NOAA FORM 76-35A

U.S. DEPARTMENT of COMMERCE
NATIONAL OCEANIC and ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE

Horizontal and Vertical Control Report

Type of Survey: *Multibeam and Sidescan Sonar*

Project No. *OPR-D302-SA-09*

Time Frame: *12 July 2009 – 18 April 2010*

LOCALITY

State: *Maryland/Virginia*

General Locality: *Atlantic Ocean*

2009 - 2010

CHIEF of PARTY

Paul L. Donaldson

Science Applications International Corporation

LIBRARY & ARCHIVES

DATE:

NOAA FORM 77-28 (11-72)	U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	REGISTRY NO.
	HYDROGRAPHIC TITLE SHEET	**H12001 H12002 H12003**
INSTRUCTIONS - The Hydrographic Sheet should be accompanied by this form, filled in as completely as possible, when the sheet is forwarded to the Office.		FIELD NO. **L, M, N**

State: Maryland

General Locality: Atlantic Ocean

Locality: *16 NM east of Assateague Island (H12001); 13 NM East of Assateague Island (H12002); 5 NM East of Assateague Island (H12003)*

Scale: 1:20,000 Date of Survey: *12 July 2009 - 18 April 2010*

Instructions Dated: 01 December 2008 Project No. OPR-D302- SA-09

Vessel: *M/V Atlantic Surveyor*, D582365

Chief of Party: Evan J. Robertson, Gary R. Davis, & Paul L. Donaldson,

Surveyed by: *Dan Baker, Alex Bernier, Jediah Bishop, Dan Burgo, Gary Davis, Paul Donaldson, Chuck Holloway, Jason Infantino, Colette LeBeau, Rick Nadeau, Katie Offerman, Gary Paquette, Gary Parker, Evan Robertson, Eva Rosendale, Jeremy Shambaugh, Deb Smith, Jennifer Stone, Bridget Williams*

Soundings taken by (**echosounder**), hand lead, pole: MULTIBEAM RESON SEABAT 7125

Graphic record scaled by:

Graphic record checked by:

Protracted by: Automated plot by:

Verification by:

Soundings in fathoms, feet, (**meters**) at MLW, (**MLLW**)

REMARKS: **Contract:** DG133C-08-CQ-0003
Contractor: Science Applications International Corp., 221 Third Street; Newport, RI 02840 USA
Subcontractors: Rotator Staffing Services, PO Box 366, 557 Cranbury Rd, E. Brunswick NJ 08816
Times: All times are recorded in UTC
UTM Zone: Zone 18
Purpose: To provide NOAA with modern, accurate hydrographic survey data for the purpose of updating relevant nautical charts of the assigned areas: Sheet L (H12001), Sheet M (H12002), and Sheet N (H12003) in Mid-Atlantic Corridor, Coast of Maryland and Virginia.

NOAA FORM 77-28 SUPERSEDES FORM C&GS-537. ☆ U.S. GOVERNMENT PRINTING OFFICE: 1976—665-661/1222 REGION NO. 6

Science Applications International Corporation (SAIC) warrants only that the survey data acquired by SAIC and delivered to NOAA under Contract DG133C-08-CQ-0003 reflects the state of the sea floor in existence on the day and at the time the survey was conducted.

Table of Contents

List of Tables

List of Figures

A. VERTICAL CONTROL

For H12001, H12002, and H12003, the NOAA tide station 8651370 Duck, NC was the source of final verified water level heights for the Mid-Atlantic Corridor, Coast of Maryland surveys. All preliminary and verified tides obtained for the 2009 and 2010 survey seasons were downloaded from the National Oceanic and Atmospheric Administration (NOAA) Tides and Currents website. All water level data were annotated with Coordinated Universal Time (UTC).

Final water level files for each tide zone were created from downloaded verified tide data using the **SABER Create Water Level Files** tool. Water level files contained water level heights that were algebraically subtracted from depths to correct the sounding for tides and water levels. These water level files were applied to the multibeam data using the **SABER Apply Tides** program.

When it was necessary to apply updated tide correctors such as verified water levels to the GSF files, the program removed the previous tide corrector and applied the new corrector. Each time a processing routine was run on the GSF multibeam data file, a history record was appended to the end of the GSF file. For quality assurance, the **Check Tides** program was run on all GSF files to confirm that the appropriate water level corrector had been applied to the GSF file.

After confirmation that verified water levels were applied to all multibeam data, grids were created and analyzed using various color change intervals. The color intervals provided a means to check for significant, unnatural changes in depth across zone boundaries due to water level correction errors, unusual currents, storm surges, etc.

In addition, cross line analysis using the **SABER Analyze Crossings** software was used to identify possible depth discrepancies resulting from the applied water level corrector. Discrepancies were further analyzed to determine if they were the result of incorrect zoning parameters or weather (wind) conditions between the tide station and the survey area. The NOAA provided preliminary zone boundaries and zoning parameters are presented in Table A-1.

