ATLANTIC HYDROGRAPHIC BRANCH
PREFACE NOTES FOR JEFFREY LEDGE COMBINED
SURVEYS W00050, W00051, W00052, W00053

The Jeffrey Ledge Combined Survey is combination of four full surveys and partial data from a fifth survey conducted in the Approaches to Boston, Massachusetts area in 1996-2003. The surveys are as follows:

1. W00050 conducted by the S/V Creed from 1996-2003 with crosslines run by NOAA S/V Thomas Jefferson in 2003.
2. W00051 conducted by the S/V Creed from 1996-2003 with crosslines run by NOAA S/V Thomas Jefferson in 2003.
3. W00052 conducted by the S/V Creed from 1996-2003 with crosslines run by NOAA S/V Thomas Jefferson in 2003.
4. W00053 conducted by the S/V Creed from 2002-2003 with crosslines run by NOAA S/V Thomas Jefferson in 2003.
5. Some junctioning data from W00048 that was not included in the W00048 h-cell was also included. Please refer to the Descriptive Report for W00048 for more information.

At the discretion of the Atlantic Hydrographic Branch (AHB), these surveys were processed together to form one deliverable to the Marine Chart Division.

Organization of the combined report is as follows:

1. W00050 Descriptive Report with associated Appendices.
2. W00051 Descriptive Report with associated Appendices.
3. W00052 Descriptive Report with associated Appendices.
4. W00053 Descriptive Report with associated Appendices.
5. AHB Evaluation and Analysis Report.

W00050

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: **W00050**

LOCALITY

State: Massachusetts

General Locality: Approaches to Boston

Sub-locality: 15 NM NE of Halibut Point

2003

CHIEF OF PARTY
Donald W. Haines, LCDR, NOAA

LIBRARY & ARCHIVES

DATE

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

REGISTRY NUMBER:

W00050

HYDROGRAPHIC TITLE SHEET

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:	**Massachusetts**		
General Locality:	**Approaches to Boston**		
Sub-Locality:	**15 NM NE of Halibut Point**		
Scale:	**1:20,000**	Date of Survey:	**04/22/96 to 01/31/03** **10/01/03 to 10/02/03**
Instructions Dated:	**07/17/03**	Project Number:	**OPR-A397-TJ-03**
Vessel:	**NOAA Ship THOMAS JEFFERSON, S-222**		
Chief of Party:	**LCDR Donald W. Haines, NOAA**		
Surveyed by:	**THOMAS JEFFERSON Personnel**		
Soundings by:	**Kongsberg Simrad EM1002 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 Personnel**		
Soundings in:	~~**Meters**~~ ***feet*** **at MLLW**		

Remarks: ***Bold, Italic, Red notes in Descriptive Report were made during office processing. Charted depths in feet at MLLW.***

1) All Times are UTC.

2) This is a Navigable Area Hydrographic Survey.

3) Projection is UTM Zone 19.

TABLE OF CONTENTS

DESCRIPTIVE REPORT

to accompany

HYDROGRAPHIC SURVEY W00050

Scale of Survey: 1:20,000
Year of Survey: 2003
NOAA Ship THOMAS JEFFERSON
LCDR Donald W. Haines, Commanding

A. AREA SURVEYED

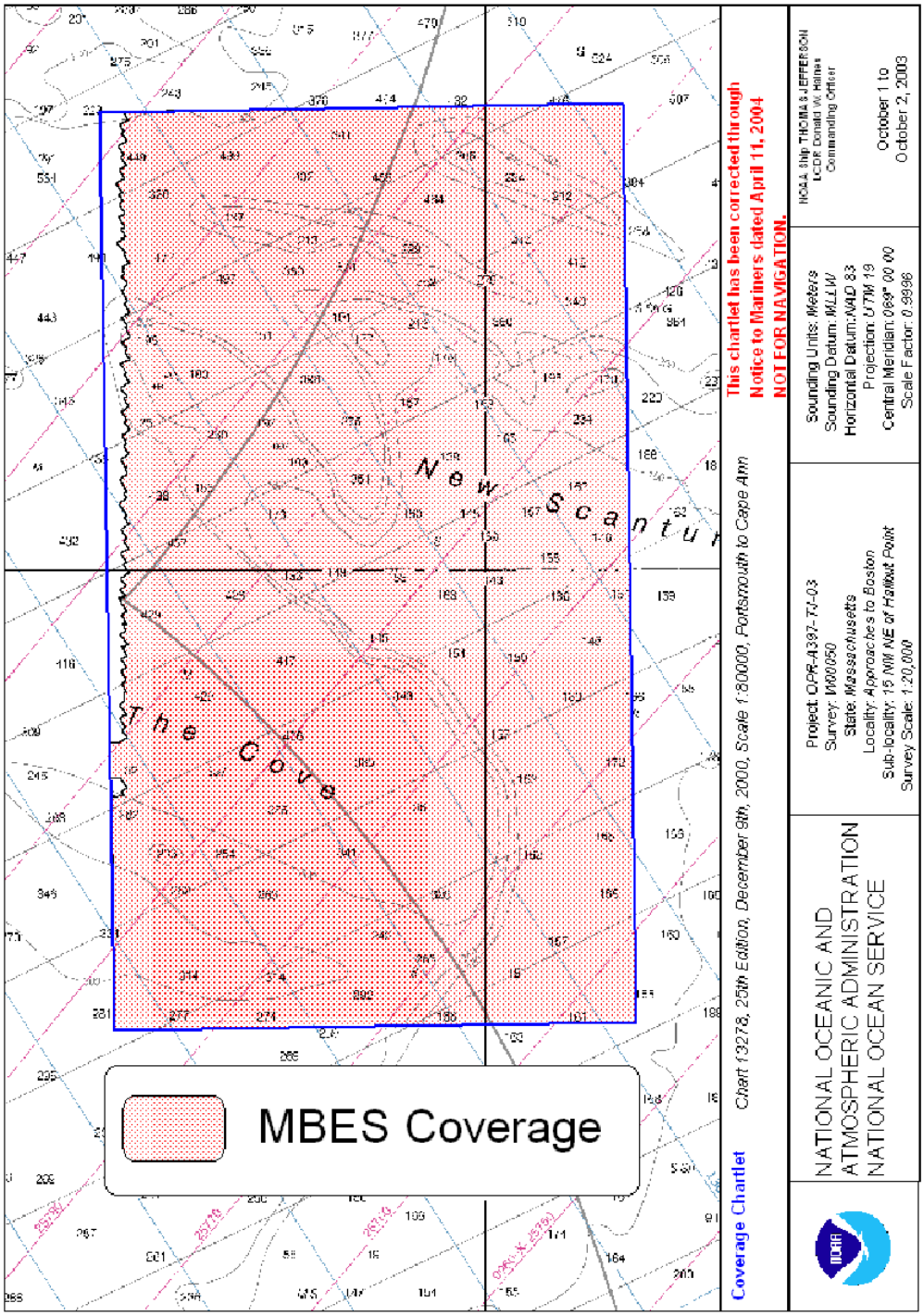
This hydrographic survey was conducted in accordance with Hydrographic Survey Letter Instructions* for project OPR-A397-TJ03, Approaches to Boston, Massachusetts. The original instructions* are dated July 17, 2003.

This Descriptive Report pertains to sheet "T" of project OPR-A397-TJ-03. The assigned registry number for this sheet is W00050, as prescribed in the Letter Instructions*.

This project is being conducted to provide contemporary hydrography with full bottom multibeam coverage in the approaches to Boston Harbor. This project responds to requests from the Massachusetts Port Authority (MASSPORT), Boston Pilots, the First U.S. Coast Guard District, Massachusetts Coastal Zone Management (Boston, MA), and the U.S. Geological Survey (Woods Hole, MA).

This project will also contribute valuable bathymetric data to the Stellwagen Bank Marine Sanctuary program in conjunction with the U.S. Geological Survey (USGS), Woods Hole Oceanographic Institution (WHOI), and the Canadian Hydrographic Service (CHS). Multibeam tracklines will be run in order to validate Outside Source Data (OSD) from the USGS and the University of New Hampshire (UNH). For complete survey limits, see the chartlet on the following page.

Data filed with original field records.


MBES Coverage
This chartlet has been corrected through
Notice to Mariners dated April 11, 2004
NOT FOR NAVIGATION.
Coverage Chartlet Chart 13278, 25th Edition, December 9th, 2000, Scale 1:80000, Portsmouth to Cape Ann
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE
Project: OPR-A397-TJ-03
Survey: W00050
State: Massachusetts
Locality: Approaches to Boston
Sub-locality: 15 NM NE of Halibut Point
Survey Scale: 1:20,000
Sounding Units: Meters
Sounding Datum: MLLW
Horizontal Datum: NAD 83
Projection: UTM 19
Central Meridian: 069° 00 00
Scale Factor: 0.9996
NOAA Ship THOMAS JEFFERSON
LCDR Donald W. Haines
Commanding Officer
October 1 to
October 2, 2003

B. DATA ACQUISITION AND PROCESSING *See Also Evaluation Report.*

EQUIPMENT

This survey took advantage of a vast data set acquired by U.S. Geological Survey (USGS). The USGS and their partnership with the Canadian Hydrographic Survey, acquired multibeam bathymetric data over a time span of ten years. The data for this sheet were acquired from April 2, 1996 to April 22, 1996. Data were delivered to NOAA in UNB swathed format. The data were assembled and converted to Caris HIPS format at University of New Hampshire=s Joint Hydrographic Center as part of the preparation for the project. This Outside Source Data (OSD) was integrated into our quality control pipeline (see Quality Control section). The majority of this OSD was located in waters greater than 20 meters and not located in high priority navigation areas as depicted in the national survey plan.

This survey also took advantage of a data set acquired by Science Applications International Corporation (SAIC) from December 19, 2002 to January 31, 2003 under contract to University of New Hampshire's Joint Hydrographic Center. SAIC acquired the data on OCEAN EXPLORER, which is equipped with a POS/MV for position and attitude, and a RESON 8101 multibeam echosounder. The data were delivered to NOAA in Caris HIPS format with tide and sound velocity already applied. This OSD was also integrated into our Quality Control pipeline.

Data were also acquired by NOAA Ship THOMAS JEFFERSON on September 30, 2003 to help verify the OSD. The ship is 208' (63.41m) long with a mean draft of 14' (4.26m).

NOAA Ship THOMAS JEFFERSON acquired multibeam echosounder (MBES) data using a Simrad 1002 multibeam system. All positioning and attitude were determined with a TSS POS/MV 320 (version 3) GPS-aided inertial navigation system. Sound velocity casts were conducted with a Sea Bird 19 profiler.

No unusual vessel configurations or problems were encountered. Refer to the Data Acquisition and Processing Report (DAPR) ***** for detailed equipment and vessel configuration information.
****Data filed with original field records.***

QUALITY CONTROL

Multibeam Quality Control

Mainscheme MBES data is defined to be the Outside Source Data (OSD). There were no known faults with the MBES system which affected data integrity. ***Concur.***

All outside source data were analyzed using Caris HIPS and SIPS 5.4, taking advantage of the new statistical analysis and error tracking capabilities. The data were used in the creation of **HIPS** BASE (Bathymetry Associated with Statistical Error) surfaces and analyzed using the standard deviation, density, and uncertainty layers. No systematic problems with the outside source data were found. ***Concur.***

Crosslines

Crossline data were acquired by NOAA Ship THOMAS JEFFERSON. Due to a roll calibration error affecting outer beams at more than 50° off nadir, all data were filtered to 45° from nadir on each side. Refer to this projects associated DAPR***** for detailed discussion of MBES system calibrations, data acquisition, and data processing.

On DN 274, DN275 data from nine MBES crosslines were acquired by NOAA Ship THOMAS JEFFERSON. Mainscheme and crossline data were analyzed in a **HIPS** BASE surface (see project DAPR*****). Crosslines agreed well with mainscheme data, being on average 0.3 meters deeper. ***Concur. See also Evaluation Report.***

Junctions

Hydrographic survey W00047, Sheet Q, adjoins the southern edge of W00050. Survey W00049, Sheet S, adjoins the western edge of W00050, but remains incomplete. Survey W00051, Sheet U, adjoins the eastern edge of W00050. Both complete surveys are part of project OPR-A397-TJ-03, and are validations of the same outside source data. As such, the data used for the survey overlaps were identical. ***Concur. See Also Evaluation Report.***

CORRECTIONS TO ECHO SOUNDING

All methods or instruments used were as described in the project DAPR*****. A table detailing all sound velocity casts is located in Separate III*****. ***Concur.***
****Data filed with original field records.***

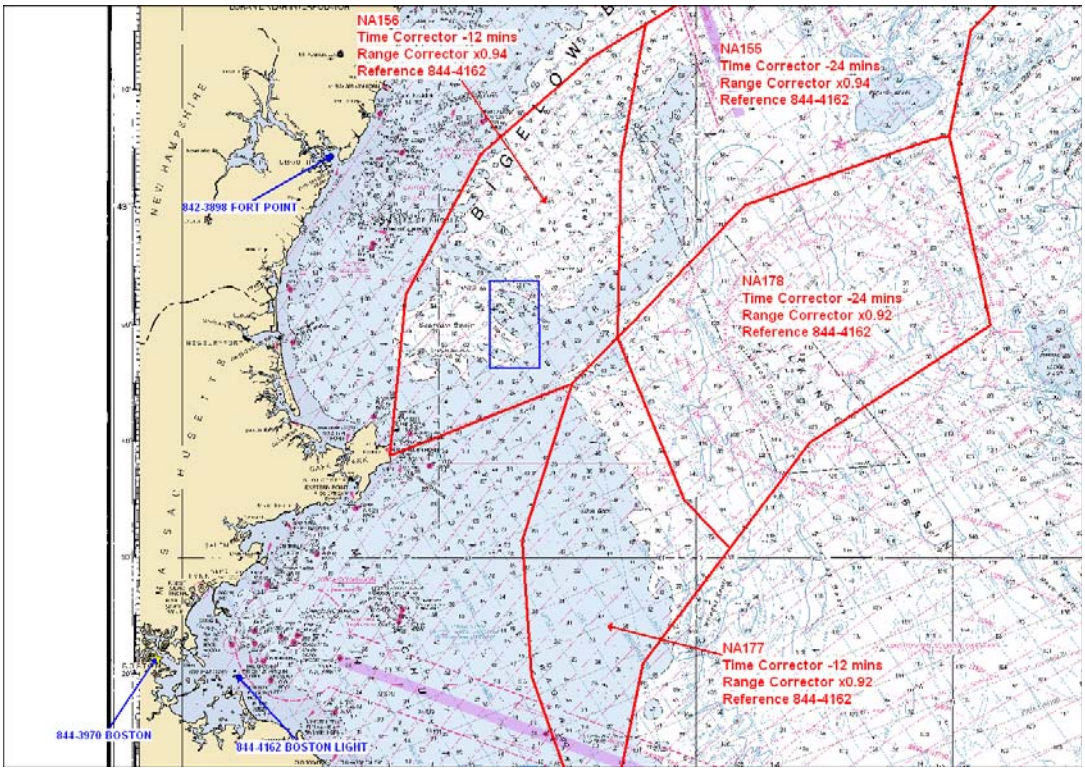
C. VERTICAL AND HORIZONTAL CONTROL

VERTICAL CONTROL

The tidal datum for this project is Mean Lower Low Water (MLLW). The operating tide stations at Boston, MA (844-3970) and Portland, ME (841-8150) served as control for datum determination. Tertiary gauges at Boston Light (844-4162) and Fort Point, NH (842-3898) provided ancillary tide data. ***Concur.***

Tidal zoning for this survey is consistent with the Letter Instructions*. The zones used for this survey are as follows:

ZONE NAME	CORRECTOR (min)	RATIO	REFERENCE
NA156	-12	0.94	8444162



A Request for Approved Tides letter was sent to N/OPS1 on October 15, 2003 (Appendix IV*). Verified tides from the N/OPS1 CO-OPS website were applied to THOMAS JEFFERSON data on June 1, 2004. Tide was not applied to the UNH Ocean Explorer data, as it was delivered with verified tides from Portland, ME (841-8150) already applied. Preliminary tides zoning using preliminary tides from Fort Point, NH (842-3898) were applied to the USGS data. ***Concur.***

HORIZONTAL CONTROL ***See also Evaluation Report.***

The horizontal datum used for this survey is the North American Datum of 1983 (NAD 83), projected using UTM zone 19.

Sounding positional control was determined using the Global Positioning System (GPS) corrected by U.S. Coast Guard differential GPS (DGPS) beacon stations. The primary and only DGPS beacon used for this survey was Portsmouth, New Hampshire (Beacon #771). No horizontal control stations were established for this survey.

Horizontal dilution of precision (HDOP) was monitored during data acquisition. That value did not exceeded 2.50, and the survey was conducted during times of adequate satellite coverage.

**** Data filed with original field records.***

D. RESULTS AND RECOMMENDATIONS *See also Evaluation Report.*

CHART COMPARISON

There are seven charts affected by this survey:

13278, 25th edition, December, 2000, scale 1:80000
13260, 39th edition, June, 2003, scale 1:378838
13009, 30th edition, August 1, 2002, scale 1:500000
13006, 31st edition, June, 2003, scale 1:675000
13003, 47th edition, June, 2003, scale 1:1200000

General Agreement with Charted soundings

The sounding data acquired during this survey agree well with the charted depths. The charted depths are from partial bottom NOS surveys conducted before 1970. The MBES data acquired for this survey are adequate to supercede the charted depths. ***Concur. See also Evaluation Report.***

AWOIS Items and Significant Contacts

There is one AWOIS item within the survey limits. The AWOIS item is discussed in the feature report in Appendix I. ***Concur.***

Dangers to Navigation

There were no Dangers to Navigation (DtoN) reported by the Hydrographer for this project. ***Concur.***

Charted Features

There is one charted features within the survey limits. The charted feature is a position approximate wreck, non-dangerous to surface navigation. The charted feature is discussed in the item investigation report in Appendix I. ***Concur. See also Evaluation Report, Chart Comparison, Additional Results, Charted AWOIS Item***

Charting Recommendations

Display survey soundings and redraw contour lines to represent the soundings acquired. ***Concur.***

ADDITIONAL RESULTS

Aids to Navigation and Other Detached Positions

There are no Aids to Navigation in the survey limits. ***Concur.***

Bridges and Overhead Cables

There are no bridges or overhead cables within the survey limits. ***Concur.***

Ferry Routes

There are no ferry routes that pass through the survey limits. ***Concur.***

Submarine Cables and Pipelines

There are no charted submarine cables or pipelines within the survey limits, nor were any found during the survey. ***Concur.***

E. APPROVAL SHEET

OPR-A397-TJ
Massachusetts
Approaches to Boston Harbor

15 NM NE of Halibut Point
Survey Registry No. W00050

Field operations for this basic hydrographic survey were conducted under my daily supervision with frequent checks of progress and adequacy. All field sheets, this Descriptive Report, and all accompanying records and data are approved.

