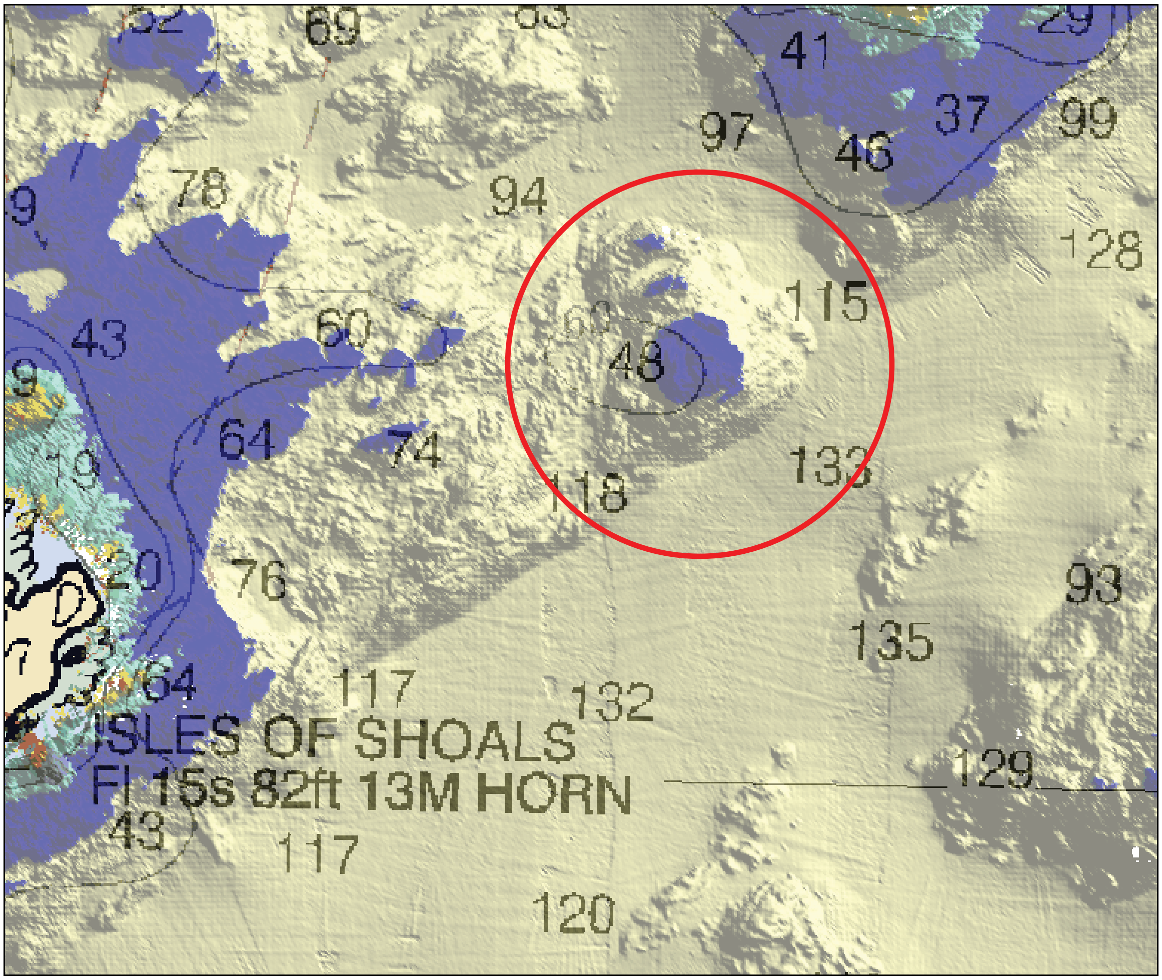

Figure 13. Charted 48 foot sounding should be changed to 38 foot sounding; 60 ft contour should be re-drawn to accurately depict the multibeam coverage. (See Table 16 for contour color description.)

Figure 13 indicates a charted 48 ft sounding inside a 60 ft contour. Full-coverage multibeam detected a least depth of ~~38~~ ***40***ft in the region. The hydrographic team recommends updating the chart with the ~~38~~ ***40***ft sounding and re-drawing associated depth curves. ***Concur. Area shown in figure 13 is in the vicinity of 42-58-11N 70-36-57W.***

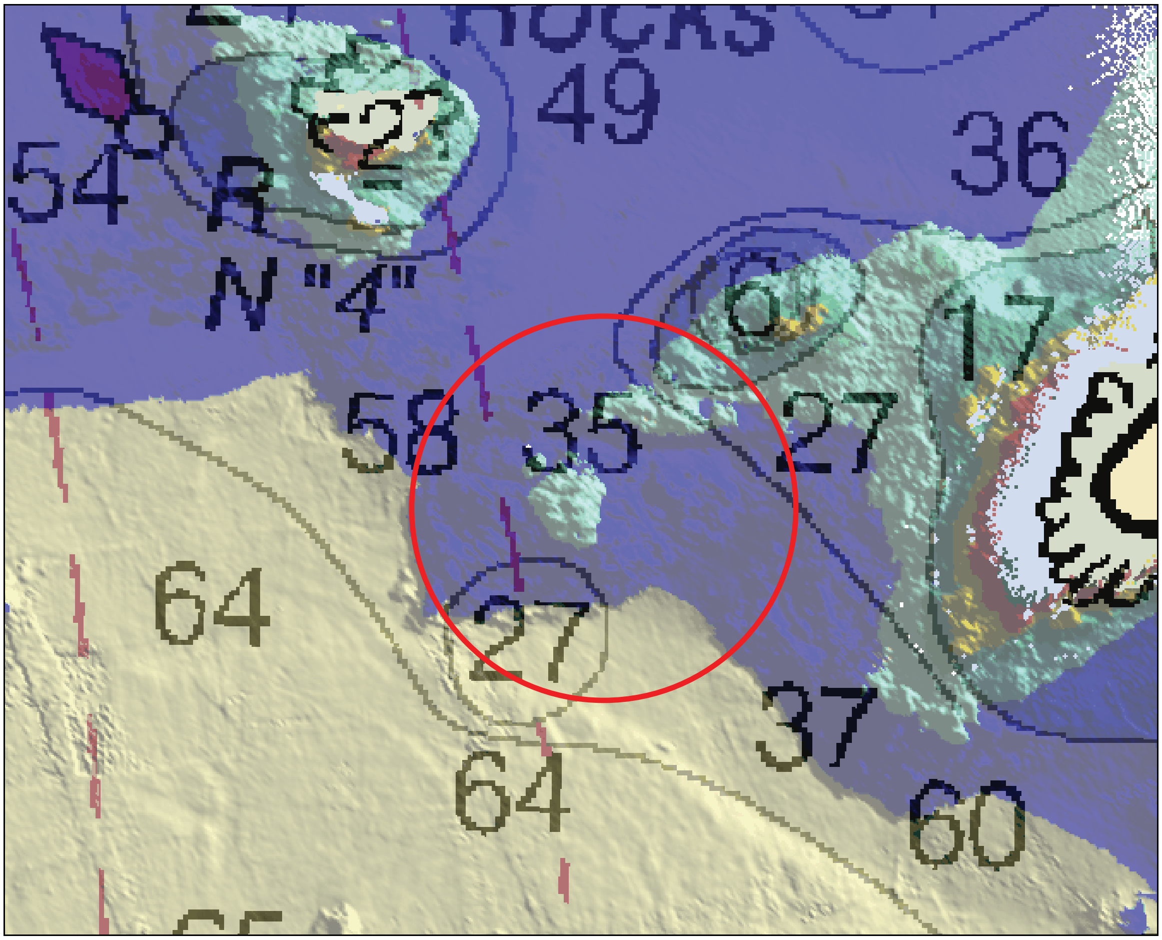

Figure 14. Uncharted rock with a depth sounding of ~21.9 ft. Recommend charting features and removing the 35 foot sounding. (See Table 16 for contour identification.)

Figure 14 indicates an uncharted rock of ~~~21.9~~ ***22.643*** ft located directly below a charted 35 ft sounding off the northwestern side of Star Island. The hydrographic team recommends charting a 22 ft rock and removing the 35 foot sounding. ***Concur with clarification. Area shown in figure 14 is in the vicinity of 42-58-36N 70-37-10W. Recommend to chart a 22ft sounding at survey location. The sounding is within a newly digitized rocky seabed area, included with the H-Cell Deliverable.***

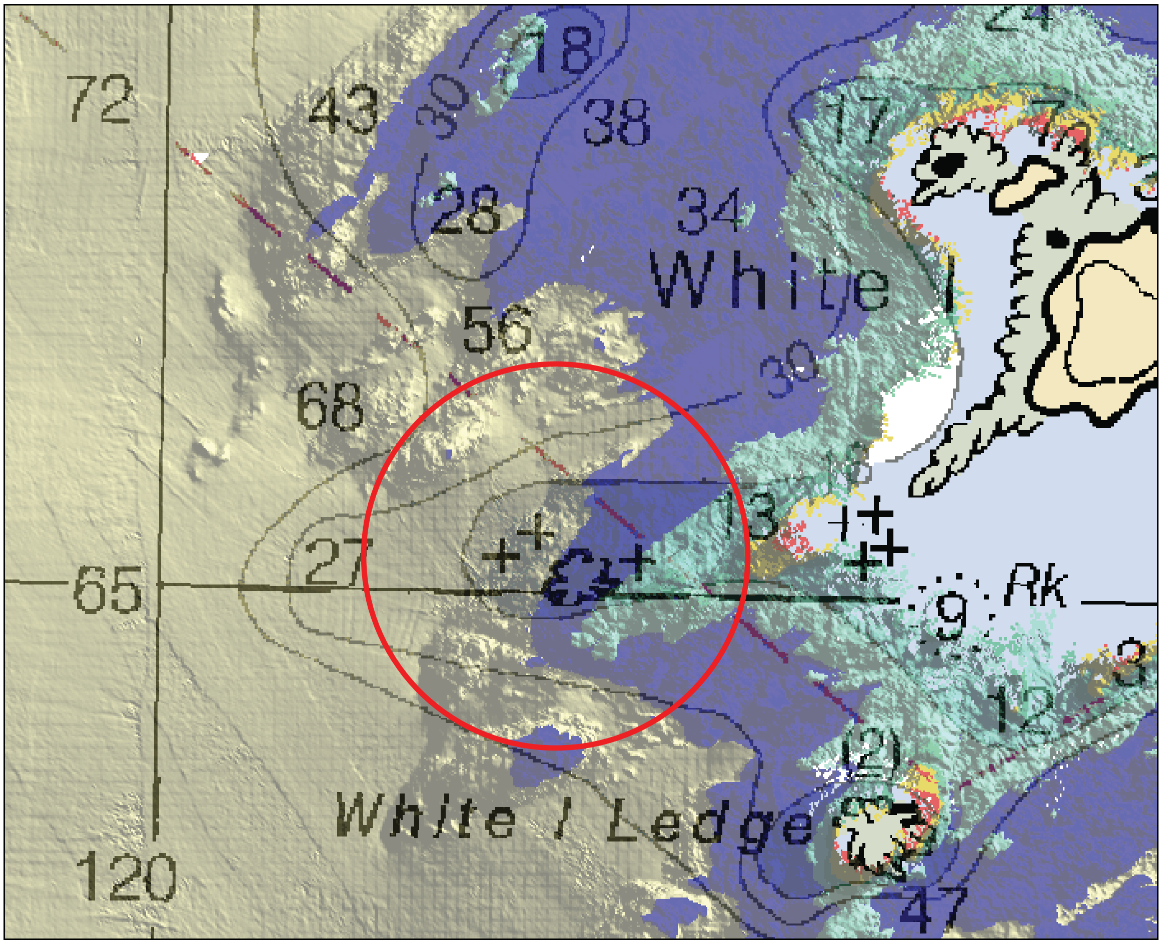

Figure 15. Disproval of charted reef and 3 charted rocks on southwestern side of White Island. Recommend removal of charted features and re-draw contour lines in area.