I have ensured that standard field surveying and processing procedures were adhered to during this project in accordance with the Hydrographic Manual, Fourth Edition; Hydrographic Survey Guidelines; Field Procedures Manual, and the NOS Hydrographic Surveys Specifications and Deliverables, as updated for March, 2003. This survey was conducted as outlined in the Data Acquisition and Processing Report (August - November, 2003) submitted March 30, 2004, as well as the DAPR Change No. 1 submitted April 11, 2004. Refer to the Horizontal and Vertical Control Report (20 January, 2004) submitted March 4, 2004 for further information not included with this Descriptive Report.

This survey is adequate to supersede all prior surveys in common areas, and for application to the relevant NOS nautical charts.

Respectfully Submitted:

ENS Matthew Ringel, NOAA
Junior Officer

Approved and Forwarded:

LT Shepard Smith, NOAA
Field Operations Officer

LCDR/NOAA

LCDR Donald W. Haines, NOAA
Commanding Officer

APPENDIX I

ITEM INVESTIGATIONS AND CHARTED FEATURES

Registry Number: W00050

State: Massachusetts

Locality: Approaches to Boston

Sub-locality: 15 NM NE of Halibut Point

Project Number: OPR-A397-TJ-03

Survey Date: 01/26/2003

Charts Affected

Number	Version	Date	Scale
13278	25th Ed.	12/09/2000	1:80000
13260	39th Ed.	06/01/2003	1:378838
13009	30th Ed.	08/01/2002	1:500000
13006	31st Ed.	06/01/2003	1:675000
13003	47th Ed.	06/01/2003	1:1200000

Features

No.	Name	Feature Type	Survey Depth	Survey Latitude	Survey Longitude	AWOIS Item
1.1	4075/49	Sounding	72.67 m	042° 51' 25.519" N	70° 23' 44.098" W	---

1.1) 4075/49

Survey Summary

Survey Position: 042° 51' 25.519" N, 70° 23' 44.098" W

Least Depth: 72.67 m

Timestamp: 2003-026.14:56:26.044 (01/26/2003)

Survey Line: jeffrey_ledge / oceanexplorer / 2003-026 / hbmba03026_d36

Profile/Beam: 4075/49

Charts Affected: 13278_1, 13260_1, 13009_1, 13006_1, 13003_1

Remarks:

Feature is the least depth from a Reson 8101 a on man-made looking object approximately 230 meters from charted position of wreck. No information was received from HSD regarding the charted wreck and it is not in the AWOIS database.

Feature Correlation

Address	Feature	Range	Azimuth	Status
jeffrey_ledge/oceanexplorer/2003-026/hbmba03026_d36	4075/49	0.00	000.0	Primary
ChartGPs - Digitized	1	215.63	236.3	Secondary (grouped)

Hydrographer Recommendations

Delete PA wreck from chart and add non-dangerous wreck in given position.

S-57 Data

Geo object 1: Wreck (WRECKS)

Attributes: CATWRK - 1:non-dangerous wreck

TECSOU - 3:found by multi-beam

VALSOU - 72.666 m

WATLEV - 3:always under water/submerged

Office Notes

Remove Wreck PA at 42°51'29.726"N, 070°23'35.699"W, chart non-dangerous wreck at 42°51'25.579"N, 070°23'44.163"W.

Feature Images

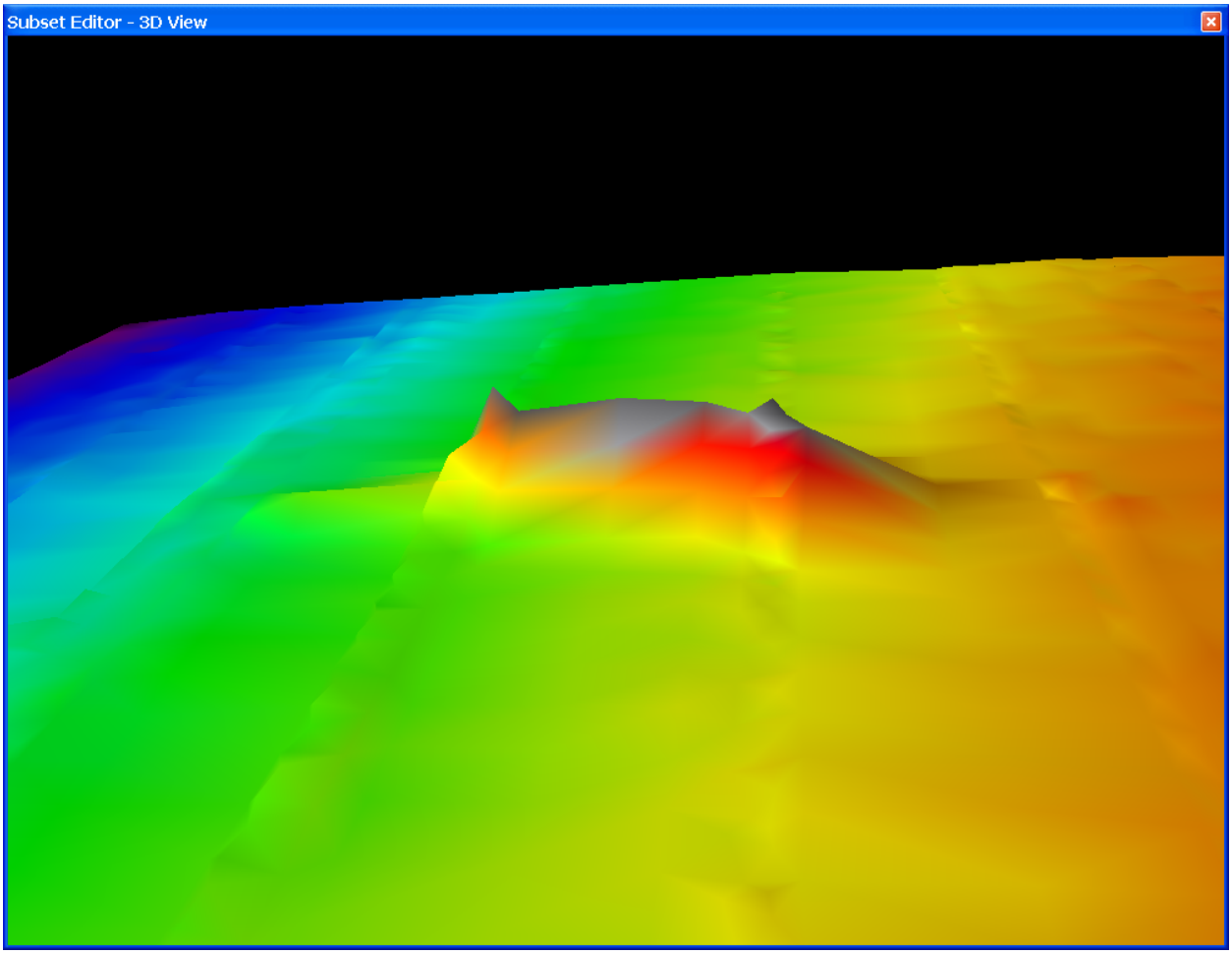


Figure 1.1.1

APPENDIX II

LIST OF GEOGRAPHIC NAMES

Geographical names as depicted on the chart were observed in common usage. Hydrographer has no particular recommendation on geographical names.

APPENDIX III

PROGRESS SKETCH

A progress sketch is included in the digital data.

APPENDIX IV

TIDES AND WATER LEVELS

October 15, 2003

MEMORANDUM FOR: Chief, Requirements and Development Division, N/OPS1

FROM: LCDR Donald Haines, NOAA Ship THOMAS JEFFERSON

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:

NOAA/NOS/Atlantic Hydrographic Branch
N/CS33, Building #2
439 West York Street
Norfolk, VA 23510
ATTN: Chief AHB

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

Project No.:	OPR-A397-TJ-03
Registry No.:	W00050 - W00053
State:	MA
Locality:	Approaches to Boston
Sublocality:	20 NM NE of Halibut Point

Attachments containing:
1) an Abstract of Times of Hydrography,
2) digital MID MIF files of the track lines from pydro on CD/diskette

cc: N/CS33

Year_DOY	Min Time	Max Time
2003_274	13:02:14	23:53:48
2003_275	00:32:56	16:14:06

APPENDIX V

SUPPLEMENTAL SURVEY RECORDS AND CORRESPONDENCES

The hydrographer reviewed the Coast Pilot report for the survey limits. There was no new additional information to be added to the Coast Pilot.

There are no other supplemental survey records or correspondences for this survey.

APPENDIX V

SUPPLEMENTAL SURVEY RECORDS AND CORRESPONDENCES

The hydrographer reviewed the Coast Pilot report for the survey limits. There was no new additional information to be added to the Coast Pilot. ***Concur.***

~~There are no other supplemental survey records or correspondences for this survey.~~

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NOAA Marine and Aviation Operations
NOAA Ship Thomas Jefferson S-222
439 W. York Street
Norfolk, VA 23510-1114

October 5, 2004

MEMORANDUM FOR: LCDR Tod Schattgen, NOAA
Chief, Atlantic Hydrographic Branch

THROUGH: CDR Emily B. Christman, NOAA
Commanding Officer, NOAA Ship THOMAS JEFFERSON

FROM: LT Shepard M. Smith, NOAA
Executive Officer, NOAA Ship THOMAS JEFFERSON

SUBJECT: USGS Stellwagen Bank Data

This memorandum serves to document the background, approach, and processing steps employed to incorporate the USGS Stellwagen Bank and Massachussets Bay multibeam data into the NOAA charting system.

Background

During the planning of OPR A397, I became aware that the survey areas assigned to WHITING, then LITTLEHALES, then THOMAS JEFFERSON overlapped significantly with the multibeam data acquired by USGS during the mid 1990s. This project was funded by USGS, with technical assistance from the Ocean Mapping Group at the University of New Brunswick and surveyed using the Canadian Hydrographic Service vessel *Frederick Creed*. It was also a cooperative project with NOAA, and several NOAA Corps hydrographers sailed aboard for portions of the project.

The data was collected under the guidance of some of the worldwide experts in multibeam surveying at the time. While it was NOAA's intention at the time to chart this data, we did not have the capability to process this large a dataset, and the data that NOAA did get languished in a collection of shoeboxes in Silver Spring.

In March 2003, after discussing the possibility with LT Jon Swallow at HSD operations, I contacted USGS in Woods Hole through Dr. Larry Mayer to inquire about the status of the data. I told them that we would be surveying the area on the NOAA Ship THOMAS JEFFERSON, and that we wanted to reduce duplication of effort. Dr. Bill Danforth replied enthusiastically that they would make the data available to us in whatever form we needed.

In addition, UNH's Center for Coastal and Ocean Mapping (CCOM) had contracted with SAIC to conduct a multibeam survey of Jeffrey's Ledge, an area just to the north of the

USGS Stellwagen Bank data set. During a break in their hydrographic survey work for NOAA, the SAIC team went up to Jeffreys Ledge and conducted the survey in the winter of 2002-2003. The data was sent to UNH in lightly edited form and turned over to graduate student Mashkoor Malik to work on. The CCOM leadership team offered the data to NOAA for charting. Because of the plans to incorporate the USGS data into NOAA's pipeline aboard the THOMAS JEFFERSON, I offered to add this SAIC data to the USGS data and work with it all together.

I then contacted HSD operations again to plan our approach to the project.

The Approach

This was an unusual opportunity to incorporate a large amount of Outside Source Data into the charting process. The most unusual aspect was that we had a ship available to junction and check the data. We came up with the following premises:

1) We would convert the data to a form where it could be manipulated as if it were our own data. This necessitated a new convertor to get the data into Caris HIPS format.
2) The tides applied to the data were inconsistent. We would plan to reapply all tides using historic NOAA station data and modern zoning.
3) We would use a Navigation Surface approach to process the data for charting. We would estimate the sensor errors for the Creed data and compute TPE as appropriate.
4) The data was edited to some extent by the Creed in the one case and CCOM in the other. We would further clean data only as necessary to produce a clean Navigation Surface.
5) The grids provided by the USGS were at a coarse resolution of 10m. For parts of the survey area, this is insufficient to capture all the seafloor detail in the data.
6) Various techniques were used by the CHS and USGS hydrographers to correct for sound velocity. The Simrad 1000 multibeam sonar system was corrected for sound velocity at the head and in the water column in real time. In order to compensate for head velocity errors and the difference between the last cast and the water column at their location, the hydrographers made extensive use of head velocity offsets and the interactive refraction editor. We would not second-guess the hydrographer's judgement on this, but merely reapply the values as they intended.
7) In general, we would compare *their results* to *our results*. We would not compare their *processes* to our *processes*. Because of the difference in the purpose of the survey and the changes in technology, it would not be useful to spend a lot of time worrying about processing techniques.
8) We would run crosslines with the TJ or her launches to check the accuracy of the data. We could also fill holidays or develop shoals at our discretion.
9) The TJ data would be combined with the OSD data to create a single survey with a "W" designation. TJ would write DRs and submit the surveys to AHB in a form

similar to that used for our own surveys. This should ease its inclusion in our workflow.

This approach was discussed with LT Jon Swallow Mike Riddle and Steve Verry, HSD Operations, and CDR Emily B. Christman at AHB, and is consistent with the project instructions issued for the project.

Preliminary Processing

Because I would be going out to the THOMAS JEFFERSON as Operations Officer and would oversee the project, I volunteered to be the focal point for data conversion and preliminary troubleshooting.

The data from USGS had all arrived by May 2003, and I was able to restore it all from CDs. The Swathed files were converted using a Swathed→Caris HIPS convertor written by Caris for this purpose. The first draft of the convertor assumed that the data had been fully merged with all refraction editing applied. This was not the case and a second version of the convertor was written which converted Swathed's three-parameter refraction editor files and converted them to a new HIPS format. In addition, the merge function in HIPS was modified to be able to perform a head velocity change in addition to changes at depth, to be consistent with the Swathed technology. After those changes, the data looked pretty good.

I contacted Cary Wong through HSD Operations and explained the project. Cary was able to find tide files going back to 1994. However, the files for 1994 were archived on a type of media that is no longer readable, so that year is only hourly data, which was interpolated by HIPS.

The Survey

THOMAS JEFFERSON arrived on scene in Massachusetts Bay in August 2003. In making up the cross line files for the survey, we estimated the total level of effort we wanted to spend on the project, then determined the number of crosslines that would be possible to run in that time frame. It came out to about three lines per sheet, run lengthwise east-west. In addition, in some areas, we ran some holiday lines and a few item investigations. On sheets D and F, we junctioned NOAA launch and ship data with the USGS data to form a complete survey.

Comparison of Data

In general, we found that the USGS data was consistently shoaler than the TJ ship multibeam data by 0.5m to 0.8m. In order to try to determine which was right, we tested several hypotheses.

1) Tidal Epoch-the tidal epoch changed in April 2003. The change is in the "right" direction to explain the difference, but the maximum magnitude in the survey area is 0.05m, not enough to explain the difference on its own.

2) Changing seafloor-The difference is too consistent
3) USGS use of the refraction editor-This could explain some differences in the outer beams, but the difference is consistent across the swath.
4) TJ draft error-We sought to test this hypothesis by doublechecking our draft and by conducting a leadline check. We conducted numerous tests and checked as many static measurements as possible. In addition, we installed a tube in the sonar void to be able to measure the waterline-reference mark directly. We were able to correct the difference by about 15 cm after adjusting our draft based on the new measurements. However, even after all the checking, we were unable to make the leadline test close with the Simrad processed soundings. The difference was about 0.4m, and the leadline measurements would be in general agreement with the USGS data.
5) The launches data was also compared to the USGS data and the TJ ship data. In general, the launch data was also shoaler than the ship data by 0.2-0.3m, placing it between the ship data and the USGS data.
6) Creed draft/loading error-*Creed* is a SWATH vessel with active stablization and controllable draft to optimize seakeeping abilities. It is possible that the draft was poorly measured or controlled. If it were poorly controlled, however, we would expect that there would be considerable inconsistency within the USGS data set. A draft measurement error would be consistent with a constant offset.

Conclusions

1) We were not able to find a single cause for the difference between the USGS data and TJ data, but believe it to be a combination of TJ draft measurement, Creed draft measurement, and tidal epoch change.
2) The data collected for these surveys by USGS and TJ were collected under circumstances other than an NOS-specified hydrographic survey for charting, and need to be treated differently than other surveys.
    a. The current version of NOS Specifications and Deliverables is inapplicable to these surveys.
    b. The results of the surveys should be examined, with far less emphasis on the processes employed during acquisition and processing.
    c. These surveys were not intended to find and characterize small features such as rocks, wrecks, and obstructions. In the few cases where these features were in fact visible in the data, they will be noted in the DR. In other cases, the items should remain as charted.
    d. Most of the survey area was in deep water (>30m) and there was continuous coverage in these areas. In shoaler areas, the line spacing was frequently too wide to achieve continuous coverage. As a result, there are a few shoals on some sheets that TJ has recommended be retained as charted because the least depth was not determined by these surveys. It was beyond the scope of this project to investigate every shoal and fill every holiday.

3) This procedure of running a few crosslines over OSD data was very successful and has resulted in a set of surveys that NOAA can stand behind for charting purposes. However, I do not think it should generally be necessary for ship's personnel take the lead on the project. I recommend that future similar efforts should be encouraged, with shoreside processing personnel taking the lead on the project from start to finish. This includes:

   a. Discussing the form of data transfer from the supplying organization to NOAA in manner conducive to continued cooperation and collaboration.
   b. Ensuring that the data is rigorously converted to our processing software (HIPS), paying special attention to the application of ancillary data such as tides, sound velocity, and draft. Conversion should also be made in such a way as to preserve any edits that the original hydrographers made to the data.
   c. Well before any planned field work, the data should be analyzed for holidays, searched for rocks, wrecks, obstructions and compared to the chart. With this information, the hydrographers can develop a survey plan that optimizes the use of the ship.
   d. Survey work should include regularly spaced crosslines sufficient to check most of the OSD survey lines. It should include holiday lines and item investigation lines as necessary to minimize unresolved items and unaddressed charted features.
   e. Preliminary processing can occur on the ship, but a shoreside team should write up the DR and do the final analysis and processing.