Figure 15 shows a charted reef and 3 surrounding charted rock symbols west of White Island. The charted features have been disproved with 100% multibeam coverage. The hydrographic team recommends the removal of the charted rocks and reef. The chart should be adjusted to the appropriate depth contours as determined by the multibeam coverage. This addresses item four of the recommended additional survey work from the "Atlantic Hydrographic Branch Evaluation Report to Accompany Survey H11296". ***Concur. Area shown in figure 15 is in the vicinity of 42-58-00N 70-37-47W.***

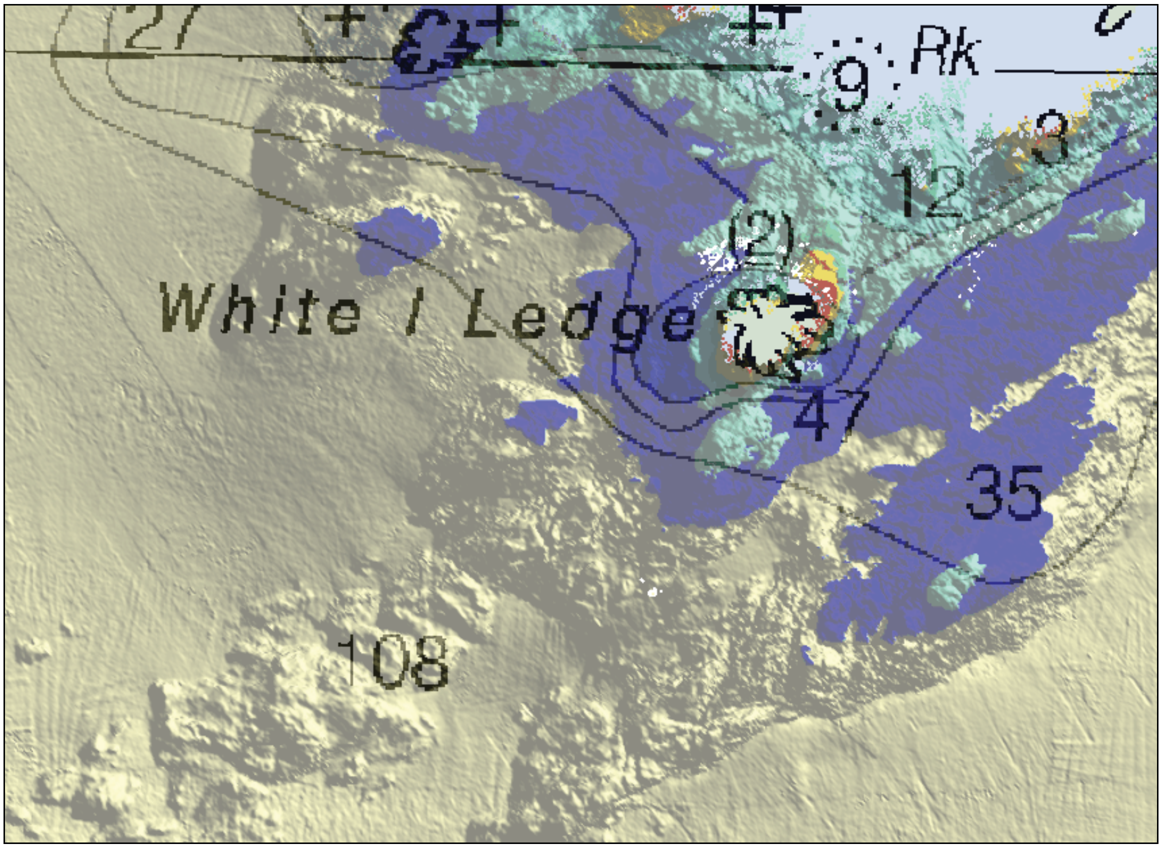

Figure 16. White Island Ledge extends further south than currently charted with least depth soundings of 20ft in charted 30-60ft depths. Recommend extending White Island Ledge extends to include 20ft soundings and establish new contour lines around ledge (See Table 16 for contour intervals.)

The rocky area extending from White Island Ledge extends farther south than currently indicated on Chart 12383 (see Figure 16). The depth contours should be extended to encompass ~~20~~ ***19***ft depth soundings, which currently reside in 30-60 ft depth contour regions. ***Concur with clarification. Area shown in figure 16 is in the vicinity of 42-57-52N 70-37-40W. H-Cell includes a 19ft sounding at 42-57-52.2902N, 70-37-39.0082W.***

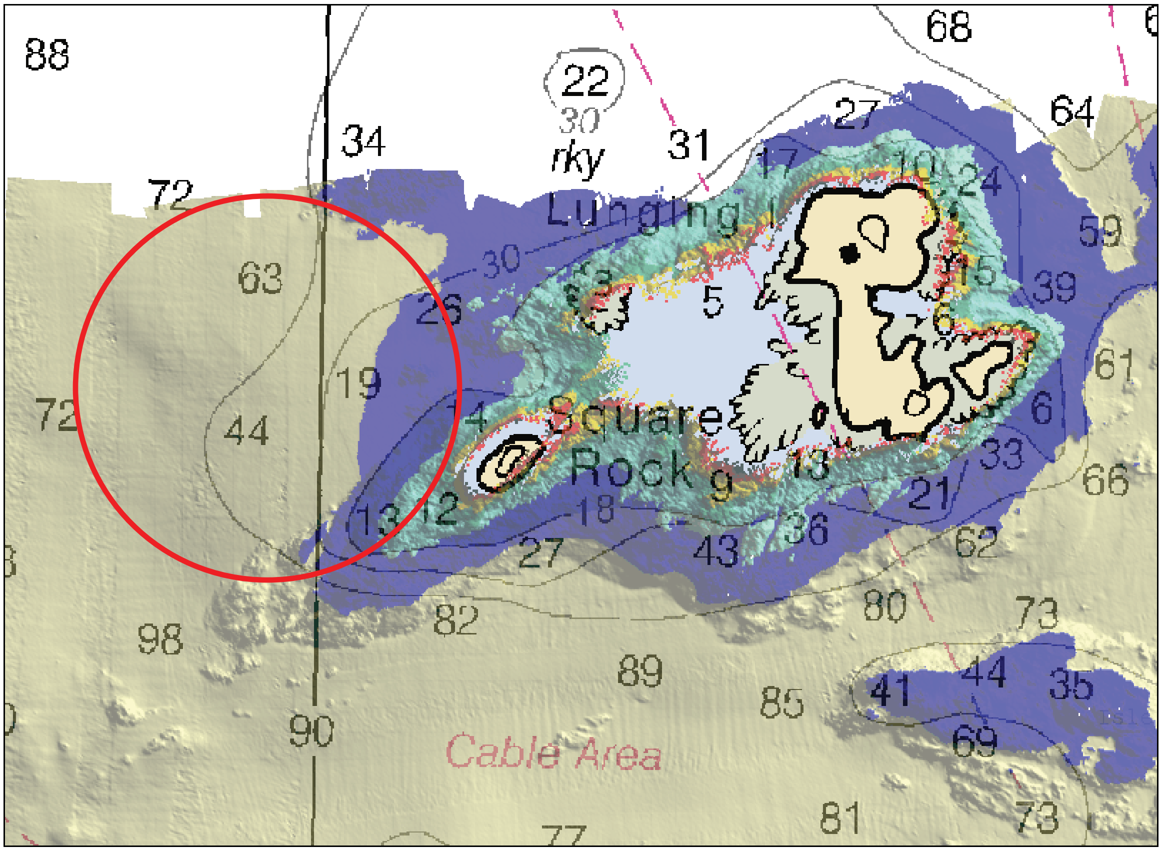

Figure 17. This figure addresses item five as described in LIDAR survey H11296; charted contour extents need to be updated to more accurately depict the sea floor. See Table 16 for color contour index.

Figure 17 addresses item five of the Recommended Additional Survey Work from the "Atlantic Hydrographic Branch Evaluation Report to Accompany Survey H11296". The instructions from the reviewing hydrographic branch, for H11296, indicated the need for verification of the existence of this shoal area (44 ft and 19 ft charted soundings). It was recommended that this charted shoal be verified or disproved. The depth soundings indicate that the shoal is improperly charted and the contour lines should be re-charted base on depths from this survey. ***Concur. Area shown in figure 17 is in the vicinity of 42-58-35N 70-38-01W.***

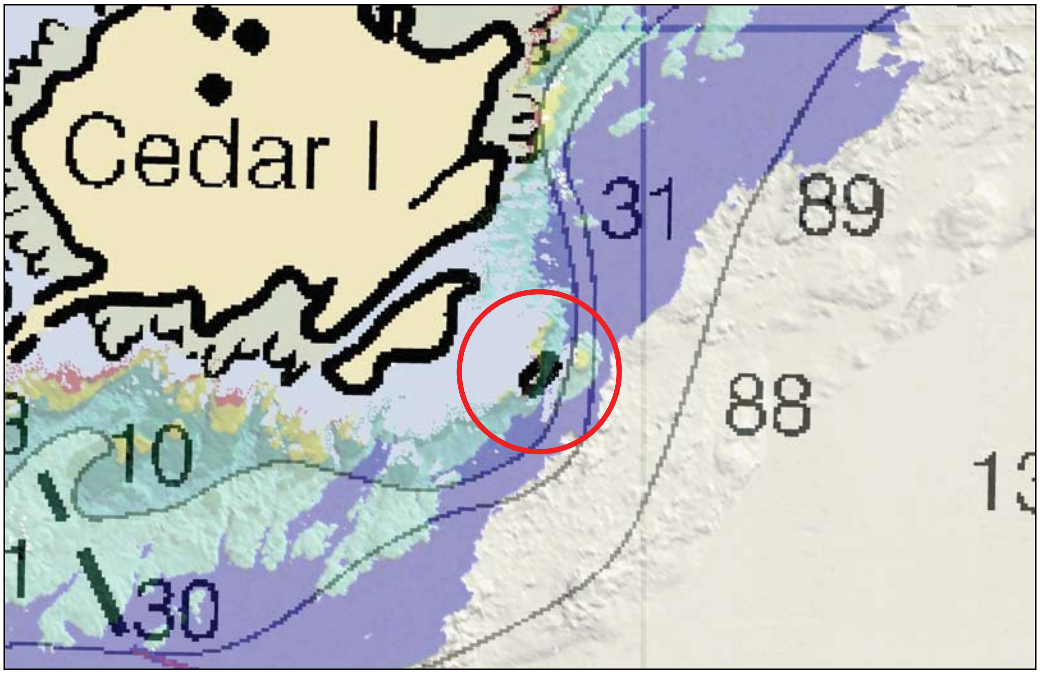

Figure 18. The charted islet immediately east of Cedar Island was observed to cover at high water.

Figure 19. Photo of charted islet looking southwest. Hotel on Star Island is visible to left. Stage of tide is unknown, but is not high. Charted Islet was observed to cover at high water.

The charted islet immediately east of Cedar Island was observed to be a rock that covers at high tide (Figure 18 and 19). A height was not obtained on this rock. The hydrographic team recommends removing the charted islet and charting a rock. Use height from LIDAR if available. ***Concur. H-Cell includes a rock awash at 42-58-37.9943N, 70-36-21.3181W.***

In addition, there may be a displacement in the charted shoreline from the actual position. However, no shoreline work was performed during this survey. The hydrographic team recommends that the shoreline be updated with additional photogrametric or field work.

E2. AWOIS

There were no pre-existing AWOIS items in the area pertaining to this hydrographic survey. ***Concur.***

E3. Aids to Navigation

There are three (3) floating aids to navigation (ATON) and one fixed light within the survey area. The charted positions of the floating aids were verified on June 15, 2009 (DN166) by RTK GPS Positioning. The fixed light on White Island (Isles of Shoals, light list number 235) was observed to be correctly charted and was operating throughout the survey. In addition to the US Coast Guard maintained ATONs, there is a charted spindle, monument, and flagpole within the survey area. These visual aids to navigation were visually verified to be correctly charted, but were not explicitly positioned. Further documentation and description can be found in *Appendix II** *(Aids to Navigation Report).* ****Appended to this document.***

E4. Dangers to Navigation

Dangers to Navigation found within the survey area, shown in Table 17, have been submitted to the hydrographic processing branch for immediate processing and addition to the appropriate nautical charts. For full DTON report, see *Appendix I** *(Danger to Navigation Report).* ****Appended to this document***

Table 17. DTON in the vicinity of Isles of Shoals.

No.	General vicinity	Feature	Depth (ft)	Depth (m)	Lat (DMS)	Lon (DMS)	Dp TPE (ft)	Dp TPE (m)	Hz TPE (m)
1	White Island	Rock	~~3.86~~	~~1.18~~	~~42-58-02.62N~~	~~070-37-18.40W~~	~~0.97~~	~~0.30~~	~~0.267~~
			3.71	***1.13***	***42-58-02.54N***	***070-37-18.31W***	***1.02***	***0.31***	***0.445***
2	Cedar Island Ledge	Rock	0.14	0.04	42-58-32.71N	070-35-51.03W	0.97	0.30	0.258
3	Smuttynose Is.	Rock	6.66	2.03	42-59-09.77N	070-36-32.1~~6~~7W	0.98	0.30	0.254

F. Additional Results

F1. LIDAR

This survey area junctioned with the 2005 LIDAR survey H11296 and addresses the recommended additional survey work from the "Atlantic Hydrographic Branch Evaluation Report to Accompany Survey H11296" where the surveys overlap. ***Concur.***

F2. Cable Areas- condition report

There are numerous cable areas charted within the survey area. There is no evidence of cables in the survey results; however, cables were not specifically searched for in this survey. ***Concur, retain cable areas as charted.***

F3. Overhead features – photographs

There are no overhead features in the survey area. ***Concur.***

F4. Significant/Practical information of survey

The seacoast region of New Hampshire and southern Maine is characterized by a glacially scoured seafloor. Exposed bedrock and glacial features such as drumlins and glacio-erratics (large boulders) dominate the coastal seafloor[1]. The islands making up the Isles of Shoals are large drumlins known as Whale Backs; these resilient granite features were smoothed thousands of years ago by over-riding glaciers, creating protruding outcrops resembling whales floating on the surface of the water. The southeastern side of the islands, or lee-side, designates the direction of movement of the ice sheet, where plucking, rather than scouring, of the rocks leaves jagged surfaces on cliffs and rocks. These same rocky surfaces are visible on the seafloor surrounding the southern portion of the Isles of Shoals.