W00051

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 No.	**W00051**

LOCALITY

State	Massachusetts
General Locality	Approaches to Boston
Sub-locality	18 NM NE of Halibut Point

2003

CHIEF OF PARTY
LCDR Donald W. Haines, NOAA

LIBRARY & ARCHIVES

DATE

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

REGISTRY NUMBER:

HYDROGRAPHIC TITLE SHEET

W00051

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:	**Massachusetts**		
General Locality:	**Approaches to Boston**		
Sub-Locality:	**18 NM NE of Halibut Point**		
Scale:	**1:20,000**	Date of Survey:	**04/12/96 to 01/31/03** **10/01/03 to 10/02/03**
Instructions Dated:	**07/17/03**	Project Number:	**OPR-A397-TJ-03**
Vessel:	**NOAA Ship THOMAS JEFFERSON, S-222**		
Chief of Party:	**LCDR Donald W. Haines, NOAA**		
Surveyed by:	**THOMAS JEFFERSON Personnel**		
Soundings by:	**KongsbergSimrad EM1002 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**~~ ***feet*** **at MLLW**		

Remarks: ***Bold, Italic, Red notes in the Descriptive Report were made during office processing.***

1) All Times are UTC.

2) This is a Navigable Area Hydrographic Survey.

3) Projection is UTM Zone 19.

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DESCRIPTIVE REPORT

to accompany

HYDROGRAPHIC SURVEY W00051

Scale of Survey: 1:20,000
Year of Survey: 2003
NOAA Ship THOMAS JEFFERSON
LCDR Donald W. Haines, Commanding

A. AREA SURVEYED

This hydrographic survey was conducted in accordance with Hydrographic Survey Letter Instructions* for project OPR-A397-TJ03, Approaches to Boston, Massachusetts. The original instructions* are dated July 17, 2003.

This Descriptive Report pertains to sheet "U" of project OPR-A397-TJ-03. The assigned registry number for this sheet is W00051, as prescribed in the Letter Instructions*.

This project is being conducted to provide contemporary hydrography with full bottom multibeam coverage in the approaches to Boston Harbor. This project responds to requests from the Massachusetts Port Authority (MASSPORT), Boston Pilots, the First U.S. Coast Guard District, Massachusetts Coastal Zone Management (Boston, MA), and the U.S. Geological Survey (Woods Hole, MA).

This project will also contribute valuable bathymetric data to the Stellwagen Bank Marine Sanctuary program in conjunction with the U.S. Geological Survey (USGS), Woods Hole Oceanographic Institution (WHOI), and the Canadian Hydrographic Service (CHS). Multibeam tracklines will be run in order to validate Outside Source Data (OSD) from the USGS and the University of New Hampshire (UNH). For complete survey limits, see the chartlet on the following page.

Data filed with original field records.

MBES Coverage
Coverage Chartlet
Chart 13278, 25th Edition, December 9th, 2000, Scale 1:80000, Portsmouth to Cape Ann
This chartlet has been corrected through Notice to Mariners dated April 11, 2004
NOT FOR NAVIGATION.
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE
Project: OPR-A397-TJ-03
Survey: W00051
State: Massachusetts
Locality: Approaches to Boston
Sub-locality: 18 NM NE of Halibut Point
Survey Scale: 1:20,000
Sounding Units: Feet
Sounding Datum: MLLW
Horizontal Datum: NAD 83
Projection: UTM 19
Central Meridian: 069° 00 00
Scale Factor: 0.9996
NOAA Ship THOMAS JEFFERSON
LCDR Donald W. Haines
Commanding Officer
October 1 to
October 2, 2003

B. DATA ACQUISITION AND PROCESSING *See Also Evaluation Report*

EQUIPMENT

This survey took advantage of a vast data set acquired by U.S. Geological Survey (USGS). The USGS and their partnership with the Canadian Hydrographic Survey, acquired multibeam bathymetric data over a time span of ten years. The data for this sheet were acquired from April 12, 1996 to December 10, 1996. Data were delivered to NOAA in UNB swathed format. The data were assembled and converted to Caris HIPS format at University of New Hampshire's Joint Hydrographic Center as part of the preparation for the project. This Outside Source Data (OSD) was integrated into our quality control pipeline (see Quality Control section). The majority of this OSD was located in waters greater than 20 meters and not located in high priority navigation areas as depicted in the national survey plan.

This survey also took advantage of a data set acquired by Science Applications International Corporation (SAIC) from December 19, 2002 to January 31, 2003 under contract to University of New Hampshire's Joint Hydrographic Center. SAIC acquired the data on OCEAN EXPLORER, which is equipped with a POS/MV for position and attitude, and a RESON 8101 multibeam echosounder. The data were delivered to NOAA in Caris HIPS format with tide and sound velocity already applied. This OSD was also integrated into our Quality Control pipeline.

Data were also acquired by NOAA Ship THOMAS JEFFERSON on September 30, 2003 to help verify the OSD. The ship is 208' (63.41m) long with a mean draft of 14' (4.26m).

NOAA Ship THOMAS JEFFERSON acquired multibeam echosounder (MBES) data using a Simrad 1002 multibeam system. All positioning and attitude were determined with a TSS POS/MV 320 (version 3) GPS-aided inertial navigation system. Sound velocity casts were conducted with a Sea Bird 19 profiler.

No unusual vessel configurations or problems were encountered. Refer to the Data Acquisition and Processing Report (DAPR*) for detailed equipment and vessel configuration information.

Data filed with original field records.

QUALITY CONTROL

Multibeam Quality Control

Mainscheme MBES data is defined to be the Outside Source Data. There were no known faults with the MBES system which affected data integrity. ***Concur.***

All outside source data were analyzed using Caris HIPS and SIPS 5.4 beta, taking advantage of the new statistical analysis and error tracking capabilities. The data were used in the creation of **HIPS** BASE (Bathymetry Associated with Statistical Error) surfaces and analyzed using the standard deviation, density, and uncertainty layers. No systematic problems with the outside source data were found. ***Concur.***

Crosslines

Crossline data were acquired by NOAA Ship THOMAS JEFFERSON. Due to a roll calibration error affecting outer beams at more than 50° off nadir, all data were filtered to 45° from nadir on each side. Refer to this projects associated DAPR***** for detailed discussion of MBES system calibrations, data acquisition, and data processing.

On DN 274, DN275 data from nine MBES crosslines were acquired by NOAA Ship THOMAS JEFFERSON. Mainscheme and crossline data were analyzed in a **HIPS** BASE surface (see project DAPR*****). Crosslines agreed well with mainscheme data, being on average 0.3 meters deeper. ***Concur. See Also Evaluation Report***

Junctions

Hydrographic survey W00048, Sheet R, adjoins the southern edge of W00051. Survey W00050, Sheet T, adjoins the western edge of W00051. Survey W00052, Sheet V, adjoins the eastern edge of W00051. Survey W00053, Sheet W, overlaps the northeastern corner of W00051. All four surveys are part of project OPR-A397-TJ-03, and are validations of the same outside source data. As such, the data used for the survey overlaps were identical. ***Concur. See Also Evaluation Report***

CORRECTIONS TO ECHO SOUNDING

All methods or instruments used were as described in the project DAPR. A table detailing all sound velocity casts is located in Separate III*****. ***Concur.***

****Data filed with original field records.***

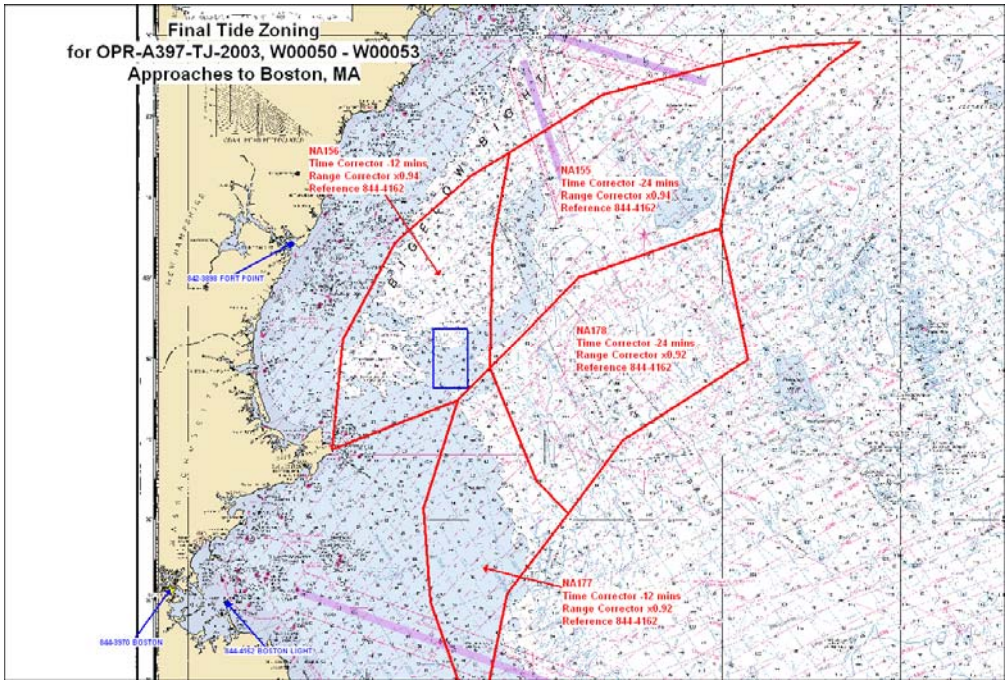
C. VERTICAL AND HORIZONTAL CONTROL

VERTICAL CONTROL

The tidal datum for this project is Mean Lower Low Water (MLLW). The operating tide stations at Boston, MA (844-3970) and Portland, ME (841-8150) served as control for datum determination. Tertiary gauges at Boston Light (844-4162) and Fort Point, NH (842-3898) provided ancillary tide data. ***Concur.***

Tidal zoning for this survey is consistent with the Letter Instructions***. The zones used for this survey are as follows:

****Data filed with original field records.***



ZONE NAME	CORRECTOR (min)	RATIO	REFERENCE
NA156	-12	0.94	844-4162

A Request for Approved Tides letter was sent to N/OPS1 on October 15, 2003 (Appendix IV*). Verified tides from the N/OPS1 CO-OPS website were applied to THOMAS JEFFERSON data on June 1, 2004. Tide was not applied to the UNH Ocean Explorer data, as it was delivered with verified tides from Portland, ME (841-8150) already applied. Preliminary tide zoning using preliminary tides from Fort Point, NH (842-3898) were applied to the USGS data. ***Concur***.

HORIZONTAL CONTROL ***See Also Evaluation Report***

The horizontal datum used for this survey is the North American Datum of 1983 (NAD 83), projected using UTM zone 19.

Sounding positional control was determined using the Global Positioning System (GPS) corrected by U.S. Coast Guard differential GPS (DGPS) beacon stations. The primary and only DGPS beacon used for this survey was Portsmouth, New Hampshire (Beacon #771). No horizontal control stations were established for this survey.

Horizontal dilution of precision (HDOP) was monitored during data acquisition. That value did not exceeded 2.50, and the survey was conducted during times of adequate satellite coverage.

D. RESULTS AND RECOMMENDATIONS *See Also Evaluation Report*

CHART COMPARISON

There are five charts affected by this survey:

13278, 25th edition, December, 2000, scale 1:80,000
13260, 39th edition, June, 2003, scale 1:378838
13009, 30th edition, August 1, 2002, scale 1:500000
13006, 31st edition, June, 2003, scale 1:675000
13003, 47th edition, June, 2003, scale 1:1200000

General Agreement with Charted soundings

The sounding data acquired during this survey agree well with the charted depths. The charted depths are from partial bottom NOS surveys conducted before 1970. The MBES data acquired for this survey are adequate to supercede the charted depths. ***Concur. See Also Evaluation Report***

AWOIS Items and Significant Contacts

There were no AWOIS items within the survey limits. ***Concur.***

Dangers to Navigation

There were no Dangers to Navigation (DtoN) reported by the Hydrographer for this project. ***Concur.***

Charted Features

There were no charted features investigated during this survey. ***Concur.***

Charting Recommendations

Display survey soundings and redraw contour lines to represent the soundings acquired. ***Concur.***

****Data filed with original field records.***

ADDITIONAL RESULTS

Aids to Navigation and Other Detached Positions

There are no Aids to Navigation in the survey limits. ***Concur***.

Bridges and Overhead Cables

There are no bridges or overhead cables within the survey limits. ***Concur***.

Ferry Routes

There are no ferry routes that pass through the survey limits. ***Concur***.

Submarine Cables and Pipelines

There are no charted submarine cables or pipelines within the survey limits, nor were any found during the survey. ***Concur***.

E. APPROVAL SHEET

OPR-A397-TJ
Massachusetts
Approaches to Boston Harbor

18 NM NE of Halibut Point
Survey Registry No. W00051

Field operations for this basic hydrographic survey were conducted under my daily supervision with frequent checks of progress and adequacy. All field sheets, this Descriptive Report, and all accompanying records and data are approved.

I have ensured that standard field surveying and processing procedures were adhered to during this project in accordance with the Hydrographic Manual, Fourth Edition; Hydrographic Survey Guidelines; Field Procedures Manual, and the NOS Hydrographic Surveys Specifications and Deliverables, as updated for March, 2003. This survey was conducted as outlined in the Data Acquisition and Processing Report (August - November, 2003) submitted March 30, 2004, as well as the DAPR Change No. 1 submitted April 11, 2004. Refer to the Horizontal and Vertical Control Report (20 January, 2004) submitted March 4, 2004 for further information not included with this Descriptive Report.

This survey is adequate to supersede all prior surveys in common areas, and for application to the relevant NOS nautical charts.

Respectfully Submitted:

_____
ENS Matthew Ringel, NOAA
Junior Officer

Approved and Forwarded:

_____
LT Shepard Smith, NOAA
Field Operations Officer

_____
LCDR Donald W. Haines, NOAA
Commanding Officer

APPENDIX I

ITEM INVESTIGATIONS AND CHARTED FEATURES

There were no charted features investigated for this survey.

APPENDIX II

LIST OF GEOGRAPHIC NAMES

Geographical names as depicted on the chart were observed in common usage. Hydrographer has no particular recommendation on geographical names.

APPENDIX III

PROGRESS SKETCH

A progress sketch is included in the digital data.

APPENDIX IV

TIDES AND WATER LEVELS

October 15, 2003

MEMORANDUM FOR: Chief, Requirements and Development Division, N/OPS1

FROM: LCDR Donald Haines, NOAA Ship THOMAS JEFFERSON

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:

NOAA/NOS/Atlantic Hydrographic Branch
N/CS33, Building #2
439 West York Street
Norfolk, VA 23510
ATTN: Chief AHB

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

Project No.:	OPR-A397-TJ-03
Registry No.:	W00050 - W00053
State:	MA
Locality:	Approaches to Boston
Sublocality:	20 NM NE of Halibut Point

Attachments containing:
1) an Abstract of Times of Hydrography,
2) digital MID MIF files of the track lines from pydro on CD/diskette

cc: N/CS33

Year_DOY	Min Time	Max Time
2003_274	13:02:14	23:53:48
2003_275	00:32:56	16:14:06

APPENDIX V

SUPPLEMENTAL SURVEY RECORDS AND CORRESPONDENCES

The hydrographer reviewed the Coast Pilot report for the survey limits. There was no new additional information to be added to the Coast Pilot. ***Concur***

~~There are no other supplemental survey records or correspondences for this survey.~~

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NOAA Marine and Aviation Operations
NOAA Ship Thomas Jefferson S-222
439 W. York Street
Norfolk, VA 23510-1114

October 5, 2004

MEMORANDUM FOR: LCDR Tod Schattgen, NOAA
Chief, Atlantic Hydrographic Branch

THROUGH: CDR Emily B. Christman, NOAA
Commanding Officer, NOAA Ship THOMAS JEFFERSON

FROM: LT Shepard M. Smith, NOAA
Executive Officer, NOAA Ship THOMAS JEFFERSON

SUBJECT: USGS Stellwagen Bank Data

This memorandum serves to document the background, approach, and processing steps employed to incorporate the USGS Stellwagen Bank and Massachussets Bay multibeam data into the NOAA charting system.

Background

During the planning of OPR A397, I became aware that the survey areas assigned to WHITING, then LITTLEHALES, then THOMAS JEFFERSON overlapped significantly with the multibeam data acquired by USGS during the mid 1990s. This project was funded by USGS, with technical assistance from the Ocean Mapping Group at the University of New Brunswick and surveyed using the Canadian Hydrographic Service vessel *Frederick Creed*. It was also a cooperative project with NOAA, and several NOAA Corps hydrographers sailed aboard for portions of the project.

The data was collected under the guidance of some of the worldwide experts in multibeam surveying at the time. While it was NOAA's intention at the time to chart this data, we did not have the capability to process this large a dataset, and the data that NOAA did get languished in a collection of shoeboxes in Silver Spring.

In March 2003, after discussing the possibility with LT Jon Swallow at HSD operations, I contacted USGS in Woods Hole through Dr. Larry Mayer to inquire about the status of the data. I told them that we would be surveying the area on the NOAA Ship THOMAS JEFFERSON, and that we wanted to reduce duplication of effort. Dr. Bill Danforth replied enthusiastically that they would make the data available to us in whatever form we needed.

In addition, UNH's Center for Coastal and Ocean Mapping (CCOM) had contracted with SAIC to conduct a multibeam survey of Jeffrey's Ledge, an area just to the north of the

USGS Stellwagen Bank data set. During a break in their hydrographic survey work for NOAA, the SAIC team went up to Jeffreys Ledge and conducted the survey in the winter of 2002-2003. The data was sent to UNH in lightly edited form and turned over to graduate student Mashkoor Malik to work on. The CCOM leadership team offered the data to NOAA for charting. Because of the plans to incorporate the USGS data into NOAA's pipeline aboard the THOMAS JEFFERSON, I offered to add this SAIC data to the USGS data and work with it all together.

I then contacted HSD operations again to plan our approach to the project.

The Approach

This was an unusual opportunity to incorporate a large amount of Outside Source Data into the charting process. The most unusual aspect was that we had a ship available to junction and check the data. We came up with the following premises:

1) We would convert the data to a form where it could be manipulated as if it were our own data. This necessitated a new convertor to get the data into Caris HIPS format.
2) The tides applied to the data were inconsistent. We would plan to reapply all tides using historic NOAA station data and modern zoning.
3) We would use a Navigation Surface approach to process the data for charting. We would estimate the sensor errors for the Creed data and compute TPE as appropriate.
4) The data was edited to some extent by the Creed in the one case and CCOM in the other. We would further clean data only as necessary to produce a clean Navigation Surface.
5) The grids provided by the USGS were at a coarse resolution of 10m. For parts of the survey area, this is insufficient to capture all the seafloor detail in the data.
6) Various techniques were used by the CHS and USGS hydrographers to correct for sound velocity. The Simrad 1000 multibeam sonar system was corrected for sound velocity at the head and in the water column in real time. In order to compensate for head velocity errors and the difference between the last cast and the water column at their location, the hydrographers made extensive use of head velocity offsets and the interactive refraction editor. We would not second-guess the hydrographer's judgement on this, but merely reapply the values as they intended.
7) In general, we would compare *their results* to *our results*. We would not compare their *processes* to our *processes*. Because of the difference in the purpose of the survey and the changes in technology, it would not be useful to spend a lot of time worrying about processing techniques.
8) We would run crosslines with the TJ or her launches to check the accuracy of the data. We could also fill holidays or develop shoals at our discretion.
9) The TJ data would be combined with the OSD data to create a single survey with a "W" designation. TJ would write DRs and submit the surveys to AHB in a form

similar to that used for our own surveys. This should ease its inclusion in our workflow.

This approach was discussed with LT Jon Swallow Mike Riddle and Steve Verry, HSD Operations, and CDR Emily B. Christman at AHB, and is consistent with the project instructions issued for the project.

Preliminary Processing

Because I would be going out to the THOMAS JEFFERSON as Operations Officer and would oversee the project, I volunteered to be the focal point for data conversion and preliminary troubleshooting.

The data from USGS had all arrived by May 2003, and I was able to restore it all from CDs. The Swathed files were converted using a Swathed→Caris HIPS convertor written by Caris for this purpose. The first draft of the convertor assumed that the data had been fully merged with all refraction editing applied. This was not the case and a second version of the convertor was written which converted Swathed's three-parameter refraction editor files and converted them to a new HIPS format. In addition, the merge function in HIPS was modified to be able to perform a head velocity change in addition to changes at depth, to be consistent with the Swathed technology. After those changes, the data looked pretty good.

I contacted Cary Wong through HSD Operations and explained the project. Cary was able to find tide files going back to 1994. However, the files for 1994 were archived on a type of media that is no longer readable, so that year is only hourly data, which was interpolated by HIPS.

The Survey

THOMAS JEFFERSON arrived on scene in Massachusetts Bay in August 2003. In making up the cross line files for the survey, we estimated the total level of effort we wanted to spend on the project, then determined the number of crosslines that would be possible to run in that time frame. It came out to about three lines per sheet, run lengthwise east-west. In addition, in some areas, we ran some holiday lines and a few item investigations. On sheets D and F, we junctioned NOAA launch and ship data with the USGS data to form a complete survey.

Comparison of Data

In general, we found that the USGS data was consistently shoaler than the TJ ship multibeam data by 0.5m to 0.8m. In order to try to determine which was right, we tested several hypotheses.

1) Tidal Epoch-the tidal epoch changed in April 2003. The change is in the "right" direction to explain the difference, but the maximum magnitude in the survey area is 0.05m, not enough to explain the difference on its own.

2) Changing seafloor-The difference is too consistent
3) USGS use of the refraction editor-This could explain some differences in the outer beams, but the difference is consistent across the swath.
4) TJ draft error-We sought to test this hypothesis by doublechecking our draft and by conducting a leadline check. We conducted numerous tests and checked as many static measurements as possible. In addition, we installed a tube in the sonar void to be able to measure the waterline-reference mark directly. We were able to correct the difference by about 15 cm after adjusting our draft based on the new measurements. However, even after all the checking, we were unable to make the leadline test close with the Simrad processed soundings. The difference was about 0.4m, and the leadline measurements would be in general agreement with the USGS data.
5) The launches data was also compared to the USGS data and the TJ ship data. In general, the launch data was also shoaler than the ship data by 0.2-0.3m, placing it between the ship data and the USGS data.
6) Creed draft/loading error-*Creed* is a SWATH vessel with active stablization and controllable draft to optimize seakeeping abilities. It is possible that the draft was poorly measured or controlled. If it were poorly controlled, however, we would expect that there would be considerable inconsistency within the USGS data set. A draft measurement error would be consistent with a constant offset.

Conclusions

1) We were not able to find a single cause for the difference between the USGS data and TJ data, but believe it to be a combination of TJ draft measurement, Creed draft measurement, and tidal epoch change.
2) The data collected for these surveys by USGS and TJ were collected under circumstances other than an NOS-specified hydrographic survey for charting, and need to be treated differently than other surveys.
    a. The current version of NOS Specifications and Deliverables is inapplicable to these surveys.
    b. The results of the surveys should be examined, with far less emphasis on the processes employed during acquisition and processing.
    c. These surveys were not intended to find and characterize small features such as rocks, wrecks, and obstructions. In the few cases where these features were in fact visible in the data, they will be noted in the DR. In other cases, the items should remain as charted.
    d. Most of the survey area was in deep water (>30m) and there was continuous coverage in these areas. In shoaler areas, the line spacing was frequently too wide to achieve continuous coverage. As a result, there are a few shoals on some sheets that TJ has recommended be retained as charted because the least depth was not determined by these surveys. It was beyond the scope of this project to investigate every shoal and fill every holiday.

3) This procedure of running a few crosslines over OSD data was very successful and has resulted in a set of surveys that NOAA can stand behind for charting purposes. However, I do not think it should generally be necessary for ship's personnel take the lead on the project. I recommend that future similar efforts should be encouraged, with shoreside processing personnel taking the lead on the project from start to finish. This includes:

   a. Discussing the form of data transfer from the supplying organization to NOAA in manner conducive to continued cooperation and collaboration.
   b. Ensuring that the data is rigorously converted to our processing software (HIPS), paying special attention to the application of ancillary data such as tides, sound velocity, and draft. Conversion should also be made in such a way as to preserve any edits that the original hydrographers made to the data.
   c. Well before any planned field work, the data should be analyzed for holidays, searched for rocks, wrecks, obstructions and compared to the chart. With this information, the hydrographers can develop a survey plan that optimizes the use of the ship.
   d. Survey work should include regularly spaced crosslines sufficient to check most of the OSD survey lines. It should include holiday lines and item investigation lines as necessary to minimize unresolved items and unaddressed charted features.
   e. Preliminary processing can occur on the ship, but a shoreside team should write up the DR and do the final analysis and processing.

W00052

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 No.	**W00052**

LOCALITY

State	Massachusetts
General Locality	Approaches to Boston
Sub-locality	22 NM NE of Halibut Point

2003

CHIEF OF PARTY
LCDR Donald W. Haines, NOAA

LIBRARY & ARCHIVES

DATE

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

REGISTRY NUMBER:

HYDROGRAPHIC TITLE SHEET

W00052

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:	**Massachusetts**		
General Locality:	**Approaches to Boston**		
Sub-Locality:	**22 NM NE of Halibut Point**		
Scale:	**1:20,000**	Date of Survey:	**04/6/96 to 01/31/03** **10/01/03 to 10/02/03**
Instructions Dated:	**07/17/03**	Project Number:	**OPR-A397-TJ-03**
Vessel:	**NOAA Ship THOMAS JEFFERSON, S-222**		
Chief of Party:	**LCDR Donald W. Haines, NOAA**		
Surveyed by:	**THOMAS JEFFERSON Personnel**		
Soundings by:	**KongsbergSimrad EM1002 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**~~ ***feet*** **at MLLW**		

Remarks: ***Bold, Italic, Red notes in the Descriptive Report were made during office processing.***

1) All Times are UTC.

2) This is a Navigable Area Hydrographic Survey.

3) Projection is UTM Zone 19.

TABLE OF CONTENTS

DESCRIPTIVE REPORT

to accompany

HYDROGRAPHIC SURVEY W00052

Scale of Survey: 1:20,000
Year of Survey: 2003
NOAA Ship THOMAS JEFFERSON
LCDR Donald W. Haines, Commanding

A. AREA SURVEYED

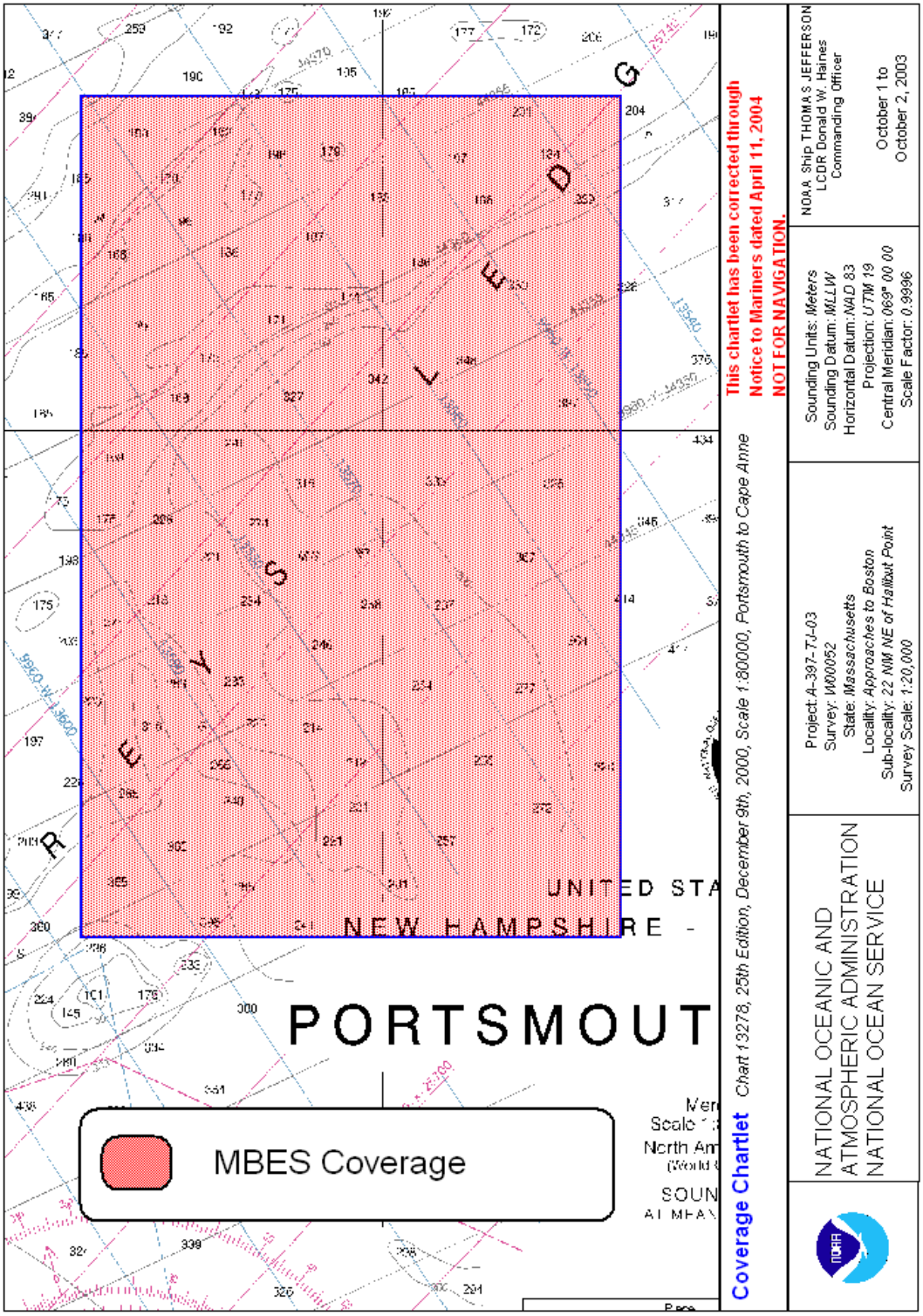
This hydrographic survey was conducted in accordance with Hydrographic Survey Letter Instructions* for project OPR-A397-TJ03, Approaches to Boston, Massachusetts. The original instructions* are dated July 17, 2003.

This Descriptive Report pertains to sheet "V" of project OPR-A397-TJ-03. The assigned registry number for this sheet is W00052, as prescribed in the Letter Instructions*.

This project is being conducted to provide contemporary hydrography with full bottom multibeam coverage in the approaches to Boston Harbor. This project responds to requests from the Massachusetts Port Authority (MASSPORT), Boston Pilots, the First U.S. Coast Guard District, Massachusetts Coastal Zone Management (Boston, MA), and the U.S. Geological Survey (Woods Hole, MA).

This project will also contribute valuable bathymetric data to the Stellwagen Bank Marine Sanctuary program in conjunction with the U.S. Geological Survey (USGS), Woods Hole Oceanographic Institution (WHOI), and the Canadian Hydrographic Service (CHS). Multibeam tracklines will be run in order to validate Outside Source Data (OSD) from the USGS and the University of New Hampshire (UNH). For complete survey limits, see the chartlet on the following page.

Data filed with original field records.


MBES Coverage
PORTSMOUT
NEW HAMPSHIRE -
UNITED STA
Coverage Chartlet Chart 13278, 25th Edition, December 9th, 2000, Scale 1:80000, Portsmouth to Cape Anne
This chartlet has been corrected through Notice to Mariners dated April 11, 2004
NOT FOR NAVIGATION.
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE
Project: A-397-TJ-03
Survey: W00052
State: Massachusetts
Locality: Approaches to Boston
Sub-locality: 22 NM NE of Halibut Point
Survey Scale: 1:20,000
Sounding Units: Meters
Sounding Datum: MLLW
Horizontal Datum: NAD 83
Projection: UTM 19
Central Meridian: 069° 00 00
Scale Factor: 0.9996
NOAA Ship THOMAS JEFFERSON
LCDR Donald W. Haines
Commanding Officer
October 1 to
October 2, 2003

B. DATA ACQUISITION AND PROCESSING *See Also Evaluation Report*

EQUIPMENT

This survey took advantage of a vast data set acquired by U.S. Geological Survey (USGS). The USGS and their partnership with the Canadian Hydrographic Survey, acquired multibeam bathymetric data over a time span of ten years. The data for this sheet were acquired from April 6, 1996 to April 25, 1996. Data were delivered to NOAA in UNB swathed format. The data were assembled and converted to Caris HIPS format at University of New Hampshire's Joint Hydrographic Center as part of the preparation for the project. This Outside Source Data (OSD) was integrated into our quality control pipeline (see Quality Control section). The majority of this OSD was located in waters greater than 20 meters and not located in high priority navigation areas as depicted in the national survey plan.

This survey also took advantage of a data set acquired by Science Applications International Corporation (SAIC) from December 19, 2002 to January 31, 2003 under contract to University of New Hampshire's Joint Hydrographic Center. SAIC acquired the data on OCEAN EXPLORER, which is equipped with a POS/MV for position and attitude, and a RESON 8101 multibeam echosounder. The data were delivered to NOAA in Caris HIPS format with tide and sound velocity already applied. This OSD was also integrated into our Quality Control pipeline.

Data were also acquired by NOAA Ship THOMAS JEFFERSON on September 30, 2003 to help verify the OSD. The ship is 208' (63.41m) long with a mean draft of 14' (4.26m).

NOAA Ship THOMAS JEFFERSON acquired multibeam echosounder (MBES) data using a Simrad 1002 multibeam system. All positioning and attitude were determined with a TSS POS/MV 320 (version 3) GPS-aided inertial navigation system. Sound velocity casts were conducted with a Sea Bird 19 profiler.

No unusual vessel configurations or problems were encountered. Refer to the Data Acquisition and Processing Report (DAPR*) for detailed equipment and vessel configuration information.

Data filed with original field records.

QUALITY CONTROL

Multibeam Quality Control

Mainscheme MBES data is defined to be the Outside Source Data. There were no known faults with the MBES system which affected data integrity. ***Concur.***

All outside source data were analyzed using Caris HIPS and SIPS 5.4, taking advantage of the new statistical analysis and error tracking capabilities. The data were used in the creation of **HIPS** BASE (Bathymetry Associated with Statistical Error) surfaces and analyzed using the standard deviation, density, and uncertainty layers. No systematic problems with the outside source data were found. ***Concur.***

Crosslines

Crossline data were acquired by NOAA Ship THOMAS JEFFERSON. Due to a roll calibration error affecting outer beams at more than 50° off nadir, all data were filtered to 45° from nadir on each side. Refer to this projects associated DAPR***** for detailed discussion of MBES system calibrations, data acquisition, and data processing.