Acoustic backscatter was also collected during the Isles of Shoals survey from June 11, 2009- June 20, 2009 in conjunction with collecting bathymetric data using the Kongsberg EM3002 dual head multibeam echosounder. A preliminary mosaic was created in FM Geocoder, a part of the IVS 3D Fledermaus 7 software suite. Geocoder provides a means to normalize and correct the backscatter intensities over the swath and the backscatter is radiometrically and geometrically corrected and positioned in a coordinate system which can be useful for remote estimation of seafloor properties and morphology. For further documentation on the procedures and results, see *Appendix V.C* (Supplemental Survey Records- Backscatter Mosaic).*
****Appended to this report***

[1] Novotny, R.F., 1969, The Geology of the Seacoast Region, New Hampshire, New Hampshire Department of Resources and Economic Development, Concord, NH, 46 p.

G. Approval Sheet

Letter of Approval

State: New Hampshire

General Locality: New Hampshire

Sub Locality: Isles of Shoals

Year: 2009

Field operations contributing to the accomplishment of this survey were conducted under my direct supervision with frequent personal checks of progress and adequacy. All surfaces and reports were reviewed in their entirety.

This survey was completed with 100% multibeam coverage. It meets all applicable specifications and requirements and should supersede all prior surveys in common areas. The survey is considered complete and adequate for nautical charting.

CAPT Andrew Armstrong, NOAA (ret.)
Director, Joint Hydrographic Center
Durham, NH

APPENDICES TO HYDROGRAPHIC SURVEY CONDUCTED IN SOUTHERN VICINITY OF ISLES OF SHOALS, NH

JUNE, 2009

TABLE OF CONTENTS

APPENDIX I

DANGER TO NAVIGATION REPORT

Danger to Navigation Report (DTON)

Survey Area: Isles of Shoals, New Hampshire
Surveyed by: University of New Hampshire, CCOM Summer Hydro Class
Date Surveyed: June 11-20, 2009
Survey Platform: R/V Coastal Surveyor, Kongsberg 3002D Multibeam
Chart Affected: 13283, 13274, 13278, 13260, 13009
Horizontal Datum: NAD83

Preliminary observed tides and zoning have been applied to soundings to reduce to MLLW.

Table 1. DTONs in vicinity of Isles of Shoals.

No.	General vicinity	Feature	Depth (ft)	Depth (m)	Lat (DMS)	Lon (DMS)	Dp TPE (ft)	Dp TPE (m)	Hz TPE (m)
1	White Island	Rock	~~3.86~~	~~1.18~~	~~42-58-02.62N~~	~~070-37-18.40W~~	~~0.97~~	~~0.30~~	~~0.267~~
			3.71	***1.13***	***42-58-02.54N***	***070-37-18.31W***	***1.02***	***0.31***	***0.445***
2	Cedar Island Ledge	Rock	0.14	0.04	42-58-32.71N	070-35-51.04~~4~~***3***W	0.97	0.30	0.258
3	Smuttynose Is.	Rock	6.66	2.03	42-59-09.77N	070-36-32.16~~6~~***7***W	0.98	0.30	0.254

1. DTON in vicinity of White Island

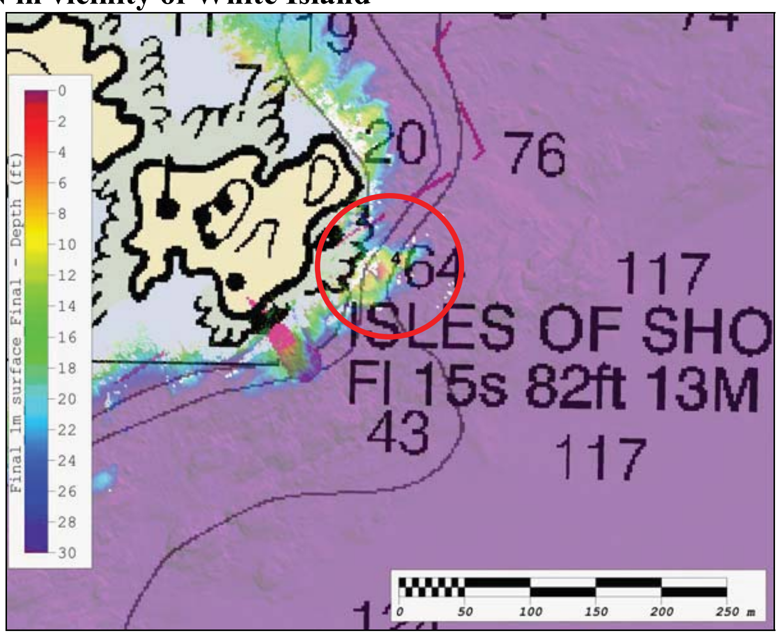

Figure 1. DTON in vicinity of White Island. Survey soundings are in NOAA rounded feet, chart soundings in feet, overlaid on NOAA chart 13283.

Hydrographic Team Comments
Submerged rock off of White Island. Pending recompilation of chart, recommend charting as rock of known least depth. This feature was found by lidar in the 2005 survey H11296 with a least depth of 3ft, but has not been reported as a DTON or compiled to the chart.
Concur. Chart rock at survey depth and location.

<u>Recommended S-57 Attribution</u>
Object Class: Underwater/awash rock
Acronym: UWTROC (P)
Attributes
NATSUR (nature of Surface): 9, rock
QUASOU (Quality of sounding measurement): 6, least depth known
VALSOU(Value of sounding): 1.1~~8~~*3* (m)
WATLEV (Water level effect): 3, always under water/submerged

2. DTON in vicinity of Cedar Island Ledge

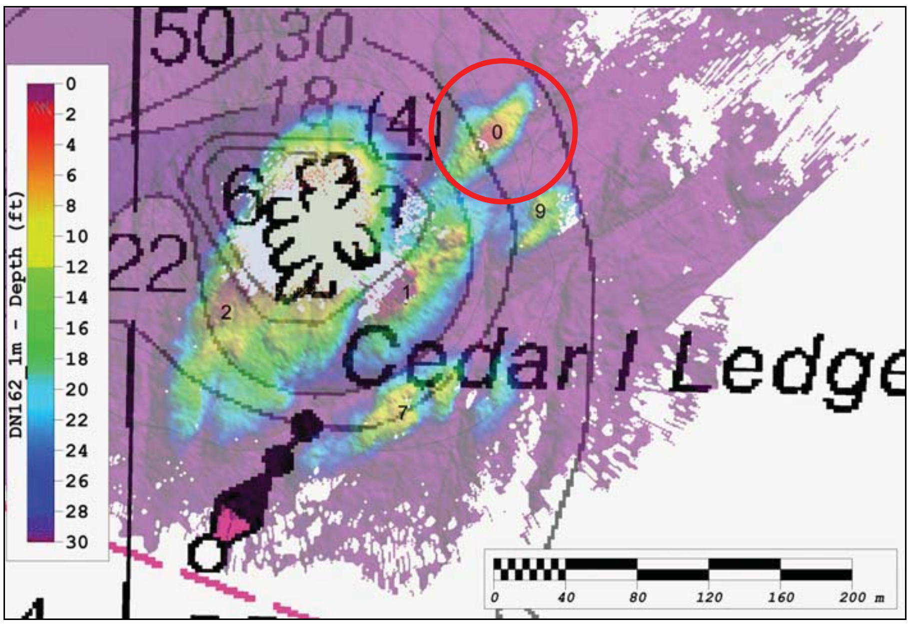

Figure 2. DTON in vicinity of Cedar Island Ledge. Survey soundings are in NOAA rounded feet, chart soundings in feet, overlaid on NOAA chart 13283.

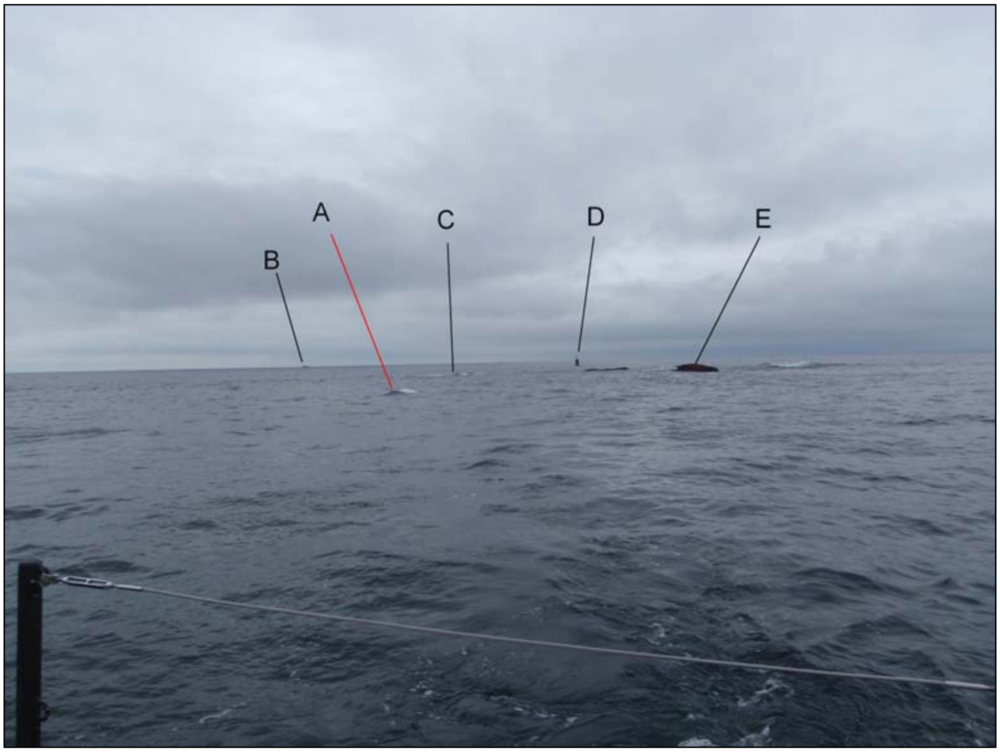

Figure 3. Photograph of Cedar Island Ledge taken looking southwest. Photo was taken at 1500 UTC on June 15. Height of tide is approximately 0.5m above MLLW.

Items in photograph are:

A: DTON, was breaking occasionally in 1-2 ft swell
B: Anderson Ledge
C: 1’ drying rock surveyed to the south east of Cedar Island Ledge, breaking heavily, rock uncovers between waves.
D: Black/ Red Can Buoy “DC”
E: Cedar Island Ledge

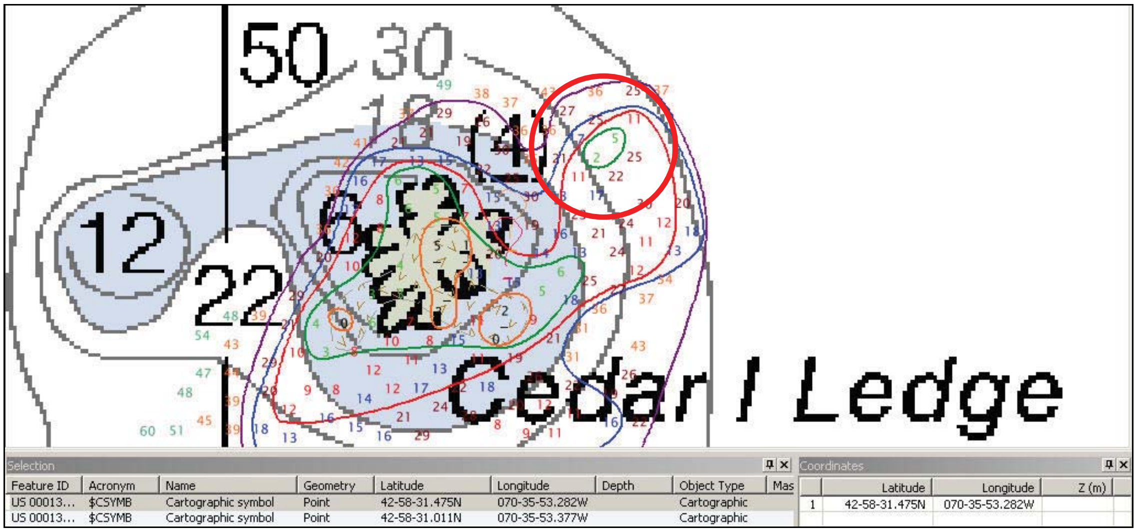

Figure 4. Survey results from 2005 Lidar survey H11296, least depth found by lidar on NE extension of ledge was 2 ft.