On DN 274, DN275 data from nine MBES crosslines were acquired by NOAA Ship THOMAS JEFFERSON. Mainscheme and crossline data were analyzed in a **HIPS** BASE surface (see project DAPR*****). Crosslines agreed well with mainscheme data, being on average 0.3 meters deeper. ***Concur. See Also Evaluation Report***

Junctions

Hydrographic survey W00048, Sheet R, adjoins the southern edge of W00042. Survey W00051, Sheet U, adjoins the western edge of W00052. Survey W00053, Sheet W, adjoins the northern edge of W00052. All three surveys are part of project OPR-A397-TJ-03, and are validations of the same outside source data. As such, the data used for the survey overlaps were identical. ***Concur. See Also Evaluation Report***

CORRECTIONS TO ECHO SOUNDING

All methods or instruments used were as described in the project DAPR*****. A table detailing all sound velocity casts is located in Separate III*****. ***Concur.***

****Data filed with original field records.***

C. VERTICAL AND HORIZONTAL CONTROL

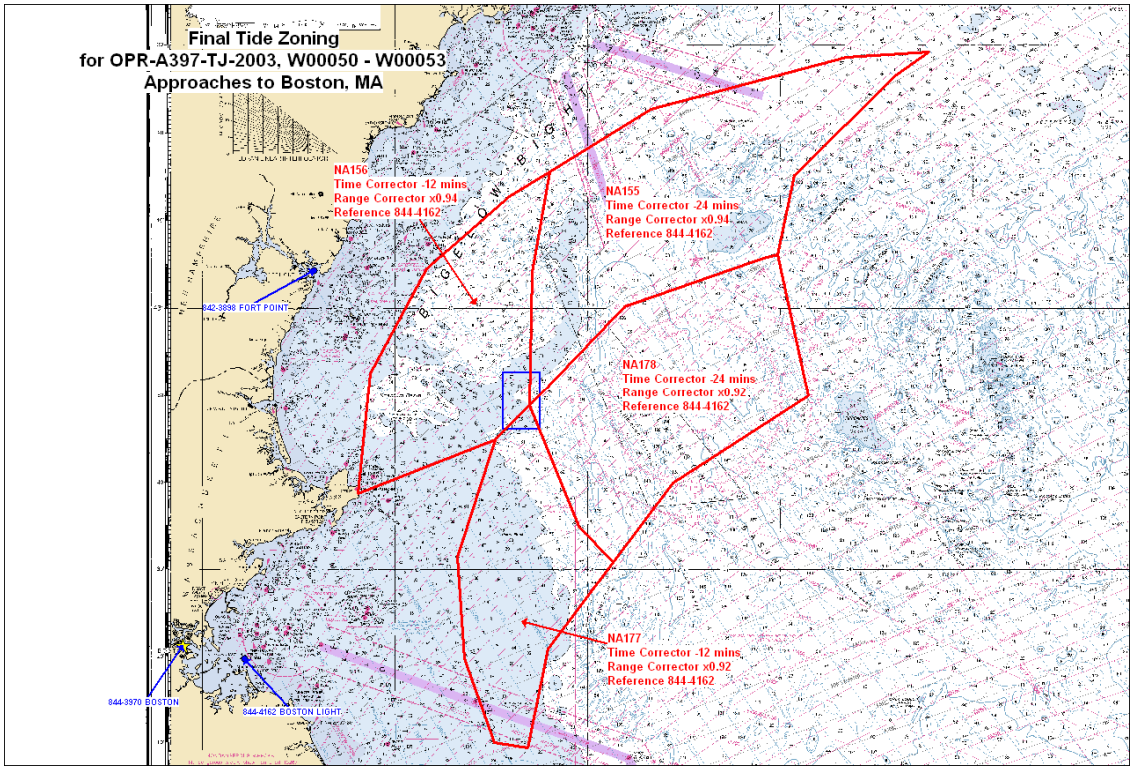
VERTICAL CONTROL

The tidal datum for this project is Mean Lower Low Water (MLLW). The operating tide stations at Boston, MA (844-3970) and Portland, ME (841-8150) served as control for datum determination. Tertiary gauges at Boston Light (844-4162) and Fort Point, NH (842-3898) provided ancillary tide data. ***Concur***.

Tidal zoning for this survey is consistent with the Letter Instructions*. The zones used for this survey are as follows:

****Data filed with original field records.***

ZONE NAME	CORRECTOR (min)	RATIO	REFERENCE
NA155	-24	0.94	844-4162
NA156	-12	0.94	844-4162
NA177	-12	0.92	844-4162
NA178	-24	0.92	844-4162



A Request for Approved Tides letter was sent to N/OPS1 on October 15, 2003 (Appendix IV*). Verified tides from the N/OPS1 CO-OPS website were applied to THOMAS JEFFERSON data on June 1, 2004. Tide was not applied to the UNH Ocean Explorer data, as it was delivered with verified tides from Portland, ME (841-8150) already applied. Preliminary tide zoning using preliminary tides from Fort Point, NH (842-3898) were applied to the USGS data. ***Concur.***

HORIZONTAL CONTROL ***See Also Evaluation Report***

The horizontal datum used for this survey is the North American Datum of 1983 (NAD 83), projected using UTM zone 19.

Sounding positional control was determined using the Global Positioning System (GPS) corrected by U.S. Coast Guard differential GPS (DGPS) beacon stations. The primary and only DGPS beacon used for this survey was Portsmouth, New Hampshire (Beacon #771). No horizontal control stations were established for this survey.

Horizontal dilution of precision (HDOP) was monitored during data acquisition. That value did not exceeded 2.50, and the survey was conducted during times of adequate satellite coverage.

D. RESULTS AND RECOMMENDATIONS *See Also Evaluation Report*

CHART COMPARISON

There are five charts affected by this survey:

13278, 25th edition, December, 2000, scale 1:80,000
13260, 39th edition, June, 2003, scale 1:378838
13009, 30th edition, August 1, 2002, scale 1:500000
13006, 31st edition, June, 2003, scale 1:675000
13003, 47th edition, June, 2003, scale 1:1200000

General Agreement with Charted soundings

The sounding data acquired during this survey agree well with the charted depths throughout the survey area. The charted depths are from partial bottom NOS surveys conducted before 1970. The MBES data acquired for this survey are adequate to supercede the charted depths. ***Concur. See Also Evaluation Report***

****Data filed with original field records.***

AWOIS Items and Significant Contacts

There were no AWOIS items within the survey limits. ***Concur***.

Dangers to Navigation

There were no Dangers to Navigation (DtoN) reported by the Hydrographer for this project. ***Concur***.

Charted Features

There was one charted feature investigated for this survey. The item is discussed in the Feature Report in Appendix I. ***Concur***.

Charting Recommendations

Display survey soundings and redraw contour lines to represent the soundings acquired. ***Concur***.

ADDITIONAL RESULTS

Aids to Navigation and Other Detached Positions

There are no Aids to Navigation in the survey limits. ***Concur***.

Bridges and Overhead Cables

There are no bridges or overhead cables within the survey limits. ***Concur***.

Ferry Routes

There are no ferry routes that pass through the survey limits. ***Concur***.

Submarine Cables and Pipelines

There are no charted submarine cables or pipelines within the survey limits, nor were any found during the survey. ***Concur***.

E. APPROVAL SHEET

OPR-A397-TJ
Massachusetts
Approaches to Boston Harbor

22 NM NE of Halibut Point
Survey Registry No. W00052

Field operations for this basic hydrographic survey were conducted under my daily supervision with frequent checks of progress and adequacy. All field sheets, this Descriptive Report, and all accompanying records and data are approved.

I have ensured that standard field surveying and processing procedures were adhered to during this project in accordance with the Hydrographic Manual, Fourth Edition; Hydrographic Survey Guidelines; Field Procedures Manual, and the NOS Hydrographic Surveys Specifications and Deliverables, as updated for March, 2003. This survey was conducted as outlined in the Data Acquisition and Processing Report (August - November, 2003) submitted March 30, 2004, as well as the DAPR Change No. 1 submitted April 11, 2004. Refer to the Horizontal and Vertical Control Report (20 January, 2004) submitted March 4, 2004 for further information not included with this Descriptive Report.

This survey is adequate to supersede all prior surveys in common areas, and for application to the relevant NOS nautical charts.

Respectfully Submitted:

_____
ENS Matthew Ringel, NOAA
Junior Officer

Approved and Forwarded:

_____
LT Shepard Smith, NOAA
Field Operations Officer

_____
LCDR Donald W. Haines, NOAA
Commanding Officer

APPENDIX I

ITEM INVESTIGATIONS AND CHARTED FEATURES

Registry Number: W00052

State: Massachusetts

Locality: Approaches to Boston

Sub-locality: 22 NM NE of Halibut Point

Project Number: OPR-A397-TJ-03

Survey Date: 04/12/1996

Charts Affected

Number	Version	Date	Scale
13278	25th Ed.	12/09/2000	1:80000
13260	39th Ed.	06/01/2003	1:378838
13009	30th Ed.	08/01/2002	1:500000
13006	31st Ed.	06/01/2003	1:675000
13003	47th Ed.	06/01/2003	1:1200000

Features

No.	Feature Type	Survey Depth	Survey Latitude	Survey Longitude	AWOIS Item
1.1	Sounding	53.06 m	42.76593893° N	70.18061747° W	---

1 - Charted Features

1.1) 174 near charted 241

Survey Summary

Survey Position: 42.76593893° N, 70.18061747° W

Least Depth: 53.06 m

Timestamp: 1996-103.12:51:50.980 (04/12/1996)

Survey Line: stellwagen / creed / 1996_103 / stell_103_0520

Profile/Beam: 749/4

Charts Affected: 13278_1, 13260_1, 13009_1, 13006_1, 13003_1

Remarks:

This shoal falls on the edge between W00052 and W00048. It will be discussed in greater detail in the DR for W00048.

Feature Correlation

Address	Feature	Range	Azimuth	Status
stellwagen/creed/1996_103/stell_103_0520	749/4	0.00	000.0	Primary
ChartGPs - Digitized	1	190.41	176.8	Secondary (grouped)

Hydrographer Recommendations

Chart per digital data submitted with W00048.

Cartographically-Rounded Depth (Affected Charts):

174ft (13278_1)

29fm (13260_1, 13009_1, 13006_1, 13003_1)

APPENDIX II

LIST OF GEOGRAPHIC NAMES

Geographical names as depicted on the chart were observed in common usage. Hydrographer has no particular recommendation on geographical names.

APPENDIX III

PROGRESS SKETCH

A progress sketch is included in the digital data.

APPENDIX IV

TIDES AND WATER LEVELS

October 15, 2003

MEMORANDUM FOR: Chief, Requirements and Development Division, N/OPS1

FROM: LCDR Donald Haines, NOAA Ship THOMAS JEFFERSON

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:

NOAA/NOS/Atlantic Hydrographic Branch
N/CS33, Building #2
439 West York Street
Norfolk, VA 23510
ATTN: Chief AHB

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

Project No.:	OPR-A397-TJ-03
Registry No.:	W00050 - W00053
State:	MA
Locality:	Approaches to Boston
Sublocality:	20 NM NE of Halibut Point

Attachments containing:
1) an Abstract of Times of Hydrography,
2) digital MID MIF files of the track lines from pydro on CD/diskette

cc: N/CS33

Year_DOY	Min Time	Max Time
2003_274	13:02:14	23:53:48
2003_275	00:32:56	16:14:06

APPENDIX V

SUPPLEMENTAL SURVEY RECORDS AND CORRESPONDENCES

The hydrographer reviewed the Coast Pilot report for the survey limits. There was no new additional information to be added to the Coast Pilot. ***Concur***

~~There are no other supplemental survey records or correspondences for this survey.~~

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NOAA Marine and Aviation Operations
NOAA Ship Thomas Jefferson S-222
439 W. York Street
Norfolk, VA 23510-1114

October 5, 2004

MEMORANDUM FOR: LCDR Tod Schattgen, NOAA
Chief, Atlantic Hydrographic Branch

THROUGH: CDR Emily B. Christman, NOAA
Commanding Officer, NOAA Ship THOMAS JEFFERSON

FROM: LT Shepard M. Smith, NOAA
Executive Officer, NOAA Ship THOMAS JEFFERSON

SUBJECT: USGS Stellwagen Bank Data

This memorandum serves to document the background, approach, and processing steps employed to incorporate the USGS Stellwagen Bank and Massachussets Bay multibeam data into the NOAA charting system.

Background

During the planning of OPR A397, I became aware that the survey areas assigned to WHITING, then LITTLEHALES, then THOMAS JEFFERSON overlapped significantly with the multibeam data acquired by USGS during the mid 1990s. This project was funded by USGS, with technical assistance from the Ocean Mapping Group at the University of New Brunswick and surveyed using the Canadian Hydrographic Service vessel *Frederick Creed*. It was also a cooperative project with NOAA, and several NOAA Corps hydrographers sailed aboard for portions of the project.

The data was collected under the guidance of some of the worldwide experts in multibeam surveying at the time. While it was NOAA's intention at the time to chart this data, we did not have the capability to process this large a dataset, and the data that NOAA did get languished in a collection of shoeboxes in Silver Spring.

In March 2003, after discussing the possibility with LT Jon Swallow at HSD operations, I contacted USGS in Woods Hole through Dr. Larry Mayer to inquire about the status of the data. I told them that we would be surveying the area on the NOAA Ship THOMAS JEFFERSON, and that we wanted to reduce duplication of effort. Dr. Bill Danforth replied enthusiastically that they would make the data available to us in whatever form we needed.

In addition, UNH's Center for Coastal and Ocean Mapping (CCOM) had contracted with SAIC to conduct a multibeam survey of Jeffrey's Ledge, an area just to the north of the

USGS Stellwagen Bank data set. During a break in their hydrographic survey work for NOAA, the SAIC team went up to Jeffreys Ledge and conducted the survey in the winter of 2002-2003. The data was sent to UNH in lightly edited form and turned over to graduate student Mashkoor Malik to work on. The CCOM leadership team offered the data to NOAA for charting. Because of the plans to incorporate the USGS data into NOAA's pipeline aboard the THOMAS JEFFERSON, I offered to add this SAIC data to the USGS data and work with it all together.

I then contacted HSD operations again to plan our approach to the project.

The Approach

This was an unusual opportunity to incorporate a large amount of Outside Source Data into the charting process. The most unusual aspect was that we had a ship available to junction and check the data. We came up with the following premises:

1) We would convert the data to a form where it could be manipulated as if it were our own data. This necessitated a new convertor to get the data into Caris HIPS format.
2) The tides applied to the data were inconsistent. We would plan to reapply all tides using historic NOAA station data and modern zoning.
3) We would use a Navigation Surface approach to process the data for charting. We would estimate the sensor errors for the Creed data and compute TPE as appropriate.
4) The data was edited to some extent by the Creed in the one case and CCOM in the other. We would further clean data only as necessary to produce a clean Navigation Surface.
5) The grids provided by the USGS were at a coarse resolution of 10m. For parts of the survey area, this is insufficient to capture all the seafloor detail in the data.
6) Various techniques were used by the CHS and USGS hydrographers to correct for sound velocity. The Simrad 1000 multibeam sonar system was corrected for sound velocity at the head and in the water column in real time. In order to compensate for head velocity errors and the difference between the last cast and the water column at their location, the hydrographers made extensive use of head velocity offsets and the interactive refraction editor. We would not second-guess the hydrographer's judgement on this, but merely reapply the values as they intended.
7) In general, we would compare *their results* to *our results*. We would not compare their *processes* to our *processes*. Because of the difference in the purpose of the survey and the changes in technology, it would not be useful to spend a lot of time worrying about processing techniques.
8) We would run crosslines with the TJ or her launches to check the accuracy of the data. We could also fill holidays or develop shoals at our discretion.
9) The TJ data would be combined with the OSD data to create a single survey with a "W" designation. TJ would write DRs and submit the surveys to AHB in a form

similar to that used for our own surveys. This should ease its inclusion in our workflow.

This approach was discussed with LT Jon Swallow Mike Riddle and Steve Verry, HSD Operations, and CDR Emily B. Christman at AHB, and is consistent with the project instructions issued for the project.

Preliminary Processing

Because I would be going out to the THOMAS JEFFERSON as Operations Officer and would oversee the project, I volunteered to be the focal point for data conversion and preliminary troubleshooting.

The data from USGS had all arrived by May 2003, and I was able to restore it all from CDs. The Swathed files were converted using a Swathed→Caris HIPS convertor written by Caris for this purpose. The first draft of the convertor assumed that the data had been fully merged with all refraction editing applied. This was not the case and a second version of the convertor was written which converted Swathed's three-parameter refraction editor files and converted them to a new HIPS format. In addition, the merge function in HIPS was modified to be able to perform a head velocity change in addition to changes at depth, to be consistent with the Swathed technology. After those changes, the data looked pretty good.

I contacted Cary Wong through HSD Operations and explained the project. Cary was able to find tide files going back to 1994. However, the files for 1994 were archived on a type of media that is no longer readable, so that year is only hourly data, which was interpolated by HIPS.

The Survey

THOMAS JEFFERSON arrived on scene in Massachusetts Bay in August 2003. In making up the cross line files for the survey, we estimated the total level of effort we wanted to spend on the project, then determined the number of crosslines that would be possible to run in that time frame. It came out to about three lines per sheet, run lengthwise east-west. In addition, in some areas, we ran some holiday lines and a few item investigations. On sheets D and F, we junctioned NOAA launch and ship data with the USGS data to form a complete survey.

Comparison of Data

In general, we found that the USGS data was consistently shoaler than the TJ ship multibeam data by 0.5m to 0.8m. In order to try to determine which was right, we tested several hypotheses.

1) Tidal Epoch-the tidal epoch changed in April 2003. The change is in the "right" direction to explain the difference, but the maximum magnitude in the survey area is 0.05m, not enough to explain the difference on its own.

2) Changing seafloor-The difference is too consistent
3) USGS use of the refraction editor-This could explain some differences in the outer beams, but the difference is consistent across the swath.
4) TJ draft error-We sought to test this hypothesis by doublechecking our draft and by conducting a leadline check. We conducted numerous tests and checked as many static measurements as possible. In addition, we installed a tube in the sonar void to be able to measure the waterline-reference mark directly. We were able to correct the difference by about 15 cm after adjusting our draft based on the new measurements. However, even after all the checking, we were unable to make the leadline test close with the Simrad processed soundings. The difference was about 0.4m, and the leadline measurements would be in general agreement with the USGS data.
5) The launches data was also compared to the USGS data and the TJ ship data. In general, the launch data was also shoaler than the ship data by 0.2-0.3m, placing it between the ship data and the USGS data.
6) Creed draft/loading error-*Creed* is a SWATH vessel with active stablization and controllable draft to optimize seakeeping abilities. It is possible that the draft was poorly measured or controlled. If it were poorly controlled, however, we would expect that there would be considerable inconsistency within the USGS data set. A draft measurement error would be consistent with a constant offset.

Conclusions

1) We were not able to find a single cause for the difference between the USGS data and TJ data, but believe it to be a combination of TJ draft measurement, Creed draft measurement, and tidal epoch change.
2) The data collected for these surveys by USGS and TJ were collected under circumstances other than an NOS-specified hydrographic survey for charting, and need to be treated differently than other surveys.
    a. The current version of NOS Specifications and Deliverables is inapplicable to these surveys.
    b. The results of the surveys should be examined, with far less emphasis on the processes employed during acquisition and processing.
    c. These surveys were not intended to find and characterize small features such as rocks, wrecks, and obstructions. In the few cases where these features were in fact visible in the data, they will be noted in the DR. In other cases, the items should remain as charted.
    d. Most of the survey area was in deep water (>30m) and there was continuous coverage in these areas. In shoaler areas, the line spacing was frequently too wide to achieve continuous coverage. As a result, there are a few shoals on some sheets that TJ has recommended be retained as charted because the least depth was not determined by these surveys. It was beyond the scope of this project to investigate every shoal and fill every holiday.

3) This procedure of running a few crosslines over OSD data was very successful and has resulted in a set of surveys that NOAA can stand behind for charting purposes. However, I do not think it should generally be necessary for ship's personnel take the lead on the project. I recommend that future similar efforts should be encouraged, with shoreside processing personnel taking the lead on the project from start to finish. This includes:

   a. Discussing the form of data transfer from the supplying organization to NOAA in manner conducive to continued cooperation and collaboration.
   b. Ensuring that the data is rigorously converted to our processing software (HIPS), paying special attention to the application of ancillary data such as tides, sound velocity, and draft. Conversion should also be made in such a way as to preserve any edits that the original hydrographers made to the data.
   c. Well before any planned field work, the data should be analyzed for holidays, searched for rocks, wrecks, obstructions and compared to the chart. With this information, the hydrographers can develop a survey plan that optimizes the use of the ship.
   d. Survey work should include regularly spaced crosslines sufficient to check most of the OSD survey lines. It should include holiday lines and item investigation lines as necessary to minimize unresolved items and unaddressed charted features.
   e. Preliminary processing can occur on the ship, but a shoreside team should write up the DR and do the final analysis and processing.

W00053

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 No. **W00053**

LOCALITY

State Massachusetts

General Locality Approaches to Boston

Sub-locality 24 NM NE of Halibut Point

2003

CHIEF OF PARTY
LCDR Donald W. Haines, NOAA

LIBRARY & ARCHIVES

DATE

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

REGISTRY NUMBER:

HYDROGRAPHIC TITLE SHEET

W00053

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:	**Massachusetts**		
General Locality:	**Approaches to Boston**		
Sub-Locality:	**24 NM NE of Halibut Point**		
Scale:	**1:20,000**	Date of Survey:	**12/19/02 to 01/31/03** **10/01/03 to 10/02/03**
Instructions Dated:	**07/17/03**	Project Number:	**OPR-A397-TJ-03**
Vessel:	**NOAA Ship THOMAS JEFFERSON, S-222**		
Chief of Party:	**LCDR Donald W. Haines, NOAA**		
Surveyed by:	**THOMAS JEFFERSON Personnel**		
Soundings by:	**KongsbergSimrad EM1002 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**~~ ***feet*** **at MLLW**		

Remarks: ***Bold, Italic, Red notes in the Descriptive Report were made during office processing.***

1) All Times are UTC.

2) This is a Navigable Area Hydrographic Survey.

3) Projection is UTM Zone 19.

TABLE OF CONTENTS

DESCRIPTIVE REPORT

to accompany

HYDROGRAPHIC SURVEY W00053

Scale of Survey: 1:20,000
Year of Survey: 2003
NOAA Ship THOMAS JEFFERSON
LCDR Donald W. Haines, Commanding

A. AREA SURVEYED

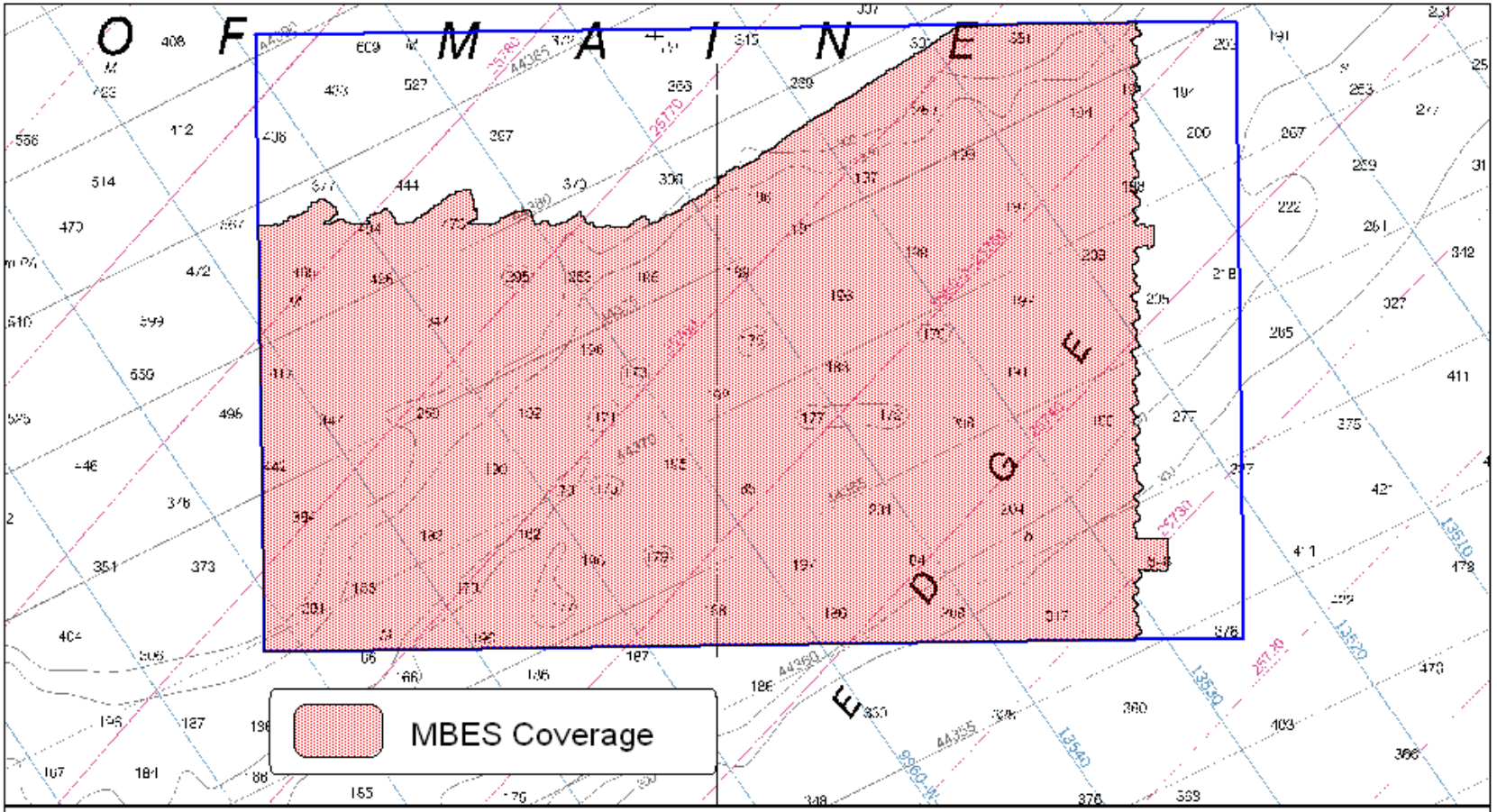
This hydrographic survey was conducted in accordance with Hydrographic Survey Letter Instructions* for project OPR-A397-TJ03, Approaches to Boston, Massachusetts. The original instructions* are dated July 17, 2003.

This Descriptive Report pertains to sheet "W" of project OPR-A397-TJ-03. The assigned registry number for this sheet is W00053, as prescribed in the Letter Instructions*.

This project is being conducted to provide contemporary hydrography with full bottom multibeam coverage in the approaches to Boston Harbor. This project responds to requests from the Massachusetts Port Authority (MASSPORT), Boston Pilots, the First U.S. Coast Guard District, Massachusetts Coastal Zone Management (Boston, MA), and the U.S. Geological Survey (Woods Hole, MA).

This project will also contribute valuable bathymetric data to the Stellwagen Bank Marine Sanctuary program in conjunction with the U.S. Geological Survey (USGS), Woods Hole Oceanographic Institution (WHOI), and the Canadian Hydrographic Service (CHS). Multibeam tracklines will be run in order to validate Outside Source Data (OSD) from the USGS and the University of New Hampshire (UNH). For complete survey limits, see the chartlet on the following page.

Data filed with original field records.



Coverage Chartlet *Chart 13278, 25th Edition, December 9th, 2000, Scale 1:80000, Portsmouth to Cape Ann*

This chartlet has been corrected through Notice to Mariners dated April 11, 2004
NOT FOR NAVIGATION.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE

Project: *OPR-A397-TJ-04*
Survey: *W00053*
State: *Massachusetts*
Locality: *Approaches to Boston*
Sub-locality: *24 NM NE of Halibut Point*
Survey Scale: *1:20,000*

Sounding Units: *Feet*
Sounding Datum: *MLLW*
Horizontal Datum: *NAD 83*
Projection: *UTM 19*
Central Meridian: *069° 00 00*
Scale Factor: *0.9996*

NOAA Ship THOMAS JEFFERSON
LCDR Donald. W. Haines
Commanding Officer

October 1 to
October 2, 2003

B. DATA ACQUISITION AND PROCESSING *See Also Evaluation Report*

EQUIPMENT

This survey took advantage of a vast data set acquired by U.S. Geological Survey (USGS). The USGS and their partnership with the Canadian Hydrographic Survey, acquired multibeam bathymetric data over a time span of ten years. The data for this sheet were acquired from April 1, 1995 to April 21, 1995. Data were delivered to NOAA in UNB swathed format. The data were assembled and converted to Caris HIPS format at University of New Hampshire's Joint Hydrographic Center as part of the preparation for the project. This Outside Source Data (OSD) was integrated into our quality control pipeline (see Quality Control section). The majority of this OSD was located in waters greater than 20 meters and not located in high priority navigation areas as depicted in the national survey plan.

This survey also took advantage of a data set acquired by Science Applications International Corporation (SAIC) from December 19, 2002 to January 31, 2003 under contract to University of New Hampshire's Joint Hydrographic Center. SAIC acquired the data on OCEAN EXPLORER, which is equipped with a POS/MV for position and attitude, and a RESON 8101 multibeam echosounder. The data were delivered to NOAA in Caris HIPS format with tide and sound velocity already applied. This OSD was also integrated into our Quality Control pipeline.

Data were also acquired by NOAA Ship THOMAS JEFFERSON on September 30, 2003 to help verify the OSD. The ship is 208' (63.41m) long with a mean draft of 14' (4.26m).

NOAA Ship THOMAS JEFFERSON acquired multibeam echosounder (MBES) data using a Simrad 1002 multibeam system. All positioning and attitude were determined with a TSS POS/MV 320 (version 3) GPS-aided inertial navigation system. Sound velocity casts were conducted with a Sea Bird 19 profiler.

No unusual vessel configurations or problems were encountered. Refer to the Data Acquisition and Processing Report (DAPR*) for detailed equipment and vessel configuration information.

Data filed with original field records.

QUALITY CONTROL

Multibeam Quality Control

Mainscheme MBES data is defined to be the Outside Source Data. There were no known faults with the MBES system which affected data integrity. ***Concur.***

All outside source data were analyzed using Caris HIPS and SIPS 5.4 beta, taking advantage of the new statistical analysis and error tracking capabilities. The data were used in the creation of **HIPS** BASE (Bathymetry Associated with Statistical Error) surfaces and analyzed using the standard deviation, density, and uncertainty layers. No systematic problems with the outside source data were found. ***Concur.***

Crosslines

Crossline data were acquired by NOAA Ship THOMAS JEFFERSON. Due to a roll calibration error affecting outer beams at more than 50° off nadir, all data were filtered to 45° from nadir on each side. Refer to this projects associated DAPR***** for detailed discussion of MBES system calibrations, data acquisition, and data processing.

On DN 273, data from four MBES crosslines were acquired by NOAA Ship THOMAS JEFFERSON. Mainscheme and crossline data were analyzed in a **HIPS** BASE surface (see project DAPR*****) in addition to being analyzed in a **HIPS** Quality Control Report. On average, the crosslines were 0.8 meters deeper than the mainscheme data. Crossline data agreed within 95% to 100% of the mainscheme data, based on the International Hydrographic Organization (IHO) Order 2 statistical standards used in the **HIPS** Quality Control Report (see Separate V). ***Concur. See Also Evaluation Report***

Junctions

Hydrographic survey W00041, Sheet K, adjoins the southern edge of W00043. Survey W00042, Sheet L, adjoins the western edge of W00043. Survey W00046, Sheet P, adjoins the northern edge of W00043. All three surveys are part of project OPR-A397-TJ-03, and are validations of the same outside source data. As such, the data used for the survey overlaps were identical. ***Concur. See Also Evaluation Report***

CORRECTIONS TO ECHO SOUNDING

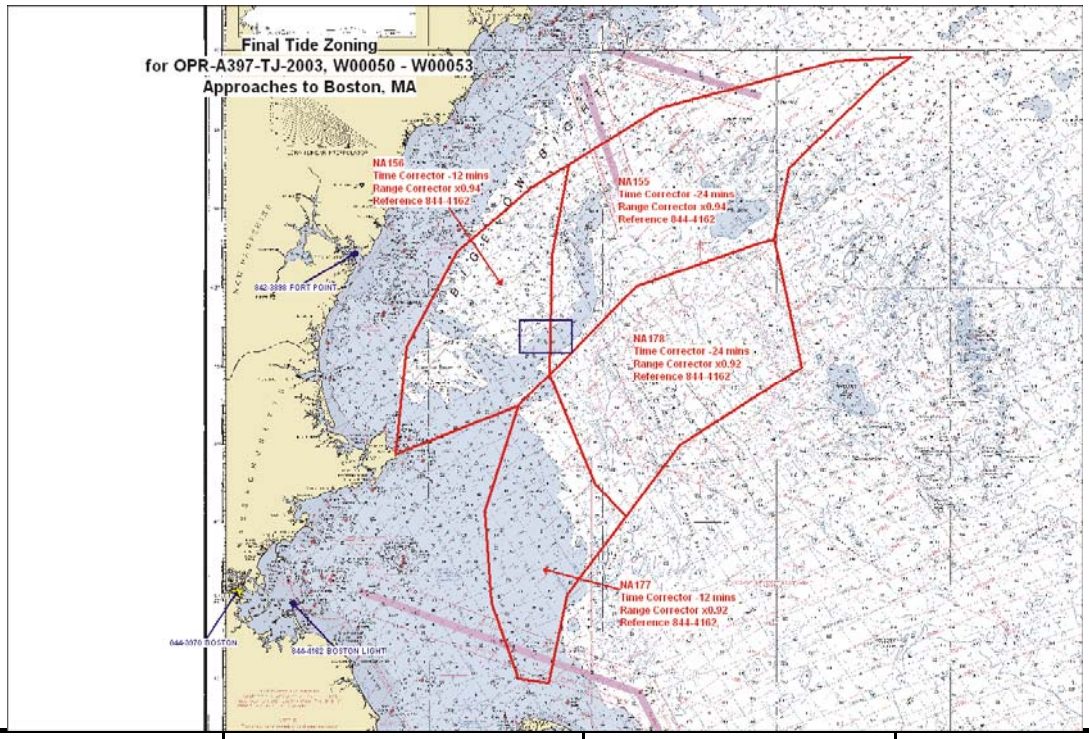
All methods or instruments used were as described in the project DAPR*****. A table detailing all sound velocity casts is located in Separate III*****. ***Concur.***
****Data filed with original field records.***

C. VERTICAL AND HORIZONTAL CONTROL

VERTICAL CONTROL

The tidal datum for this project is Mean Lower Low Water (MLLW). The operating tide stations at Boston, MA (844-3970) and Portland, ME (841-8150) served as control for datum determination. Tertiary gauges at Boston Light (844-4162) and Fort Point, NH (842-3898) provided ancillary tide data. ***Concur***.

Tidal zoning for this survey is consistent with the Letter Instructions***. The zones used for this survey are as follows:



ZONE NAME	CORRECTOR (min)	RATIO	REFERENCE
NA155	-24	0.94	844-4162
NA156	-12	0.94	844-4162
NA178	-24	0.92	844-4162

Data filed with original field records.

A Request for Approved Tides letter was sent to N/OPS1 on October 15, 2003 (Appendix IV*). Verified tides from the N/OPS1 CO-OPS website were applied to THOMAS JEFFERSON data on June 1, 2004. Tide was not applied to the UNH Ocean Explorer data, as it was delivered with verified tides from Portland, ME (841-8150) already applied. Preliminary tide zoning using preliminary tides from Fort Point, NH (842-3898) were applied to the USGS data. ***Concur.***

HORIZONTAL CONTROL *See Also Evaluation Report*

The horizontal datum used for this survey is the North American Datum of 1983 (NAD 83), projected using UTM zone 19.

Sounding positional control was determined using the Global Positioning System (GPS) corrected by U.S. Coast Guard differential GPS (DGPS) beacon stations. The primary and only DGPS beacon used for this survey was Portsmouth, New Hampshire (Beacon #771). No horizontal control stations were established for this survey.

Horizontal dilution of precision (HDOP) was monitored during data acquisition. That value did not exceeded 2.50, and the survey was conducted during times of adequate satellite coverage.

D. RESULTS AND RECOMMENDATIONS *See Also Evaluation Report*

CHART COMPARISON

There are five charts affected by this survey:

13278, 25th edition, December, 2000, scale 1:80,000
13260, 39th edition, June, 2003, scale 1:378838
13009, 30th edition, August 1, 2002, scale 1:500000
13006, 31st edition, June, 2003, scale 1:675000
13003, 47th edition, June, 2003, scale 1:1200000

General Agreement with Charted soundings

The sounding data acquired during this survey agree well with the charted depths, except at isolated shoals as noted in the item investigations found in Appendix I. The charted depths are from partial bottom NOS surveys conducted before 1970. The MBES data acquired for this survey are adequate to supercede the charted depths. ***Concur. See Also Evaluation Report***

****Data filed with original field records.***

AWOIS Items and Significant Contacts

There were no AWOIS items within the survey limits. ***Concur***.

Dangers to Navigation

There were no Dangers to Navigation (DtoN) reported by the Hydrographer for this project. ***Concur***.

Charted Features

~~The item investigation reports describing three charted features are contained in Appendix I.~~ ***There are no item investigations for this survey.***.

Charting Recommendations

Display survey soundings and redraw contour lines to represent the soundings acquired. ***Concur***.

ADDITIONAL RESULTS

Aids to Navigation and Other Detached Positions

There are no Aids to Navigation in the survey limits. ***Concur***.

Bridges and Overhead Cables

There are no bridges or overhead cables within the survey limits. ***Concur***.