<u>Hydrographic Team Comments</u>

Cedar Island Ledge extends beyond charted extents. Ledge is marked by buoy that serves intended purpose. All selected soundings are rock outcrops. Pending recompilation of chart, recommend charting 0 ft sounding northeast of Cedar Island Ledge. Recommend charting as an awash rock of known least depth. This feature was found by lidar in the 2005 survey H11296 with a least depth of 2ft, but has not been reported as a DTON or compiled to the chart. ***Concur with clarification. Chart rock awash as survey depth and location***

Recommended S-57 Attribution
Object Class: Underwater/awash rock
Acronym: UWTROC (P)
Attributes
NATSUR (nature of Surface): 9, rock
QUASOU (Quality of sounding measurement): 6, least depth known
VALSOU(Value of sounding): 0.04 (m)
WATLEV (Water level effect): 5, awash

3. DTON in vicinity of Smuttynose Island

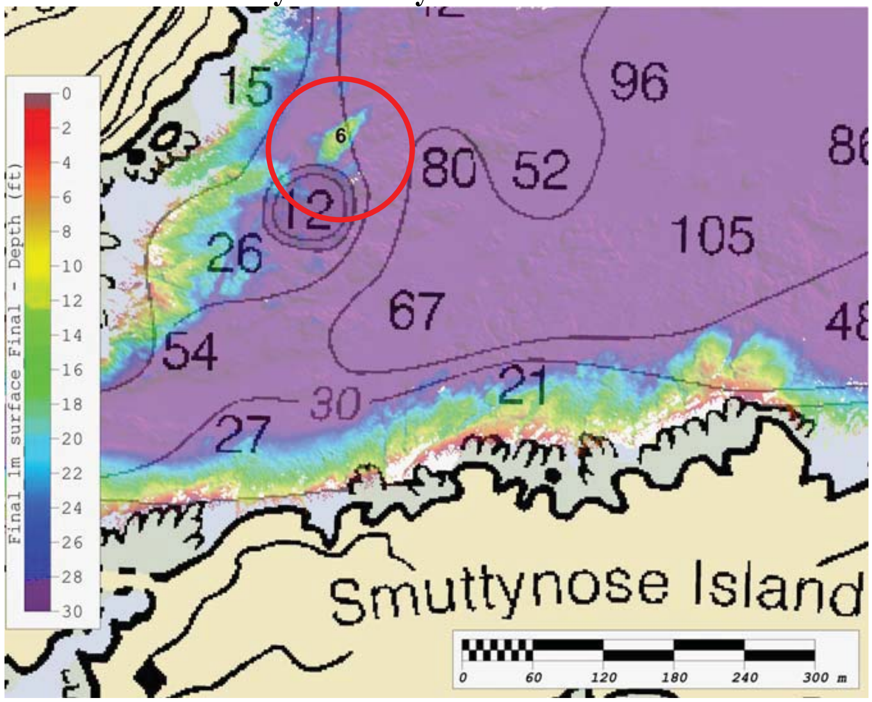

Figure 5. DTON in vicinity of Smuttynose Island. Survey soundings are in NOAA rounded feet, chart soundings in feet, overlaid on NOAA chart 13283.

<u>Hydrographic Team Comments</u>
Submerged rock between Smuttynose and Appledore Islands. Rock is displaced from charted 12 ft sounding. Pending recompilation of chart, recommend charting as rock of known least depth. This feature was found by lidar in the 2005 survey H11296 with a least depth of 7ft, but has not been reported as a DTON or compiled to the chart. ***Concur with clarification. Chart rock at survey depth and location.***

Recommended S-57 Attribution
Object Class: Underwater/awash rock
Acronym: UWTROC (P)
Attributes
NATSUR (nature of Surface): 9, rock
QUASOU (Quality of sounding measurement): 6, least depth known
VALSOU(Value of sounding): 2.03 (m)
WATLEV (Water level effect): 3, always under water/submerged

APPENDIX II

AIDS TO NAVIGATION REPORT

Aids to Navigation Report

There are three (3) floating aids to navigation (ATON) and one fixed light within the survey area at the completion of the fieldwork in June, 20th 2009 (DN 171), as shown by Figure 1 and in Table 1.

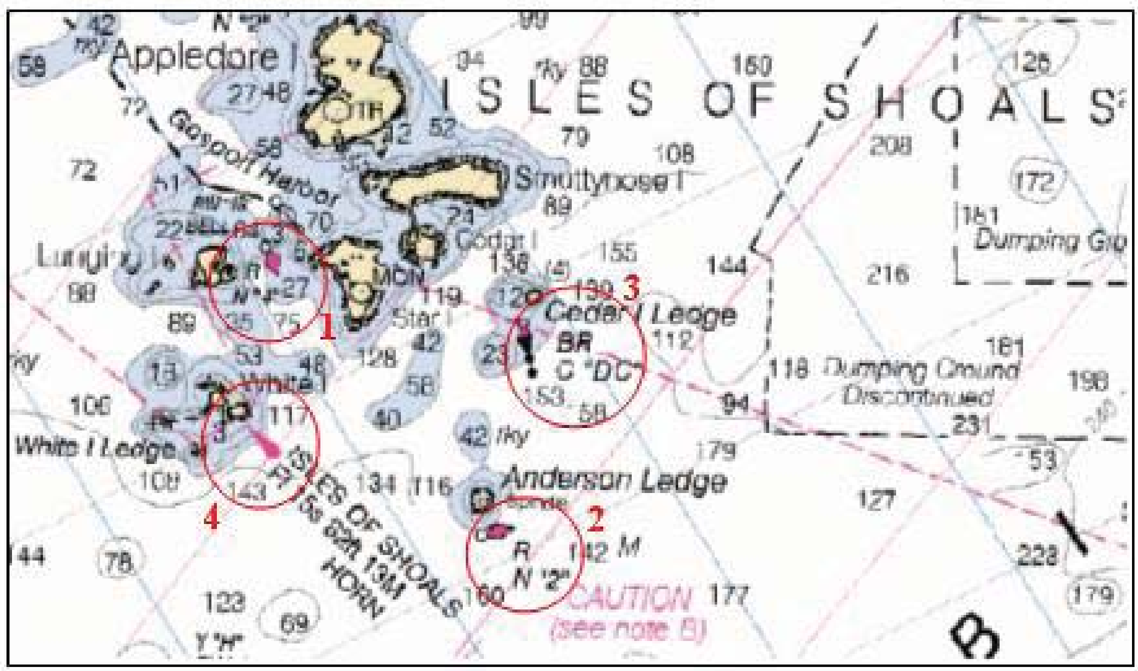

Figure 1. Extract of RNC No. 13278 (scale 1:80,000) showing the charted locations of all aids to navigation in the survey area.

Table 1. The numbered red circles in the Figure 1 and their locations.

1	RN “4”	Halfway Rocks
2	RN “2”	Anderson Ledge
3	BR C “DC”	Cedar Island Ledge
4	Fixed light	White Island

The charted position of the floating aids was verified on June 15, 2009 (DN166) by RTK GPS Positioning where the vessel would approach the ATON from the bow (as shown by Figure 2) and its position was verified against RNC No. 13283. The GPS antenna was positioned somewhere in the bow, in such a way as to be at a distance no greater than 5 m from the floating aid. All were found to be correctly charted and serving their intended purpose. Observed GPS positions are not included in the data for this survey.

Figure 2. Positioning of floating aids to navigation.

The fixed light on White Island (Isle of Shoals, light list number 235) was observed to be correctly charted and was operating throughout the survey. It is shown in Figure 3.

Figure 3. Fixed light on White Island (Isle of Shoals, light list number 235). Photo is looking towards the southwest.

Figures 4 to 7 show the floating ATONs found in the area along with an extract of RNC No. 13278 or 13283 (whichever is the largest scale chart that pictures each ATON) to show how they have been charted.

Figure 4. Aid to Navigation RN "4" also shown in extract from Chart No. 13283.

Figure 5. Aid to Navigation RN "2" is not located within survey area, also shown in extract from Chart No. 13278. Anderson Ledge is partially shown on southern edge of chart 13283, but the buoy marking it is not. Photo is looking to the north.

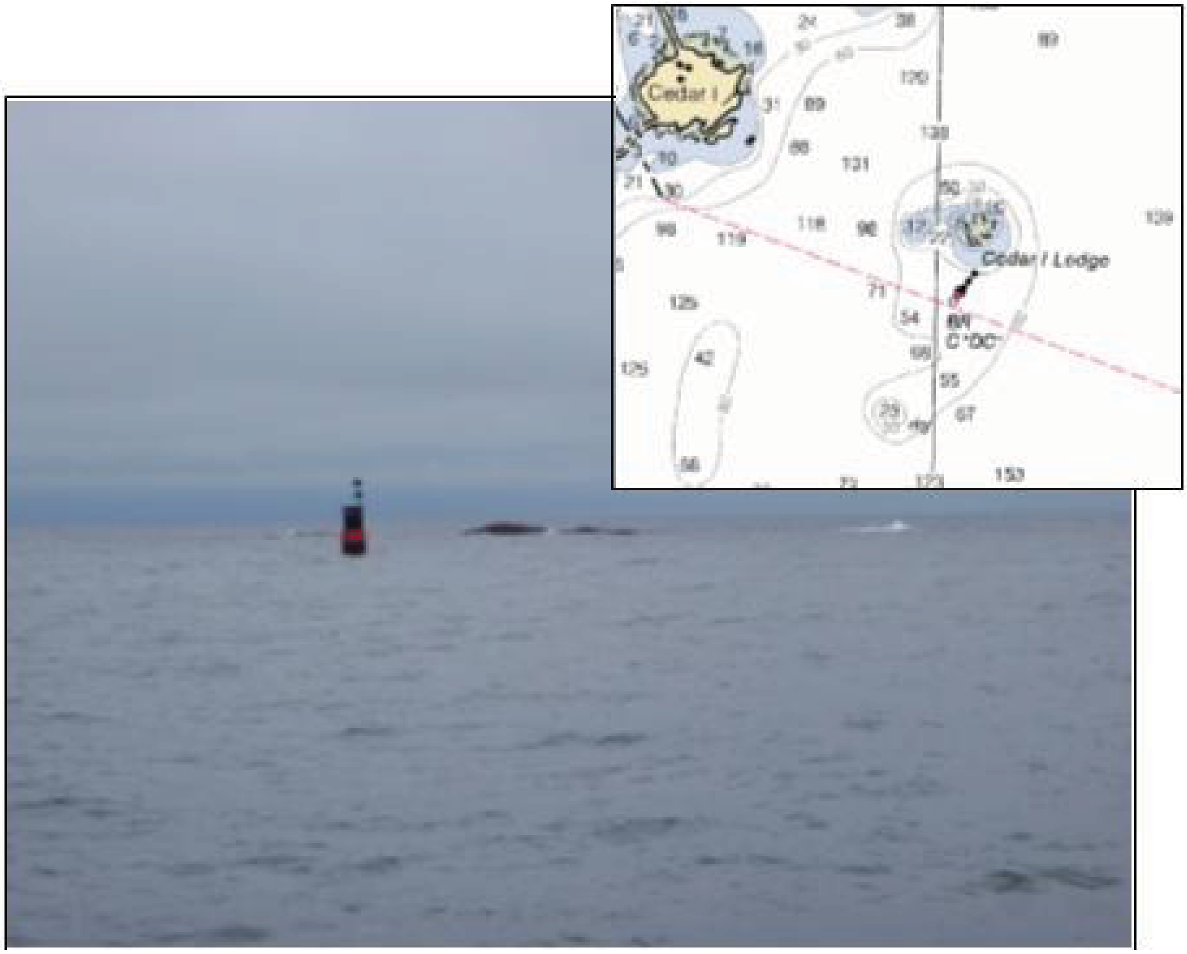

Figure 6. Aid to Navigation BR C "DC", in front of Cedar Ledge, also shown in extract from Chart No. 13283. Photo is looking to the north.

Figure 7. Close up view of Aid to Navigation BR C "DC.

In addition to the US Coast Guard maintained ATONS, there is a charted spindle (Fig. 5), monument (Fig.8), and flagpole at Hotel Flagstaff (Fig. 9) within the survey area. These visual aids to navigation were visually verified to be correctly charted, but were not positioned.

Figure 8. Hotel Flagstaff, viewed from Gosport Pier, looking south.

Figure 9. Star Island Monument (obelisk on right), viewed from southwest.

APPENDIX III

VESSEL DESCRIPTION AND OFFSETS

Vessel Specifications

The R/V Coastal Surveyor was used as the multibeam data acquisition platform. The vessel is 40' (12.19m) in length, 12' (3.66m) in width, and has a draft of 5.5' (1.8m). The vessel is equipped with a mechanical ram-mount on the bow for sonar/instrument mounting. Table 1 shows vessel specifications for the R/V Coastal Surveyor.

Table 1. Vessel specifications for the R/V Coastal Surveyor.