Ferry Routes

There are no ferry routes that pass through the survey limits. ***Concur***.

Submarine Cables and Pipelines

There are no charted submarine cables or pipelines within the survey limits, nor were any found during the survey. ***Concur***.

E. APPROVAL SHEET

OPR-A397-TJ
Massachusetts
Approaches to Boston Harbor

24 NM NE of Halibut Point
Survey Registry No. W00053

Field operations for this basic hydrographic survey were conducted under my daily supervision with frequent checks of progress and adequacy. All field sheets, this Descriptive Report, and all accompanying records and data are approved.

I have ensured that standard field surveying and processing procedures were adhered to during this project in accordance with the Hydrographic Manual, Fourth Edition; Hydrographic Survey Guidelines; Field Procedures Manual, and the NOS Hydrographic Surveys Specifications and Deliverables, as updated for March, 2003. This survey was conducted as outlined in the Data Acquisition and Processing Report (August - November, 2003) submitted March 30, 2004, as well as the DAPR Change No. 1 submitted April 11, 2004. Refer to the Horizontal and Vertical Control Report (20 January, 2004) submitted March 4, 2004 for further information not included with this Descriptive Report.

This survey is adequate to supersede all prior surveys in common areas, and for application to the relevant NOS nautical charts.

Respectfully Submitted:

_____
ENS Matthew Ringel, NOAA
Junior Officer

Approved and Forwarded:

_____
LT Shepard Smith, NOAA
Field Operations Officer

_____
LCDR Donald W. Haines, NOAA
Commanding Officer

APPENDIX I

ITEM INVESTIGATIONS AND CHARTED FEATURES

APPENDIX II

LIST OF GEOGRAPHIC NAMES

Geographical names as depicted on the chart were observed in common usage. Hydrographer has no particular recommendation on geographical names.

APPENDIX III

PROGRESS SKETCH

A progress sketch is included in the digital data.

APPENDIX IV

TIDES AND WATER LEVELS

October 15, 2003

MEMORANDUM FOR: Chief, Requirements and Development Division, N/OPS1

FROM: LCDR Donald Haines, NOAA Ship THOMAS JEFFERSON

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:

NOAA/NOS/Atlantic Hydrographic Branch
N/CS33, Building #2
439 West York Street
Norfolk, VA 23510
ATTN: Chief AHB

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

Project No.:	OPR-A397-TJ-03
Registry No.:	W00050 - W00053
State:	MA
Locality:	Approaches to Boston
Sublocality:	20 NM NE of Halibut Point

Attachments containing:
1) an Abstract of Times of Hydrography,
2) digital MID MIF files of the track lines from pydro on CD/diskette

cc: N/CS33

Year_DOY	Min Time	Max Time
2003_274	13:02:14	23:53:48
2003_275	00:32:56	16:14:06

APPENDIX V

SUPPLEMENTAL SURVEY RECORDS AND CORRESPONDENCES

The hydrographer reviewed the Coast Pilot report for the survey limits. There was no new additional information to be added to the Coast Pilot. ***Concur***

~~There are no other supplemental survey records or correspondences for this survey.~~

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NOAA Marine and Aviation Operations
NOAA Ship Thomas Jefferson S-222
439 W. York Street
Norfolk, VA 23510-1114

October 5, 2004

MEMORANDUM FOR: LCDR Tod Schattgen, NOAA
Chief, Atlantic Hydrographic Branch

THROUGH: CDR Emily B. Christman, NOAA
Commanding Officer, NOAA Ship THOMAS JEFFERSON

FROM: LT Shepard M. Smith, NOAA
Executive Officer, NOAA Ship THOMAS JEFFERSON

SUBJECT: USGS Stellwagen Bank Data

This memorandum serves to document the background, approach, and processing steps employed to incorporate the USGS Stellwagen Bank and Massachussets Bay multibeam data into the NOAA charting system.

Background

During the planning of OPR A397, I became aware that the survey areas assigned to WHITING, then LITTLEHALES, then THOMAS JEFFERSON overlapped significantly with the multibeam data acquired by USGS during the mid 1990s. This project was funded by USGS, with technical assistance from the Ocean Mapping Group at the University of New Brunswick and surveyed using the Canadian Hydrographic Service vessel *Frederick Creed*. It was also a cooperative project with NOAA, and several NOAA Corps hydrographers sailed aboard for portions of the project.

The data was collected under the guidance of some of the worldwide experts in multibeam surveying at the time. While it was NOAA's intention at the time to chart this data, we did not have the capability to process this large a dataset, and the data that NOAA did get languished in a collection of shoeboxes in Silver Spring.

In March 2003, after discussing the possibility with LT Jon Swallow at HSD operations, I contacted USGS in Woods Hole through Dr. Larry Mayer to inquire about the status of the data. I told them that we would be surveying the area on the NOAA Ship THOMAS JEFFERSON, and that we wanted to reduce duplication of effort. Dr. Bill Danforth replied enthusiastically that they would make the data available to us in whatever form we needed.

In addition, UNH's Center for Coastal and Ocean Mapping (CCOM) had contracted with SAIC to conduct a multibeam survey of Jeffrey's Ledge, an area just to the north of the

USGS Stellwagen Bank data set. During a break in their hydrographic survey work for NOAA, the SAIC team went up to Jeffreys Ledge and conducted the survey in the winter of 2002-2003. The data was sent to UNH in lightly edited form and turned over to graduate student Mashkoor Malik to work on. The CCOM leadership team offered the data to NOAA for charting. Because of the plans to incorporate the USGS data into NOAA's pipeline aboard the THOMAS JEFFERSON, I offered to add this SAIC data to the USGS data and work with it all together.

I then contacted HSD operations again to plan our approach to the project.

The Approach

This was an unusual opportunity to incorporate a large amount of Outside Source Data into the charting process. The most unusual aspect was that we had a ship available to junction and check the data. We came up with the following premises:

1) We would convert the data to a form where it could be manipulated as if it were our own data. This necessitated a new convertor to get the data into Caris HIPS format.
2) The tides applied to the data were inconsistent. We would plan to reapply all tides using historic NOAA station data and modern zoning.
3) We would use a Navigation Surface approach to process the data for charting. We would estimate the sensor errors for the Creed data and compute TPE as appropriate.
4) The data was edited to some extent by the Creed in the one case and CCOM in the other. We would further clean data only as necessary to produce a clean Navigation Surface.
5) The grids provided by the USGS were at a coarse resolution of 10m. For parts of the survey area, this is insufficient to capture all the seafloor detail in the data.
6) Various techniques were used by the CHS and USGS hydrographers to correct for sound velocity. The Simrad 1000 multibeam sonar system was corrected for sound velocity at the head and in the water column in real time. In order to compensate for head velocity errors and the difference between the last cast and the water column at their location, the hydrographers made extensive use of head velocity offsets and the interactive refraction editor. We would not second-guess the hydrographer's judgement on this, but merely reapply the values as they intended.
7) In general, we would compare *their results* to *our results*. We would not compare their *processes* to our *processes*. Because of the difference in the purpose of the survey and the changes in technology, it would not be useful to spend a lot of time worrying about processing techniques.
8) We would run crosslines with the TJ or her launches to check the accuracy of the data. We could also fill holidays or develop shoals at our discretion.
9) The TJ data would be combined with the OSD data to create a single survey with a "W" designation. TJ would write DRs and submit the surveys to AHB in a form

similar to that used for our own surveys. This should ease its inclusion in our workflow.

This approach was discussed with LT Jon Swallow Mike Riddle and Steve Verry, HSD Operations, and CDR Emily B. Christman at AHB, and is consistent with the project instructions issued for the project.

Preliminary Processing

Because I would be going out to the THOMAS JEFFERSON as Operations Officer and would oversee the project, I volunteered to be the focal point for data conversion and preliminary troubleshooting.

The data from USGS had all arrived by May 2003, and I was able to restore it all from CDs. The Swathed files were converted using a Swathed→Caris HIPS convertor written by Caris for this purpose. The first draft of the convertor assumed that the data had been fully merged with all refraction editing applied. This was not the case and a second version of the convertor was written which converted Swathed's three-parameter refraction editor files and converted them to a new HIPS format. In addition, the merge function in HIPS was modified to be able to perform a head velocity change in addition to changes at depth, to be consistent with the Swathed technology. After those changes, the data looked pretty good.

I contacted Cary Wong through HSD Operations and explained the project. Cary was able to find tide files going back to 1994. However, the files for 1994 were archived on a type of media that is no longer readable, so that year is only hourly data, which was interpolated by HIPS.

The Survey

THOMAS JEFFERSON arrived on scene in Massachusetts Bay in August 2003. In making up the cross line files for the survey, we estimated the total level of effort we wanted to spend on the project, then determined the number of crosslines that would be possible to run in that time frame. It came out to about three lines per sheet, run lengthwise east-west. In addition, in some areas, we ran some holiday lines and a few item investigations. On sheets D and F, we junctioned NOAA launch and ship data with the USGS data to form a complete survey.

Comparison of Data

In general, we found that the USGS data was consistently shoaler than the TJ ship multibeam data by 0.5m to 0.8m. In order to try to determine which was right, we tested several hypotheses.

1) Tidal Epoch-the tidal epoch changed in April 2003. The change is in the "right" direction to explain the difference, but the maximum magnitude in the survey area is 0.05m, not enough to explain the difference on its own.

2) Changing seafloor-The difference is too consistent
3) USGS use of the refraction editor-This could explain some differences in the outer beams, but the difference is consistent across the swath.
4) TJ draft error-We sought to test this hypothesis by doublechecking our draft and by conducting a leadline check. We conducted numerous tests and checked as many static measurements as possible. In addition, we installed a tube in the sonar void to be able to measure the waterline-reference mark directly. We were able to correct the difference by about 15 cm after adjusting our draft based on the new measurements. However, even after all the checking, we were unable to make the leadline test close with the Simrad processed soundings. The difference was about 0.4m, and the leadline measurements would be in general agreement with the USGS data.
5) The launches data was also compared to the USGS data and the TJ ship data. In general, the launch data was also shoaler than the ship data by 0.2-0.3m, placing it between the ship data and the USGS data.
6) Creed draft/loading error-*Creed* is a SWATH vessel with active stablization and controllable draft to optimize seakeeping abilities. It is possible that the draft was poorly measured or controlled. If it were poorly controlled, however, we would expect that there would be considerable inconsistency within the USGS data set. A draft measurement error would be consistent with a constant offset.

Conclusions

1) We were not able to find a single cause for the difference between the USGS data and TJ data, but believe it to be a combination of TJ draft measurement, Creed draft measurement, and tidal epoch change.
2) The data collected for these surveys by USGS and TJ were collected under circumstances other than an NOS-specified hydrographic survey for charting, and need to be treated differently than other surveys.
    a. The current version of NOS Specifications and Deliverables is inapplicable to these surveys.
    b. The results of the surveys should be examined, with far less emphasis on the processes employed during acquisition and processing.
    c. These surveys were not intended to find and characterize small features such as rocks, wrecks, and obstructions. In the few cases where these features were in fact visible in the data, they will be noted in the DR. In other cases, the items should remain as charted.
    d. Most of the survey area was in deep water (>30m) and there was continuous coverage in these areas. In shoaler areas, the line spacing was frequently too wide to achieve continuous coverage. As a result, there are a few shoals on some sheets that TJ has recommended be retained as charted because the least depth was not determined by these surveys. It was beyond the scope of this project to investigate every shoal and fill every holiday.

3) This procedure of running a few crosslines over OSD data was very successful and has resulted in a set of surveys that NOAA can stand behind for charting purposes. However, I do not think it should generally be necessary for ship's personnel take the lead on the project. I recommend that future similar efforts should be encouraged, with shoreside processing personnel taking the lead on the project from start to finish. This includes:

   a. Discussing the form of data transfer from the supplying organization to NOAA in manner conducive to continued cooperation and collaboration.
   b. Ensuring that the data is rigorously converted to our processing software (HIPS), paying special attention to the application of ancillary data such as tides, sound velocity, and draft. Conversion should also be made in such a way as to preserve any edits that the original hydrographers made to the data.
   c. Well before any planned field work, the data should be analyzed for holidays, searched for rocks, wrecks, obstructions and compared to the chart. With this information, the hydrographers can develop a survey plan that optimizes the use of the ship.
   d. Survey work should include regularly spaced crosslines sufficient to check most of the OSD survey lines. It should include holiday lines and item investigation lines as necessary to minimize unresolved items and unaddressed charted features.
   e. Preliminary processing can occur on the ship, but a shoreside team should write up the DR and do the final analysis and processing.

ATLANTIC HYDROGRAPHIC BRANCH
EVALUATION REPORT FOR W00050-W00053 (1996,2002,2003)

This Evaluation 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.

B. DATA ACQUISITION AND PROCESSING

B.1 EQUIPMENT

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

PYDRO, version 7.3 (R2110)
CARIS HIPS/SIPS version 6.1 SP1 HF 1-8
CARIS BathyDataBASE Manager 2.1 HF 1-3
CARIS HOM ENC Version 3.3 SP3 HF 1-7
dKART INSPECTOR, version 5.0 Build 732

B.2 PROCESSING

H-CELL

H-Cell W00050-53_hcell.des was created in HOM to produce the Base Cell final product W00050-53_CU.000 at 1:80,000 scale as per Chart 13278 and the Base Cell final product W00050-53_SS.000 at 1:20,000 survey Scale.

Office processing entailed the use of CARIS BASE Editor to generate a Bathymetry Associated with Statistical Error (BASE) navigation surface model. The BASE Surface model serves as the bathymetric and feature presentation source for all cartographic components incorporated within the submitted Electronic Navigational Chart Base Cell file.

Finalized BASE surfaces were used as the source data for the nautical chart update products. The field unit submitted surfaces of 2m, 5m, and 10m resolution. During office processing, it was determined to exclude the Thomas Jefferson crossline data due to an undetermined inconsistency between the two data sources. Creed data was selected as the source for BASE surfaces and nautical chart products. New finalized surfaces were generated at 8m and 10m resolution with depth thresholds of 0m-50m and 48m-300m respectively. These surfaces were merged using the BASE editor Combine surfaces tool at a 10m resolution.

BASE Editor processing included the generation of a product surfaces at 30m resolution for creation of a single depth area. Survey scale (1:20,000) soundings were extracted from the 10m resolution Combined Surface.

Chart scale soundings were hand selected from the 1:20,0000 survey scale sounding set which best represents the sounding density shown on chart 13278. Soundings were selected during HOM processing with the CARIS GIS Environmental Variable set to a metric scale (-1,-1,t) in order to accommodate millimeter precision of the sounding value (CARIS default rounding regime with truncation) during H-Cell processing and export of Base Cell file. This environmental variable was reset to NOAA standard values (0,0,N) when converting the metric exchange file to chart depth units after the Base Cell File export.

BASE CELL TESTING

The base cell file W00050-53_CU.000 was examined using dKart Inspector. Warnings received were all inconsequential. The DSPM.HUNI and DSPM.DUNI were reported to have illegal values, but these errors were expected as originating during ENC conversion to NOAA chart values, so they also can be ignored.

CROSS LINES

The cross line analyses conducted at AHB were consistent with the field analysis. W00050, W00051, W00052, and W00053 have been deemed acceptable for charting purposes.

The vertical depth variance at crossline junctions for W00050, W00051,and W00052 were on average 0.3m. The vertical depth variance at crossline junctions for W00053 was on average 0.8m. This discrepancy falls between the IHO Order 1 depth accuracy vertical error budget which ranges between 0.63m to 4.44m for the survey's depth range. This method does not technically meet the conventional standards set forth in the *NOS HHSSD*. However, Hydrographic Surveys Technical Directive 2004-03, dated 01/08/05, has given approval that NOAA field units may vary from the established procedures and documentation with respect to CARIS HIPS BASE Surface processing methods.

JUNCTIONS

Hydrographic surveys W00050, W00051, W00052, and W00053 junction with one another as well as with surveys W00049, W00048 and W00047. All eight surveys are part of project OPR-A397-TJ-03, and are validations of the same outside source data. As such, the data used for the survey overlaps were identical.

C. HORIZONTAL CONTROL

Office ENC processing of this survey required translating the datum to meet S-57 ENC requirements. During CARIS HOM processing the horizontal geodetic datum was translated to Latitude and Longitude (LLDG) World Geodetic System-84 (WGS-84). The S-57 ENC format serves as the exchange file submitted to Marine Chart Division.

D.1 CHART COMPARISON

13278 (26th Edition, June,2005)
Corrected through NM Jun 11/05
Corrected through LNM May 31/05

13260 (40th Edition, May,2007)
Corrected through NM May 26/07
Corrected through LNM May 15/07

13009 (33rd Edition, May,2007)
Corrected through NM May 26/07
Corrected through LNM May 15/07

13006 (34th Edition, May,2007)
Corrected through NM May 26/07
Corrected through LNM May 15/07

13003 (49th Edition, April,2007)
Corrected through NM Apr 7/07
Corrected through LNM Apr 3/07

ENC Comparison **US4MA04M (Edition 9 2007-02-08)**

The charted hydrography originates with prior surveys and requires no further consideration. The hydrographer makes adequate chart comparisons in the Descriptive Report. The MBES data acquired for this survey are adequate to supersede the charted hydrography.

ADDITIONAL RESULTS

General Agreement with Charted soundings

The charted depths are from partial bottom NOS surveys before 1970. The MBES data acquired for this survey are adequate to supercede the charted soundings.

Charted Bottom Characteristics

The field unit did not acquire bottom samples during survey operations. It is therefore recommended to retain the present charted bottom characteristics.

COMPARISON WITH PRIOR SURVEYS

A comparison with prior surveys was not done during office processing in accordance with section 4. of the memorandum titled "Changes to Hydrographic Survey Processing", dated May 24, 1995.

ADEQUACY OF SURVEY

The OSD were acquired prior to the formulation of NOAA standards for MBES coverage. As such, the data do not generally meet the sounding density and coverage requirements. The data are, however, sufficient to supercede the charted hydrography where survey depths are shoaler than charted depths. Full seafloor coverage was not achieved and uncharted features hazardous to surface navigation are not expected but may exist.

MISCELLANEOUS

ENC products were created by Atlantic Hydrographic Branch personnel, Norfolk, Virginia, using CARIS HOM v3.3. ENC products and electronic data will be forwarded to Marine Chart Division, Silver Spring, Maryland.