Dimensions:	40' x 12' x 3.7'
USCG:	Designated Research Vessel, subchapter "C"
Flag:	U.S.
Registry:	U.S. Coastwise and Registry
Official Number:	999206
Tonnage:	16 GRT 11 DWT
Lab space:	9' x 11' 6' x 10'
Speed:	10 knots
Minimum speed for full roll stabilization:	5 knots
Minimum survey speed:	2.5 knots
Propulsion:	1 x Cat 3116; 205 shp cont."A"; 2.57:1 reduction
Auxiliary:	1 x Isuzu/Lima 20 kw; 240/120 V; 60 Hz;
Power distribution:	38 ea. 115 volt receptacles 2 ea. 230 volt receptacles 1 ea. 12 volt receptacles 7 ea. 24 volt receptacles
Fuel capacity:	400 gallons
Roll stabilization:	Niad active fins
Loran:	Micrologic Mariner
DGPS:	Magellan 1200XL GPS w/ Magellan 19019 DBR
Magnetic compass:	Ritchie 5"
Fluxgate compass:	Robertson RFC 300
Radar:	Furuno 1933CCBB NavNet
Air conditioning:	3 x 1.25 tons
Heating:	3 x 16,000 BTU

* Not used for hydrographic survey purposes

Vessel Offsets

Offsets were measured while the Coastal Surveyor was alongside the pier at New Castle, NH. Vertical distances were determined with a self-leveling surveyor's level (NEDO #T100548). Horizontal distances were measured with a survey tape. All offsets except for the vertical offset between the transducer and the reference point were measured prior to the installation of the multibeam sonar.

The Applanix POS Inertial motion Unit (IMU-200, S/N 179) was defined as the reference point of the vessel. The IMU is located on the centerline of the vessel near the center of motion.

The offsets between the primary GPS antenna and the IMU were entered into the POS software so the navigation and attitude solution output by the POS was referenced to the IMU location. No angular alignment values were entered into the POS configuration. The IMU was taken to define the origin of the vessels reference system as well as the orientation. All offsets (both translational and angular) between the IMU and the sonar head were entered into the Seafloor Information System (SIS) acquisition system and were applied on acquisition. No correctors were applied in Caris post-processing with the exception of dynamic draft.

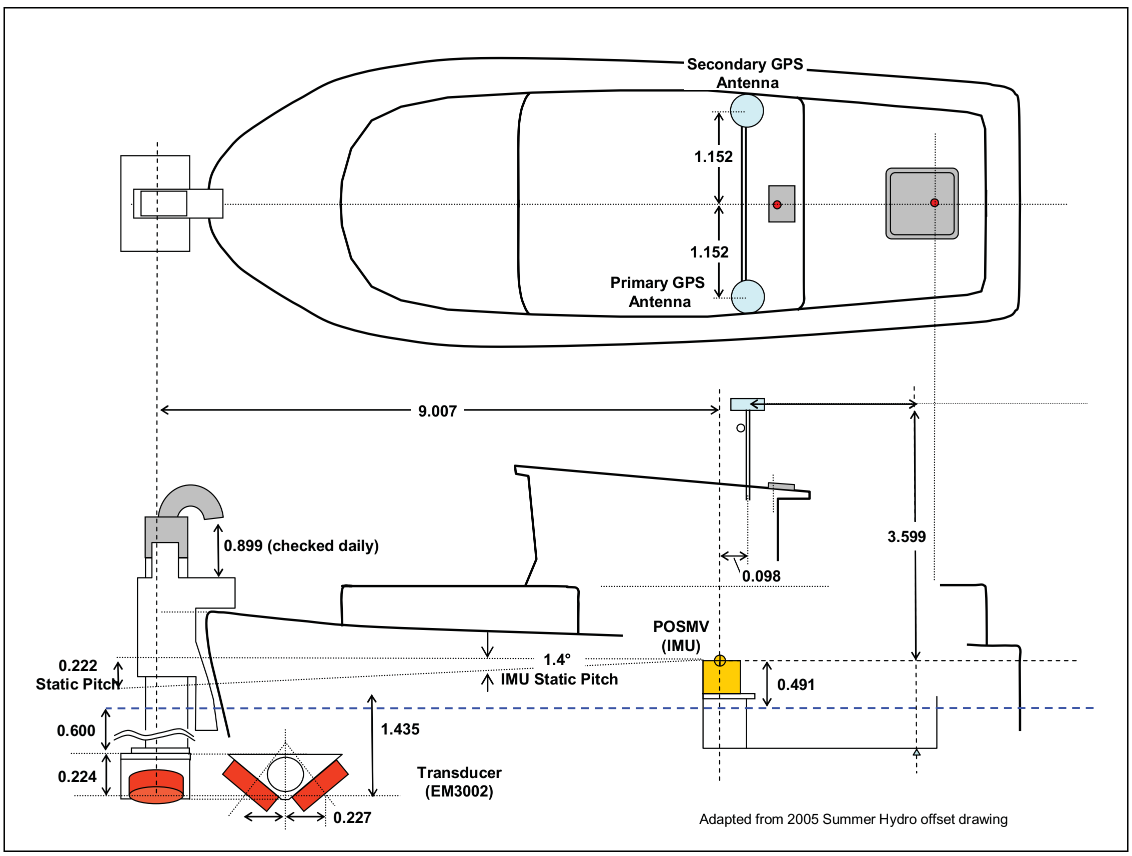

Figure 1. Offsets for the R/V Coastal Surveyor, all dimensions are in meters.

Coordinate System

The coordinate system used by Kongsberg and Applanix is different from that used in Caris. In this report, we have used the Kongsberg system of x-forward, y-starboard, and z-down. For offsets entered into Caris for post acquisition processing, this has been converted to x-starboard, y-forward, and z-up system.

GPS Antenna Offset

Fiberglass measuring tape was used to measure horizontal distances. To determine the x-offset (fore/ aft), the horizontal distance was measured from the IMU to a level rod held vertically through the aft hatch. The level rod was used to transfer a vertical through the aft hatch of the vessel. The distance from the level rod to the antenna support was then measured. The y offset (athwartships) was determined by taking half the distance between the antennae. This assumes that the two antennae were evenly spaced from the centerline.

The vertical offset between the primary antenna and the IMU was determined by leveling. A spirit level was set up on the fixed pier and level rods were held on the top of the GPS antenna and through the aft hatch. The distance in the cabin between the level rod through the aft hatch and the IMU was too short to allow the surveyor's level to be focused. Therefore, a laser was put on top of the level and used to pick off the values on the staff (See Figure 2).

Figure 2. A self leveling surveyor's level was used to measure the vertical offset from the IMU to Antenna. Inside the cabin, a laser was set on top of the level as the distance was too short to focus the telescope.

The measured values (See Table 2) for the antenna offset were used to confirm the values that had been previously determined by a survey when the vessel was out of the water. These values agreed to within 5 cm and the previously surveyed values were retained.

Table 2. Measurement of offset values for primary GPS antenna compared with previously surveyed values.

(m) x		y	z
measured -	0.052	-1.103	-3.570
POS -	0.098	-1.152	-3.599
difference -	0.046	-0.049	-0.029

<u>Sonar Offset</u>

The x (fore/ aft) offset was measured from a vertical above the IMU to a mark on the forward window of the cabin and then from the cabin window to the ram mount. Distances from the ram to the center of the sonar head were measured with a metal tape measure. The y (athwartships) offset was measured from the on the mount and assumed that the centerline of the transducer mount was aligned with the centerline of the IMU. The vertical offset was determined by measuring the height of the IMU above the waterline via a draft tube at the IMU. At the same time, the distance from the top of the sonar mount to the waterline was measured with a level rod held on top of the sonar mount, and the static trim angle of the IMU with respect to gravity was read off the POS. This static trim angle was 1.4° bow down.

Because the measurement of the vertical offset was made with respect to gravity, and the horizontal offset between the IMU and the sonar is substantial, this vertical offset needs to be corrected to account for the static pitch offset between the IMU reference frame with respect to gravity. This correction was calculated as 0.222 m as follows as seen in Figure 3:

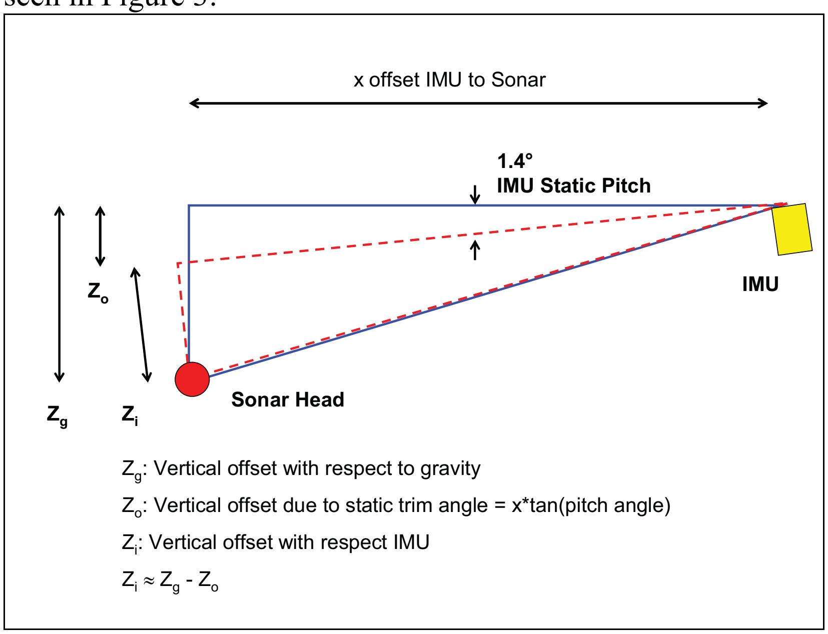

Figure 3. Corrections for static trim of sonar, angles are greatly exaggerated for clarity. No other offsets were corrected for the misalignment of the IMU with gravity as the lever arms are much smaller.

Table 3 is a summary of offsets measure while aboard the R/V Coastal Surveyor. Details of the offset calculations are found on the following spread sheets.
A summary table of sonar offsets from the IMU.

Table 3. A summary table of sonar offsets from the IMU.

(m)	X	y	z
Head 1	9.007	-0.226	1.093
Head 2	9.007	0.226	1.093

APPENDIX IV

EQUIPMENT DESCRIPTION

Survey Equipment

The primary equipment utilized for this hydrographic survey incorporated a POS/MV IMU (Inertial Motion Unit) for attitude positioning, real time kinematic horizontal positioning and a mulitbeam echosounder provided by Kongsberg.

POS/MV IMU

Applanix POSMV V.4	S/N	2171
P/N		PC5-29
DATE		APRIL 2005

Applanix IMU-200	S/N	179
P/N		10001506
DATE		MAY 2001

RTK POSITIONING

Trimble Trimmark 3 radio modem

P/N	46000-46
S/N	4526152531

Antenna	**Port**	**Starboard**
TRIMBLE ZEPHYR		
P/N	39105-00-DC4505	38105-00-DC4505
S/N	6000 4297	6000 8122

EM3002D Equipment

Table 1. Kongsberg EM3002D multibeam echosounder equipment inventory list.

	ITEM	QUANTITY	DESCRIPTION	S/N	P/N
BOX 1	1	1	SURFACE SVP CABLE (SURFACE SVP - SERIAL)	NO	NO
	2	1	COAXIAL CABLE	NO	NO
	3	1	VGA CABLE MALE/MALE	NO	NO
	4	1	SURFACE SVP (APPLIED MICROSYSTEM)	5218	NO
	5	1	SIS MANUAL (KUTI)	NO	NO
	6	1	PC KEYBOARD "CHERRY"	G0000215 5Q46	NO
BOX 2	1	1	SONAR HEAD EM 3000	322	100-211464
BOX 3	1	1	45 MT SONAR CABLE	322	20041863
BOX 4	1	1	SONAR HEAD EM 3000	474	100-211464
BOX 5	1	1	SVPLUS (APPLIED MICROSYSTEM)	3319	NO
	2	1	CONNECTOR CABLE (DEVICE-PARALLEL & PARALLEL-SERIAL)	NO	NO
	3	1	SVP KEYLOCK	NO	NO
BOX 6	1	2	9 PIN SERIAL CABLE FEMALE-FEMALE	NO	NO
	2	3	POWER CORDS	NO	NO
	3	1	MOUSE "CHERRY"	371	NO
	4	1	ETHERNET CABLE	NO	NO
	5	1	HARD DISK "SUPER SWAP 1000"	N70004191	NO
	6	1	HARD DISK "SUPER SWAP 1000"	N70004192	NO
	7	1	CD OPERATIONAL & SYS SW EM 3002 VER. 3.6.4	BUILD 174	NO
	8	1	KUTI DEMO MANUAL	NO	NO
	9	1	MBES KEYLOCK (DONGLE)	798E55A5	NO
	10	1	KONGSBERG CPU 1 EM 3002 KUTI DEMO HW S10	230	125-218784
	11	1	KONGSBERG CPU 2 EM 3002 KUTI (BLACK BOX)	NO	NO
BOX 7	1	1	FLAT SCREEN MONITOR 17"	JHMMDBR STD-A1	NO
	2	1	45 MT SONAR CABLE	NO	NO

APPENDIX V

SUPPLEMENTAL SURVEY RECORDS

A. Survey Planning

Survey Planning

The pre-survey planning was carried out in the HYPACK software suite. The projection used was UTM zone 19 and the ellipsoid used was WGS 84. The charted seafloor depths in the survey area vary from 3 to 60 meters. These depths were utilized to plan appropriate line spacing for the survey.

Initial investigation into swath width and line spacing was conducted using the HYPACK Total Propagated Error (TPE) uncertainty model (Fig. 1). The model was used to estimate the line spacing needed to achieve IHO Order 1A specifications for depth and position accuracy. The resulting TPE plots indicate that regions beyond 57° on either side of the transducers fall outside the required specifications for the position error, which suggests that a swath width of 3 times water depth line spacing was necessary.

Therefore, a line plan composed of 3 times the water depth spacing was created in HYPACK, which includes 311 lines with total length of 321.236 km. This accounts for approximately 29 hours of survey time. As a result of the number of total lines, the survey area was divided into 15 sub-areas according to the depth range.

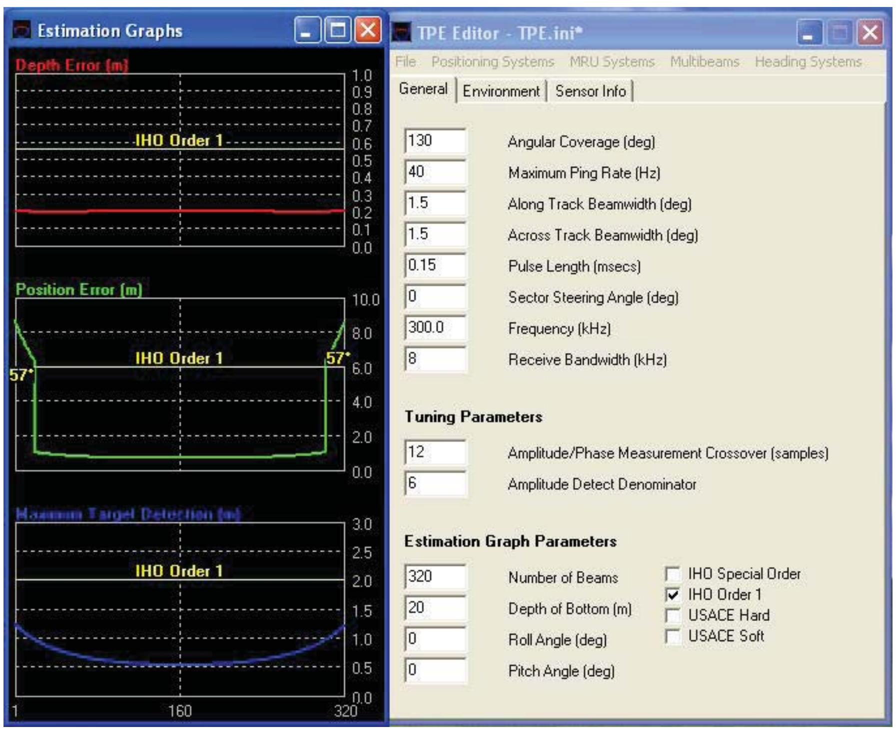

Figure 1. Uncertainty model of depth and position using HYPACK TPE model. The plot of position indicates that in order to achieve IHO Order 1 specifications, the beams greater than 57° on either side of nadir should be filtered out.

However, according to a TPE test conducted utilizing Caris HIPS software with a 3 x 3 grid of the seafloor established during the patch test, analysis verified that a line spacing of 4 times the water depth is within IHO Order 1A specifications. Ultimately, the hydrographers determined that a line spacing of 4 times the water depth was a prudent survey estimation given the charted depths of the area. The cause of the high position error estimate in the Hypack error model has not been investigated.

The final line plan includes line spacing of 4 times the water depth with 170 lines and a total length of 189.503 km. Total survey time was estimated around 20 survey hours. The survey area was roughly divided into 10 sub-areas. Each sub-area was created based on varying charted contour intervals of the seafloor.

APPENDIX V

SUPPLEMENTAL SURVEY RECORDS

B. Patch Test Procedure

Patch Test Procedure

Correct calibration of the vessel attitude sensors as well as the time delay of the positioning data is a crucial step in ensuring quality data is collected by the multibeam echosounder. The patch test was carried out on 9 June 2009 and the offsets determined using the calibration utility within the Kongsberg SIS software suite with independent verification conducted on 10 June 2009 by a second team of surveyors on the same vessel and using the Caris calibration utility. The patch test location consisted of a prominent feature with an adjacent flat seafloor (see Figure 1).

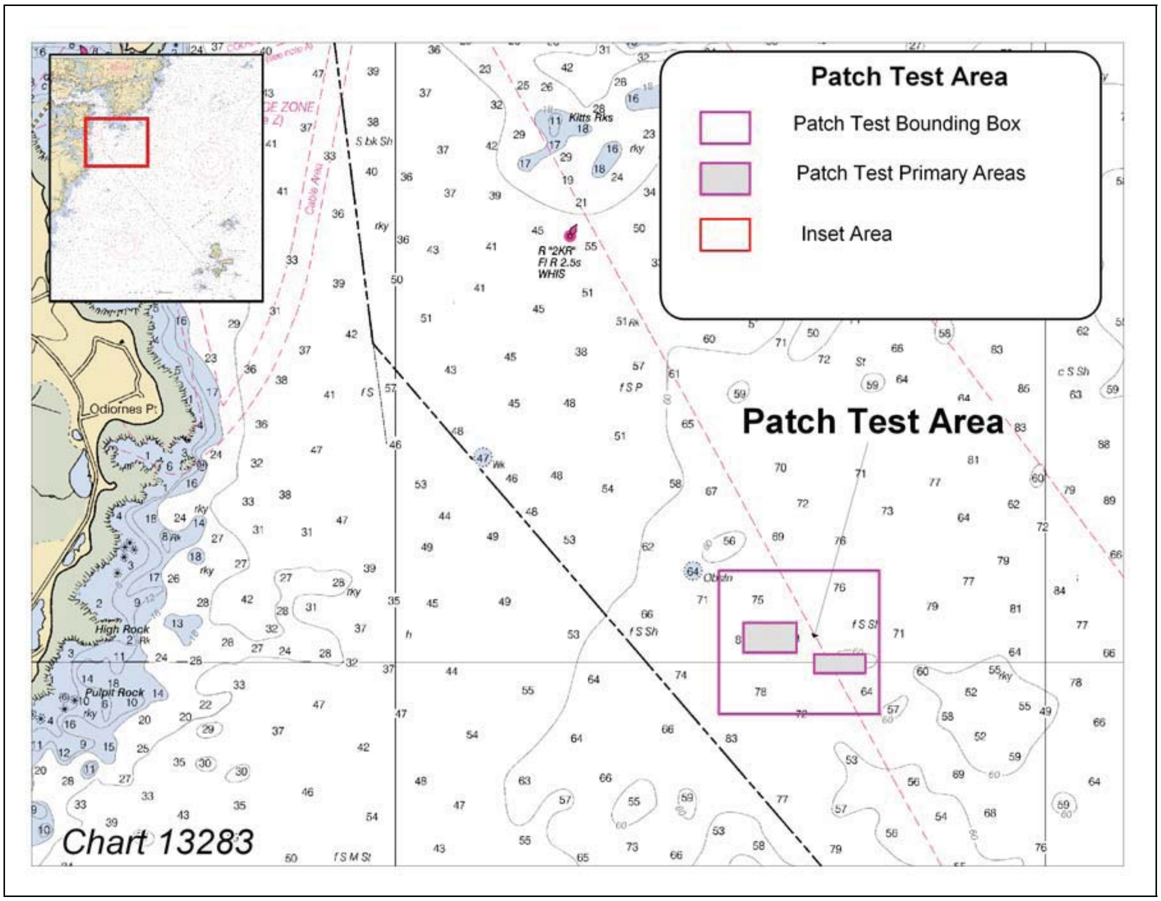

Figure 1. Patch test regions are within the vicinity of an area previously surveyed with a high-resolution multibeam echosounder. Primary patch test areas of interest within pink bounding box are designated by hatched boxes. Area of interest is designated by the red box located on inset of Chart 13283, approaches to Portsmouth Harbor.

The timing, pitch and heading biases were determined using the following guidelines for conducting a patch test with a dual head system, adapted from the Caris Training Manual and the Kongsberg SIS Operating Manual. (Although the Caris calibration technique does not require the time and pitch errors to be run separately, note that with a dual head system it is often easier to run each test twice, one for each transducer head, in order to best avoid confusion.)

In order to obtain the navigation time error, which would result in an along track horizontal displacement between the center beam profiles, two coincident lines were run in the same direction over the same sloping feature on 9 June 2009 (DN 160). The first line was run at 4 knots and the second at 8 knots; the greater the difference in speed the more chance there is of resolving the error. Offset was determined through using the calibration utility within the Kongsberg SIS software, processed and applied the SIS software immediately following the acquisition of both lines. See Table 1 for offset values.

After establishing that no time offset was present, the pitch offset was then determined. Two coincident lines were run in opposite directions at the same speed over the same sloping terrain. A pitch error resulted in an along track horizontal displacement between the center beam profiles. This procedure was conducted separately for each transducer head and the pitch offset values determined in the calibration utility located within the SIS software suite. These values were then applied directly into the SIS configuration tab, used for real time acquisition of bathymetric data. See Table 1 for offset values.

In order to determine the heading offset, two lines were run in the same direction on either side of the same feature, ensuring that the port side outer beam passed over the feature. A yaw (heading) error resulted in an along-track horizontal displacement of the feature. This procedure was repeated for the starboard transducer, thereby ensuring that the starboard side outer beams also passed over the feature. These values were then applied directly into the SIS configuration tab, used for real time acquisition of bathymetric data. See Table 1 for offset values.

The roll offset was determined by running two lines in opposite directions over a flat seabed. The lines were offset from each other by half the swath width. This procedure was performed separately for each transducer head. A roll offset resulted in depth differences between the data sets, which increased with acrosstrack distance from the center. The offsets were again determined and entered directly into the SIS calibration tab. See Table 1 for offset values.

Table 1. Patch test offsets for the R/V Coastal Surveyor obtained on 9 June 2009

Type of Bias	Offset Port Head	Offset Starboard Head
Time 0°		0°
Pitch 2.1°		2.2°
Roll 39.35°		-41.45°
Heading 0°		359.4°

The offset values obtained during the patch test were entered directly into the SIS software for real time full bottom coverage during data acquisition (see Table 1 for offset values). After the patch test calibration values were entered into SIS, a second independent patch test was run on 10 June, 2009 (DN 161). The same patch test lines were run; both transducers heads were run concurrently. The resulting lines were processed using the Caris calibration tool. This test confirmed that any remaining offsets were not significantly different than zero. These values can be seen in Table 2. No additional offset corrections were applied during processing, either in SIS or post-processing.

Table 2. Each trial represents a different subset of the data. Calibration values were randomized before a final value was determined. Lines were acquired after the offset values of the previous patch test were applied in the SIS calibration tab. The results from the second patch test do not significantly deviate from zero. Standard deviations were used to update the TPE values in the vessel HVF file in Caris.

Pitch

trans 1-p	(lines 002, 003)	trans 2-s	(lines 002, 003)
trial	value	trial	value
1	(0.20)	1	(0.11)
2	(0.40)	2	(0.27)
3	(0.26)	3	0.01
4	(0.10)	4	-
5	(0.28)	5	(0.12)
average	(0.25)	average	(0.10)
st dev	0.11	st dev	0.11

Roll

trans 1-p	(lines 006, 007)	trans 2-s	(lines 006,008)
trial	value	trial	value
1	(0.31)	1	0.11
2	(0.03)	2	0.11
3	(0.10)	3	0.03
4	(0.13)	4	0.17
5	(0.24)	5	0.09
average	(0.16)	average	0.10
st dev	0.11	st dev	0.05

Yaw

trans 1-p	(lines 009, 011)	trans 2-s	(lines 002, 003)
trial	value	trial	value
1	0.67	1	0.77
2	0.34	2	0.52
3	0.60	3	(1.43)
4	(0.07)	4	1.17
5	0.65	5	1.77
average	0.44	average	0.56
st dev	0.31	st dev	1.21

APPENDIX V

SUPPLEMENTAL SURVEY RECORDS

C. Backscatter Mosaic

Backscatter Mosaic

Acoustic backscatter was also collected during the Isle of Shoals survey from June 11, 2009- June 20, 2009 in conjunction with collecting bathymetric data using the Kongsberg EM3002 dual head multibeam echosounder. The acoustic energy that returns to the echosounder (backscatter) is influenced by a variety of factors of the surficial sediments of the seafloor including the roughness, grain size and acoustic impedence. In addition, the transmitted acoustic wave intersects the seafloor at an angle, which scatters some of the acoustic energy. The signal recorded by the echo sounder carries important information about all these factors that can be used for classifying the physical properties of the seafloor for geologic, engineering and habitat purposes (Fonseca and Mayer, 2007; Fonseca et al., 2008).

Firstly, in order to achieve any of the aforementioned purposes, an accurate backscatter mosaic for the survey area must be created (Fig. 4). A first approximation of this was conducted in FM Geocoder, a part of the IVS 3D Fledermaus 7 software suite. Geocoder provides a means to normalize and correct the backscatter intensities over the swath, which are generally stronger near nadir and weaker farther away on a relatively flat seafloor, regardless of bottom type. In Geocoder the backscatter is radiometrically and geometrically corrected and positioned in a coordinate system (Fonseca and Calder, 2005).