For charted features the field unit used positions sourced from the raster chart. These positions appear in the item investigation forms and vary slightly form the positions of corresponding features in the H-Cell. The positions of the charted features in the H-Cell are from the last version of the ENC at the time of processing.

AHB PRE-COMPILATION PROCESS

REGISTRY No. W00050, W00051, W00052, W00053
PROJECT No. OPR-A397-TJ-03
FIELD UNIT TJ
PRE-COMPILER Bridget Williams

Milestones	File Name
Product Surface Creation	PS_Jeffrey_Ledge_Combined_20k_200mrad_30mres
	PS_Jeffrey_Ledge_Combined_20k_200mrad_30mres_Interp
Shifted Surface	Shifted_PS_Jeffrey_Ledge_Combined_20k_200mrad_30mres_Interp
Contour Layer	PS_Jeffrey_Ledge_Combined_20k_200mrad_30mres_Interp_Contours.hob
Survey Scale Soundings	PS_Jeffrey_Ledge_Combined_20k_200mrad_30mres_SS_Soundings
Chart Scale Soundings	PS_Jeffrey_Ledge_Combined_20k_200mrad_30mres_CU_Soundings
Feature Layer	Jeffrey_Ledge_Combined_Features
Meta-objects Layer	Jeffrey_Ledge_Combined_Metaobjects
Blue notes	Jeffrey_Ledge_Combined_Blue_notes
Content Review	**01/14/08 14.00-15.30**

Folder: OPR_A397_TJ-03\Jeffrey_Ledge_Combined\AHB_Jeffrey_Ledge_Combined
LARGEST SCALE CHART: 13278, edition 26, 20050601
CHART SCALE: 1:80000
SURVEY SCALE: 1: 20000
SPECIFICATIONS:

I. COMBINED SURFACE:

- Problem- combining at 10m resolution the entire survey was not combined. The Output indicated start and ending times and the Sources Output included all the surface names. Also tried it at a 5m resolution

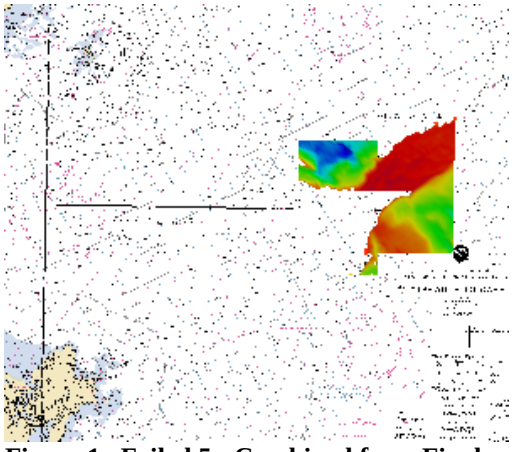


Figure 1. Failed 5mCombined from Finals

- Solution- Bring back into HIPS & SIPS to recreate new fieldsheets after which bring them back into BASE Manager to recombine and continue with the pre-compilation process

A. HIPS & SIPS

Directory Information:

Projects: OPR-A397-TJ_03

Fieldsheets: OPR-A397_TJ_03\Jeffrey_Ledge_Combined\ AHB_Jeffrey_Ledge_Combined\Fieldsheets

a. Jeffrey_Ledge
    i. Ocean Explorer
        1. All of them

b. A397_03_STUVW
    i. S222_MB
        1. 2003-274
        2. 2003-275

PLAN:

- Produced a new fieldsheet: Jeffrey_Ledge_Combined
  this encompassed all W00050-W00053 survey data and chopped off the bottom where it was only Creed data. Scale 1:40,000
- Opened W00047 and W00048 as they are junction pieces
- Created 4 grids using outlines of the fieldsheets:
- Make 2m and 4m for each PLAN: cookie cutter together into 1 H-cell (used 2m and 4m because the data at depth is not dense enough to support 2m resolution)
- Will do a separate gird for the junction "strip" refer the source to look at W00048; even though the M-COVR of my H-cell would include it and also make another on the side of W00050.
- Use only CREED Data → super strip with Stellwagen at 5m and 10m resolution
- TOTAL: 10 grids to BW then combine at 40m or 20m
- *In evaluation report will have to reference the Junction piece, suggested to add it to W00050.
- Fieldsheets saved to Fieldsheets folder of AHB_Jeffrey_Ledge_Combind
    a. W00050, W00051, W00052, and W00053 in: Jeffrey_Ledge_Combined_AHB
    b. Junction in : Jeffrey_Ledge_Combined_AHB_Junction

    c. Create 2m and 4m for all 4 surveys
       (only used the data from the Ocean Explorer)
        i. W00050_2m_AHB
            1. Single at 2.000m resolution, Swath angle
            2. 9x9, all selected except Deep
        ii. W00050_4m_AHB
            1. Single at 4.000m resolution, Swath angle
            2. 9x9, all selected except Deep
        iii. Repeated for: W00051_2m_AHB, W00051_4m_AHB; W00052_OE_2m_AHB, W00052_OE_4m_AHB; W00053_2m_AHB, W00053_4m_AHB
    d. Create Junction fieldsheet
        i. At 5m and 10m resolution
    e. Problem – the ship's 2m Final matches the 4m Final produced by AHB
        i. Looked at each XML final and both had the appropriate resolution, the difference comes from the ship having used an older software package that essentially interpolated the data

CHANGE IN PLANS:

a. Make new fieldsheet that encompasses all four surveys at 2m and 4m, the Junction at 5m and 10m
    i. NAME: Jeffrey_Ledge_Combined_AHB
        1. Create with resolution of 2m
            a. NAME: Jeffrey_Ledge_Combined_2m_AHB
            b. SPECIFICATIONS
                i. Single at 2.000m resolution, Swath angle
                ii. 9x9, all selected except Deep
        2. Create with resolution of 4m
            a. NAME: Jeffrey_Ledge_Combined_4m_AHB
            b. SPECIFICATIONS
                i. Single at 4.000m resolution, Swath angle
                ii. 9x9, all selected except Deep
    ii. Create Junction fieldsheet
        1. NAME: Jeffrey_Ledge_Combined_Junction_AHB
        2. Create BASE surface at 5m and 10m
            a. NAME: Jeffrey_Ledge_Combined_Junction_5m_AHB
            b. SPECIFICATIONS
                i. Single at 5.000m resolution, Swath angle
                ii. 9x9, all selected except Deep
            c. NAME: Jeffrey_Ledge_Combined_Junction_10m_AHB
            d. SPECIFICATIONS
                i. Single at 10.000m resolution, Swath angle
                ii. 9x9, all selected except Deep
b. Finalize each fieldsheet
    iii. Jeffrey_Ledge_Combined_AHB
        1. DEPTH THRESHOLD for 2m: min:0.000m and max: 54.000m
        2. DEPTH THRESHOLD for 4m: min:52.000m and max: 300.000m
    iv. Jeffrey_Ledge_Combined_Junction_AHB
        1. DEPTH THRESHOLD: for 5m: min 0.000m and max 30.000m
        2. DEPTH THRESHOLD: for 10m: min 28.000m and max 400.000m

The Combined Final still had such gaps and speckles that it is not worthwhile to use the 2m, the fieldsheet was recreated at 8m instead.

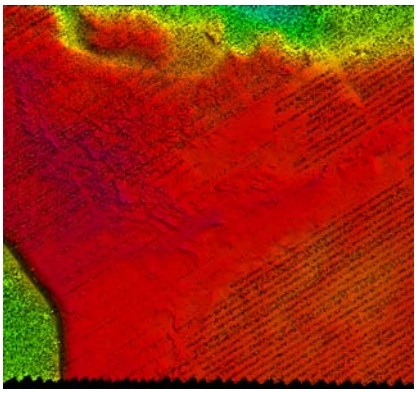


Figure 2. Jeffrey_Ledge_Combined_2m_AHB grid.

c. New grid created at 8m for Jeffrey_Ledge_Combined
    a. NAME: Jeffrey_Ledge_Combined_8m_AHB
    b. SPECIFICATIONS
        1. Single at 8.000m resolution, Swath angle
        2. 9x9, all selected except Deep

d. New grid created at 8m for Jeffrey_Ledge_Combined_Junction
    a. NAME: Jeffrey_Ledge_Combined_AHB_Junction_8m
    b. SPECIFICATIONS
        1. Single at 8.000m resolution, Swath angle
        2. 9x9, all selected except Deep

e. Finalize each fieldsheet
    v. Jeffrey_Ledge_Combined_AHB
        1. DEPTH THRESHOLD for 4m: min:0.000m and max: 56.000m
        2. DEPTH THRESHOLD for 8m: min:54.000m and max: 300.000m
    vi. Jeffrey_Ledge_Combined_Junction_AHB
        1. DEPTH THRESHOLD for 8m: min 0.000m and max 50.000m
        2. DEPTH THRESHOLD for 10m min 48.000m and max 300.000m

f. HIPS&SIPS session saved in Session folder: HIPS_SIPS_Jeffrey_Ledge_Combined_Session

II. COMBINED SURFACE:
a. Jeffrey_Ledge_Combined_10m_Combined
b. Resolution: 10m

III. PRODUCT SURFACE:
a. Scale: 1:20000
b. Radius: 200m
c. Resolution: 30m

d. Depth
    i. Minimum: 28.712 m
    ii. Maximum: 184.147 m

e. Interpolated
    i. 5x5 Neighbors:10

ii. PS_Jeffrey_Ledge_Combined_20k_200mrad_30mres_Interp

IV. SHIFTED SURFACE:
   a. Single Shift Value: -.229

V. CONTOUR LAYER:
   a. Use a Depth List: NOAA_depth_curves_list, in feet
   b. Output Options:
      i. Create contour lines:
         1. Line Object: DEPCNT
         2. Value Attribute: VALDCO

VI. SOUNDING SELECTION:
*Sounding selection was not based from the Interpolated Product Surface
   a. Selection Criteria:
      i. Radius
      ii. Shoal biased
      iii. Use Single-Defined Radius: 180 distance on ground (m)
      iv. Filter: Generalized !=1
      v. Sounding Rounding Rule: NOAA Feet
   b. Generalized Contour layers created to be a guide for the Chart Unit Soundings Selection
      i. PS_Jeffrey_Ledge_Combined_80k_2000mrad_90mres_5def
         1. Scale: 1: 80000
         2. Radius: 2000m
         3. Resolution: 90m
         4. Surface Defocusing: horizontal error: 5m
         5. PS_Jeffrey_ledge_Combined_80k_2000mrad_90mres_5def_Contours
      ii. PS_Jeffrey_Ledge_Combined_80k_3000mrad_200mres_10def
         1. Scale: 1: 80000
         2. Radius: 3000m
         3. Resolution: 200m
         4. Surface Defocusing: horizontal error: 10m
         5. PS_Jeffrey_Ledge_Combined_80k_3000mrad_200mres_10def_Contours
   c. Chart Unit Soundings- area of problem in the lower right hand corner where the NOAA and chart information is placed, and the next largest scale chart, 13260 40th edition, is in fathoms. The soundings were chosen based on spacing and spacing comparison to chart 13260.

VII. FEATURES:
   a. From Pydro
      i. Wreck (located in file W00050.pss)
      ii. File: (located under Compile\HOM) Jeffrey_Ledge_Combined_SA

Survey Position	Latitude 42°51'25.519"N Longitude 070°23'44.098"W
Profile/Beam	4075/49
Least Depth	72.67m
Remarks from DR	Man-made looking object, approx. 230m from charted position of wreck Not in AWOIS database
Recommendations from DR	Delete PA Add non-dangerous wreck in given position
S-57	Wreck

	CATWRK:1- non-dangerous wreck TECSOU:3- found by multibeam VALSOU:72.666m WATLEV:3- always underwater/submerged SORDAT: 20031002 INFORM: W00050 non-dangerous wreck SORIND: US,US,nsurf,W00050 Vertical Datum: 12 MLLW Recording Date: 20080107
Office Notes	Concur. Delete charted non-dangerous wreck, least depth unknown and text "PA" at latitude 42°51'29.38"N, longitude 070°23'36.17"W. Chart non-dangerous wreck, least depth 236 ft in latitude 42°51'25.579"N, longitude 070°23'44.163"W.

iii. Rejected the three soundings in W00053
iv. No features in the files for W00051 and W00052
1. DR of W00052 references a 171 near charted 241 and recommended "chart per digital data submitted with W00048." Dan conferred in H-cell W00048.

b. From ENC: US3EC10M
i. DMGRD: Dumping ground 42°47'06.41"N, 070°31'00.96"W
ii. SBDARE: Seabed area 42°49'05.22"N, 070°18'34.95"W
iii. SBDARE: Seabed area 42°49'04.43"N, 070°10'38.14"W
iv. WRECKS: Wreck 42°55'44.20"N, 070°10'33.06"W

- W00050-53
  - Wreck PA
    - Survey Position: Latitude 42°55'44.20"N
      Longitude 070°10'33.06"W
    - Item not addressed in the DR, Retain as charted
  - Obstruction PA
    - Survey Position: Latitude 42°54'15.72"N
      Longitude 070°16'39.11"W
    - Item not addressed in the DR, Retain as charted
  - Seabed Areas
    - 2 areas brought in from the ENC
- Junction:
  - Dumping ground: Unexploded Mine
    - Survey Position: Latitude 42°54'15.72"N
      Longitude 070°16'39.11"W
    - Item not addressed in the DR, Retain as charted
    - INFORM of Blue note corresponding to this feature: Retain as charted. Exists on ENC US3EC10M as a CATDPG explosives dumping ground.
    - See below in the Evaluation Report Notes

VIII. META-OBJECTS:

a. M_COVR attributes:

Acronym	Value
INFORM	Jeffrey_Ledge_Combined, OPR_A397_TJ-03, NOAA S/V Thomas Jefferson
CATCOV	1
SORDAT	20031002
SORIND	US,US,surve,Jeffrey_Ledge_Combined

b. M_NSYS attributes:

Acronym	Value
INFORM	Jeffrey_Ledge_Combined, OPR_A397_TJ-03, NOAA S/V Thomas Jefferson
MARSYS	IALA B
SORDAT	20031002
SORIND	US,US,surve,Jeffrey_Ledge_Combined

c. M_QUAL attributes:

Acronym	Value
CATZOC	A2
INFORM	Jeffrey_Ledge_Combined, OPR_A397_TJ-03, NOAA S/V Thomas Jefferson
POSACC	10
SORIND	US,US,surve,Jeffrey_Ledge_Combined
SORDAT	20031002
SUREND	20031002
SURSTA	19960412

Evaluation Report Notes

Regarding the Unexploded Mine:

Dangers-obstructions: unexploded mine reported 1981 at latitude 42°51'31.03"N, longitude 070°30'58.84"W. It is recommended that the charted unexploded mine be retained as charted unless proven otherwise. Defer final charting disposition to the Marine Chart Division (MCD) Source Data Branch.

INFORM Field for the Blue note: Retain as charted. Exists on ENC US3EC10M as a CATDPG explosives dumping ground.

Regarding the "Spruce Strip" Junction:

It has to be referenced to one of the W00050-W00053 surveys as it does not have its own DR; use W00048. Surface name: Jeffrey_Ledge_Combined_AHB_Junction

DR Edit Notes "Red notes"

W00050:

- General locality: ~~Approaches to Boston~~ Massachusetts Bay
  - Appears on the cover page and Hydrographic Title Sheet

W00051:

- General locality: ~~Approaches to Boston~~ Massachusetts Bay
  - Appears on the cover page, Hydrographic Title Sheet, and Page 1

W00052:

- General locality: ~~Approaches to Boston~~ Massachusetts Bay
  - Appears on the cover page, Hydrographic Title Sheet, and Page 1

W00053:

- General locality: ~~Approaches to Boston~~ Massachusetts Bay
  - Appears on cover page, Hydrographic Title Sheet, and Page 1
- Inconsistency between reports:
  - Page 7 of the DR reports under Charted Features, "The item investigation reports describing three charted features are contained in Appendix I."
- Appendix I:

- Registry number, Locality, Sub-locality, Survey Dates, and Charts Affected are not consistent with the DR
  - Registry number: ~~W00047~~ W00053
  - Locality: ~~Approaches to Boston~~ Massachusetts Bay
  - Sub-locality: ~~8NM NE of Rockport Harbor~~ 24 NM NE of Halibut Point
  - Survey Dates: ~~04/15/96-12/10/1996~~ 12/19/02-01/31/03; 10/01/03-10/02/03
  - Charts Affected:

Number	Version	Date	Scale
13279	30th Ed.	03/01/2003	1:20000
13274	25th Ed.	09/01/2003	1:40000
13278	25th Ed.	12/09/2000	1:80000
13260	39th Ed.	06/01/2003	1:378838
13200	33rd Ed.	01/19/2002	1:400000
13009	30th Ed.	08/01/2002	1:500000
13006	31st Ed.	06/01/2003	1:675000
13003	47th Ed.	06/01/2003	1:1200000

Number	Version	Date	Scale
13278	26th Ed.	06/01/05	1:80,000
13260	40th Ed.	05/01/07	1:378,838
13009	33rd Ed.	05/01/07	1:500,000
13006	34th Ed.	05/01/07	1:675,000
13003	49th Ed	04/01/07	1:1,200,000

- Features described are not consistent with the survey area and do not match the Charted Features section of the DR

APPROVAL SHEET
W00050-W00053

The completed surveys have been inspected with regard to survey coverage, delineation of depth curves, development 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 these surveys. The survey records and digital data comply with NOS requirements except where noted in the Evaluation Report.

Bridget E. Williams
2008.01.24 14:03:32
-05'00'

Date: _____

Bridget Williams
Hydrographic Intern,
Atlantic Hydrographic Branch

Sarah M Eggleston
2008.01.24 14:02:02
-05'00'

Date: _____

Sarah M. Eggleston
Physical Scientist,
Atlantic Hydrographic Branch

I have reviewed the Base Cell files, accompanying data, and reports. This survey and accompanying Marine Chart Division deliverables meet or exceed NOS requirements and standards for products in support of nautical charting except where noted in the Evaluation Report.

Approved: Shepard Smith
I am approving this document
2008.01.24 14:15:12 -05'00' Date: _____

Commander Shepard M. Smith, NOAA
Chief, Atlantic Hydrographic Branch

Jeremy McHugh
Digitally signed by Jeremy McHugh
DN: cn=Jeremy McHugh, c=US
Reason: I am approving this document
Date: 2008.02.06 17:26:16 -05'00'