The .all files logged in the Kongsberg Seafloor Information System (SIS) system were imported directly into FM Geocoder and, as a first approximation, many of the default parameters already established for the Kongsberg systems within FM Geocoder were used. No offsets were applied in the calibration parameters window (Fig.1) since they were already applied directly in SIS during data acquisition.

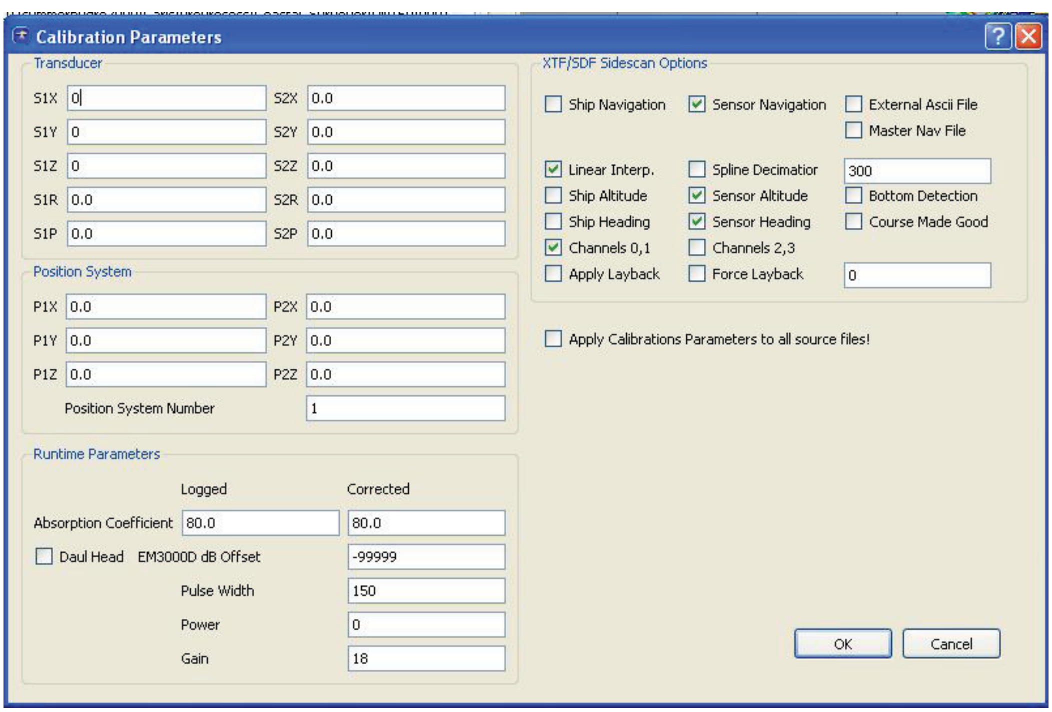

Figure 1. Calibration parameters window within FMGeocoder.

The backscatter was corrected for angle varying gains (AVG) and a Flat AVG algorithm used to smooth out small variations in the backscatter level in an attempt to reduce noise in the signal (Fig. 2).

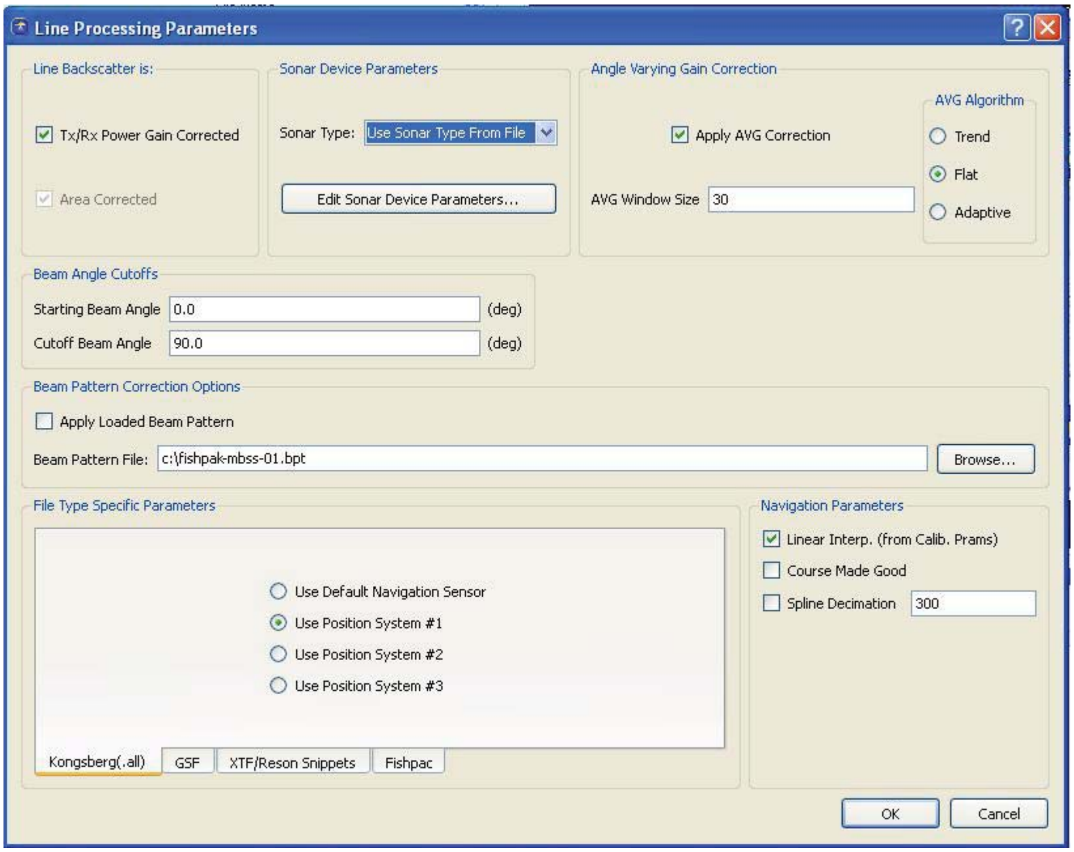

Figure 2. The Kongsberg (.all) window was selected in the Line Processing Parameters window.

In addition, an SD Fledermaus object of the bathymetry acquired in survey area was imported into FM Geocoder in order that the final backscatter intensities are corrected for the seafloor slope (Fig. 3).

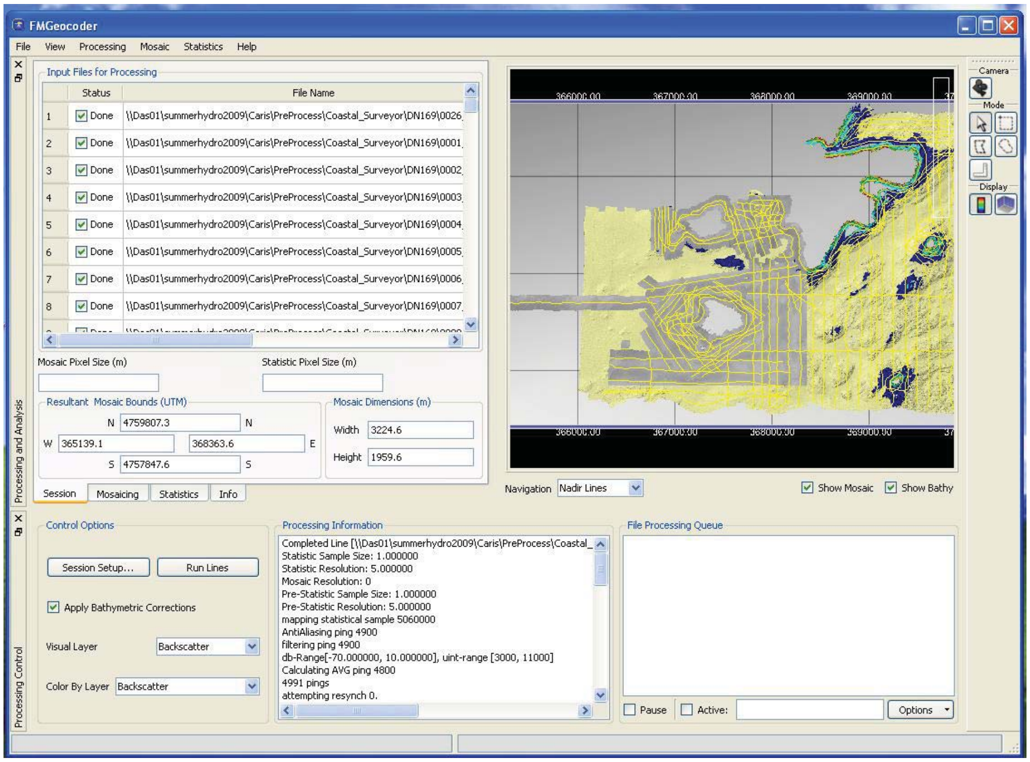

Figure 3. The main window of FMGeocoder where a background bathymetric surface was imported and the backscatter corrected for seafloor slope.

A preliminary mosaic was created (Fig.4), and some variation and features are evident in the backscatter intensity (Fig. 5and 6). Once a final mosaic is established, an Angular Range Analysis (ARA) analysis could be conducted and used for remote estimation of seafloor morphology and properties. However, before this can be accomplished, several parameters may require more attention, including the choice of a suitable AVG correction method, proper absorption coefficient (note that in the Kongsberg SIS software, a default salinity of 35 was used throughout the survey, which was high as observed in the CTD records, and calibration parameters. ARA analysis is beyond the scope of this survey.

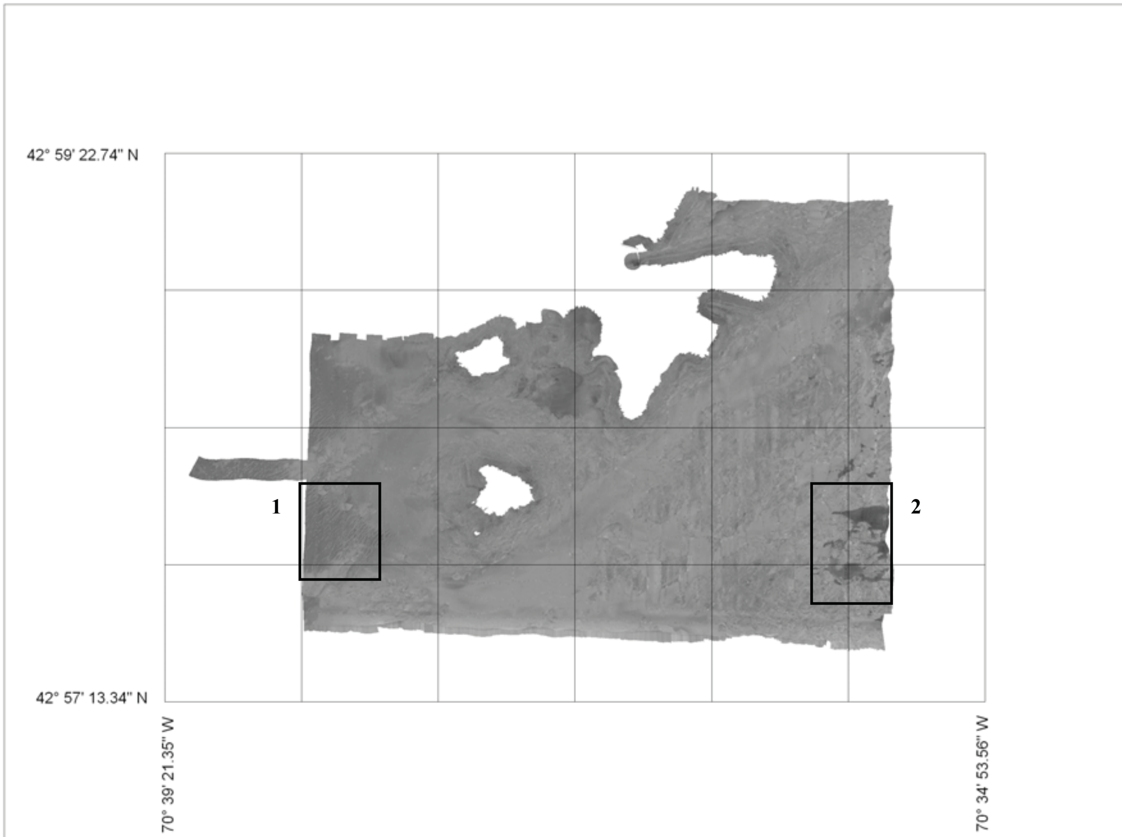

Figure 4. Preliminary backscatter mosaic of Isle of Shoals survey area.

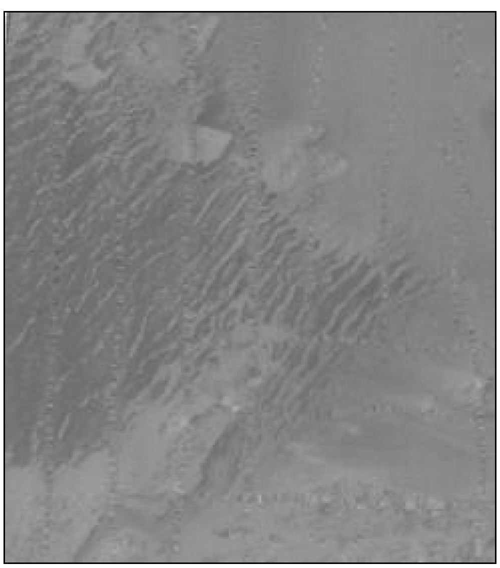

Figure 5. Zoomed in view of box 1 in backscatter mosaic.

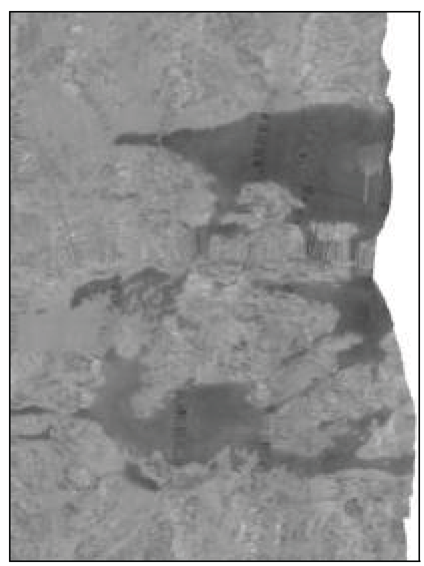

Figure 6. Zoomed in view of box 2 in backscatter mosaic.

References:

Fonseca, L. and Calder, B.R., 2005, Geocoder: an efficient backscatter map constructor, U.S. Hydrographic Conference proceedings.

Fonseca, L. and Mayer, L., 2007, Remote estimation of surficial seafloor properties through the application Angular Range Analysis to multibeam sonar data, Marine Geophysical Research v. 28 p. 119-126.

Fonseca L et al., Angular range analysis of acoustic themes from Stanton Banks Ireland: A Link…, Appl Acoust (2008).

APPENDIX VI

AWOIS

No previously reported AWOIS items found in AWOIS database.

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AHB COMPILATION LOG

General Survey Information	
REGISTRY No.	W00206
FIELD UNIT	R/V COASTAL SURVEYOR
DATE OF SURVEY	06/12/2009-06/19/2009
LARGEST SCALE CHART	***13283, edition 20, 20071001, 1:20, 000***
ADDITIONAL CHARTS	***13274, edition 27, 20070601, 1: 40, 000*** ***13278, edition 26, 20050601, 1:80, 000***
SOUNDING UNITS	**Feet**
COMPILER	Allison C. Stone

Source Grids	**File Name** H:\Compilation\W00206_OSD09_UNH\AHB_W00206\E-SAR Final Products\GRIDS
	Isle_of_Shoal_1m_Final.csar
Surfaces	**File Name** H:\Compilation\W00206_OSD09_UNH\AHB_W00206\COMPILE\Working
Interpolated TIN	\Interpolated TIN**W00206_1m_InterpTIN.hns**
Shifted Interpolated TIN	\Shifted Surface**W00206_1m_InterpTIN_Shifted.hns**
Final HOBs	**File Name** H:\Compilation\W00206_OSD09_UNH\AHB_W00206\COMPILE\Final_Hobs
Survey Scale Soundings	**W00206_SS_Soundings.hob**
Chart Scale Soundings	**W00206_CS_Soundings.hob**
Contour Layer	**W00206_Contours.hob**
Feature Layer	**W00206_Features.hob**
Meta-Objects Layer	**W00206_MetaObjects.hob**
Blue Notes	**W00206_BlueNotes.hob**

Meta-Objects Attribution	
Acronym	**Value**
M_COVR	
CATCOV	Coverage Available
SORDAT	20090620
SORIND	US,US,graph,W00206
M_QUAL	
CATZOC	Zone of Confidence U (data not assessed)
INFORM	R/V Coastal Surveyor
POSACC	10.0000 m
SORDAT	20090620
SORIND	US,US,graph,W00206
SUREND	20090620
SURSTA	20090611
DEPARE	
DRVALV 1	-7.874 ft
DRVALV2	280.054 ft
SORDAT	20090620
SORIND	US,US,graph,W00206
M_CSCL	
CSCALE	40,000 and 80,000
SORDAT	20090620

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SORIND	US,US,graph,W00206

SPECIFICATIONS:

I. COMBINED SURFACE:
   a. Number of ESAR Final Grids: 1
   b. Resolution of Combined (m): 1.00

II. SURVEY SCALE SOUNDINGS (SS):
   a. Radius
   b. Shoal biased
   c. Use Single-Defined Radius (mm at 20,000): ; Radius Value = 1
   d. Queried Depth of All Soundings
      i. Minimum: -7.575
      ii. Maximum: 208.054

III. INTERPOLATED TIN SURFACE:
   a. Resolution (m): 1.00
   b. Natural Neighbor
   c. Shifted value: -.75 ft

IV. CONTOURS:
   a. Use a Depth List: W00206_NOAA_depth_curves_list.txt
   b. Line Object: DEPCNT
   c. Value Attribute: VALDCO

V. FEATURES:
   a. Total Number of Features: 4 rocks. 5 rocky seabed areas

VI. CHART SURVEY SOUNDINGS (CS):
   a. Number of ENC CS Soundings: 239
   b. Radius
   c. Shoal biased
   d. Use Single-Defined Radius: m on the ground
      Sounding Space Range Table: W00206_20k_SSR.txt
   e. Filter: Interpolated != 1
   f. Number Survey CS Soundings: 285

ATLANTIC HYDROGRAPHIC BRANCH
H-CELL REPORT to ACCOMPANY
SURVEY W00206 (2009)

This H-Cell Report has been written to supplement and/or clarify the original Descriptive Report. Sections in this report refer to the corresponding sections of the Descriptive Report.

C. DATA ACQUISITION AND PROCESSING

C.1 DATA PROCESSING

The following software was used to process data at the Atlantic Hydrographic Branch:

CARIS Base Manager version 2.3 SP1 HF 1-16
CARIS S-57 Composer version 2.1 HF 1-4
DKART INSPECTOR, version 5.0 Build 732 SP1
CARIS HOM version 3.3 SP3 HF 8

C.2. QUALITY CONTROL

C.2.1. H-Cell

The AHB source depth grid for the survey's nautical chart update product entailed the field's original 1m grid. The survey scale soundings were created from the 1m resolution source grid at 1mm radius at 1:20,000. The chart scale selected soundings are a subset of the survey scale selected soundings. The surface model was referenced when selecting the chart scale soundings, to ensure that the selected soundings portrayed the bathymetry within the common area.

A TIN (Triangulated Irregular Network) surface was created from the survey scale soundings from which an interpolated surface was generated for the purpose of automatically generating depth contours. These contours were minimally edited and forwarded to MCD for reference only. The contours were utilized during chart scale sounding selection and quality assurance efforts at AHB. The depth contours are incorporated into the SS H-Cell product as per 2009 H-Cell Specifications.

The pre-compilation products or components (Stand Alone HOB files (SAHOB)) are detailed in the Compile Log attached directly before this H-Cell Report. The SAHOB files included depth areas (DEPARE), depth contours (DEPCNT), sounding selections (SOUNDG), features (UWTROC, SBDARE), Meta objects (M_COVR, M_QUAL, M_CSCL), and cartographic Blue Notes ($CSYMB).

All of the components with the exception of the sounding selection and depth contours were inserted into one feature layer (including the Blue notes, as dictated by Hydrographic Technical Directive 2008-8 and HSD's H-Cell Specifications 2009). The SAHOB H-Cell layers were exported to S-57 format for the H-Cell deliverable. W00206

H-Cell chart scale soundings were selected based upon the scale of the applicable chart. The H-Cell's SS deliverable includes survey scale selected soundings and depth contours.

The SAHOB's were exported from CARIS Bathy DataBASE to a metric S-57 file (H11827_SS_metric.000 and H11827_CS_metric.000). These files were then opened in CARIS HOM and were converted from metric to chart units (feet) and exported for delivery to MCD. The final deliverables are two S-57 files; one that contains the chart scale soundings, all the features, meta objects, and blue notes (W00206_CS.000), and one that contains the survey scale sounding selections and depth contours (W00206_SS.000). Quality assurance checks were made utilizing CARIS S-57 Composer 2.0 validation checks and dKart Inspector 5.0 tests.

Chart compilation was performed by Atlantic Hydrographic Branch personnel in Norfolk, Virginia. Compilation data will be forwarded to Marine Chart Division, Silver Spring, Maryland.

W00206 CARIS H-Cell final deliverables include the following products:

W00206_CS.000	1:20,000 Scale	W00206 H-Cell with Chart Scale Selected Soundings
W00206_SS.000	1:20,000 Scale	W00206 Selected Soundings (Survey Scale)

D. VERTICAL AND HORIZONTAL CONTROL

Final vertical correction processing was completed by the field unit with no additional correction required by Atlantic Hydrographic Branch. The field unit applied verified water levels. Sounding datum is Mean Lower Low Water (MLLW). Vertical datum is Mean High Water (MHW)

Horizontal control used for this survey during data acquisition is based upon the North American Datum of 1983 (NAD83), UTM projection zone 19N.

E. RESULTS AND RECOMMENDATIONS

E.1 CHART COMPARISON

13283_1 (20th Edition, Oct. /07)
Corrected through NM 06/12/2010
Corrected through LNM 06/01/2010
Scale 1:20,000

13274_2 (27th Edition, June/07)
Corrected through NM 06/12/2010
Corrected through LNM 06/01/2010
Scale 1:40,000

13278_1 (27th Edition, Oct. /09)
Corrected through NM 06/12/2010
Corrected through LNM 06/01/2010
Scale: 1:80,000

ENC Comparison **US5NH02M**

Portsmouth Harbor Cape Neddick- Isle of Shoals
Edition 11
Application Date 2010-03-04
Issue Date 2010-06-02
Chart 13283

US4MA04M
Portsmouth to Cape Ann; Hampton Harbor
Edition 13
Application Date 2010-04-22
Issue Date 2010-04-22
Chart 13278

E.1.1 Hydrography

The charted hydrography originates with prior surveys and requires no further consideration. The hydrographer makes adequate chart comparisons in section "D" and Appendix I and II of the Descriptive Report. The following exceptions are noted:

a. Five rocky seabed areas were digitized and included in the H-Cell to represent the geology of the survey seafloor.
b. The cable areas are recommended to be retained as charted.

E.3. MISCELLANEOUS

Chart compilation was done by Atlantic Hydrographic Branch personnel, in Norfolk, Virginia. Compilation data will be forwarded to Marine Chart Division, Silver Spring, Maryland. See Section D.1. of this report for a list of the Raster Charts and Electronic Navigation Charts (ENC) used for compiling the present survey:

E.4. ADEQUACY OF SURVEY

The present survey is adequate to supersede the charted bathymetry within the common area. Any features not specifically addressed either in the H-Cell BASE Cell File or the Blue Notes should be retained as charted. Refer to the Descriptive Report for further recommendations by the hydrographer.

APPROVAL SHEET
W00206

<u>Initial Approvals</u>:

The completed survey has been inspected with regard to survey coverage, delineation of depth curves, representation of critical depths, cartographic symbolization, and verification or disproval of charted data. All revisions and additions made to the H-Cell files during survey processing have been entered in the digital data for this survey. The survey records and digital data comply with National Ocean Service and Office of Coast Survey requirements except where noted in the Descriptive Report and the Evaluation Report.

All final products have undergone a comprehensive reviews per the Hydrographic surveys Division Office Processing Manual and are verified to be accurate and complete except where noted.

Digitally signed by Allison C. Stone
DN: cn=Allison C. Stone, o=NOAA, ou=NOS, email=allison.c.stone@noaa.gov, c=US
Date: 2010.06.24 10:00:33 -04'00'

Allison Stone
Hydrographic STEP Intern
Atlantic Hydrographic Branch

Digitally signed by Katrina Wyllie
DN: cn=Katrina Wyllie, o=NOAA, ou=AHB, email=katrina.wyllie@noaa.gov, c=US
Date: 2010.06.23 13:14:29 -04'00'

Katrina Wyllie
Hydrographic Intern
Atlantic Hydrographic Branch

I have reviewed the H-Cell files, accompanying data, and reports. This survey and accompanying Marine Chart Division deliverables meet National Ocean Service requirements and standards for products in support of nautical charting except where noted.

Richard T. Brennan
I am approving this document
2010.06.30 16:05:02 -04'00'

Approved: ______________________________

Richard T. Brennan
Commander, NOAA
Chief, Atlantic Hydrographic Branch

Digitally signed by Rachel Soraruf
DN: cn=Rachel Soraruf, o=NOAA/NOS/OCS/HSD, ou=Operations Branch, email=Rachel.Sorasuf@noaa.gov, c=US
Reason: AWOIS and SURF check complete
Date: 2010.07.06 13:17:43 -04'00'