Table A-1. Preliminary Tide Zone Parameters

Zone	Time Corrector (minutes)	Range Ratio	Reference Station
SA45	0.00	1.05	8651370
SA46A	0.00	1.08	8651370

A.1 FINAL TIDE NOTE

H12001, H12002, and H12003 surveys were entirely within preliminary water level zones SA45 and SA46A for Duck, NC 8651370. Analysis of the multibeam data from all three surveys in **MVE** and in depth grids revealed minimal depth jumps across the junction of the

zones. A spreadsheet analysis of the correctors for each zone (summarized in Table A-2) also confirmed the adequacy of zoning correctors based on Duck, NC (8651370). For this analysis, observed verified water levels from 12 July 2009 through 18 April 2010, were entered into the spreadsheet. Correctors were computed at 6 minute intervals for each zone. Differences were computed zone-to-zone. As a result, the NOAA preliminary zone boundaries and zoning parameters for Duck, NC (8651370) were accepted as final and applied to all multibeam data for H12001, H12002, and H12003.

Table A-2. Comparison of Water Level Correctors with Zoning Parameters for Station 8651370

Zone Boundary	SA46A – SA45
Minimum Difference	-0.007
Maximum Difference	0.054
Average Difference	0.021
Standard Deviation	0.012

Analysis of the PFM gridded multibeam data in **MVE** and in depth grids revealed vertical offsets of 20 to 25 centimeters between some overlapping lines of survey data within a single tide zone. These offsets are attributed to different environmental conditions between the survey area and tide gauge location at Duck, NC.

B. HORIZONTAL CONTROL

The survey data for sheets H12001, H12002, and H12003 were collected in horizontal datum NAD-83, using geodetic coordinates, while data display and products used the UTM Zone 18 projection. The following equipment was used for positioning on the *M/V Atlantic Surveyor*:

- Applanix POS/MV, Model 320 Version 4, Serial Number 2575 with a Trimble Probeacon Differential Receiver (primary sensor)
- Trimble 7400 Rsi GPS Receiver, Serial Number 3815A22469 with a Trimble Probeacon Differential Receiver (secondary sensor)
- Trimble 4000 DS GPS Receiver, Serial Number 3504A09516 with a Trimble Probeacon Differential Receiver (secondary sensor)

All antenna and transducer offsets were measured relative to the Position Orientation System/Marine Vessel (POS/MV) Inertial Measurement Unit (IMU). Offsets from the RESON 7125 transducer were then computed from these measurements. The POS/MV offsets Reference to Vessel are the same as the Reference to RESON 7125 transducer so that the vessel positions in the GSF multibeam files are the position of the transducer. Therefore, vessel offsets to the Trimble GPS antenna and to the A-Frame Tow Block are entered in the ISS-2000 as offsets from the RESON 7125 transducer. Tow Block Z is entered as height above the water for use in computing the tow fish layback. The RESON 7125 transducer offsets from the IMU were surveyed in June 2009, while the *M/V Atlantic Surveyor* was in dry dock. The POS/MV and Trimble GPS antenna positions were resurveyed during the 2009 SAT and offsets from the IMU were calculated and entered into the ISS-2000 system

parameters, vessel file and POS/MV. Offset measurements were confirmed in 2010, when the vessel was in dry dock and during the 2010 Sea Acceptance Test (SAT). For the 2010 survey season, a modification was made to the tow block height above water value from the value reported in the Data Acquisition and Processing Report for OPR-D302-SA-09; the value was originally reported as 4.87 meters and is now 4.67 meters. The results are depicted in Table B-1 and Figure B-1.

Table B-1. *M/V Atlantic Surveyor* Antenna and Transducer Offsets (measurements in meters with 68% CI measurement uncertainties)

Sensor	Offset in ISS-2000		Offset in POS/MV	
Multibeam RESON 7125 Transducer Hull Mount			X	-0.34 ±0.005
			Y	-0.29 ±0.011
			Z	+1.71 ±0.013
Reference to Heave			X	0.00
			Y	0.00
			Z	0.00
Reference to Vessel			X	-0.34 ±0.005
			Y	-0.29 ±0.011
			Z	+1.71 ±0.013
POS/MV GPS Master Antenna			X	4.26 ±0.012
			Y	-0.66 ±0.005
			Z	-6.38 ±0.015
Trimble GPS Antenna From Transducer	X	+4.60 ±0.013		
	Y	+0.63±0.012		
	Z	-8.06 ±0.020		
A-Frame Tow Block (X and Y from RESON 7125 Transducer. Z is height above water.	X	-19.56 ±0.150		
	Y	+0.69 ±0.150		
	Z	-4.67 ±0.150		

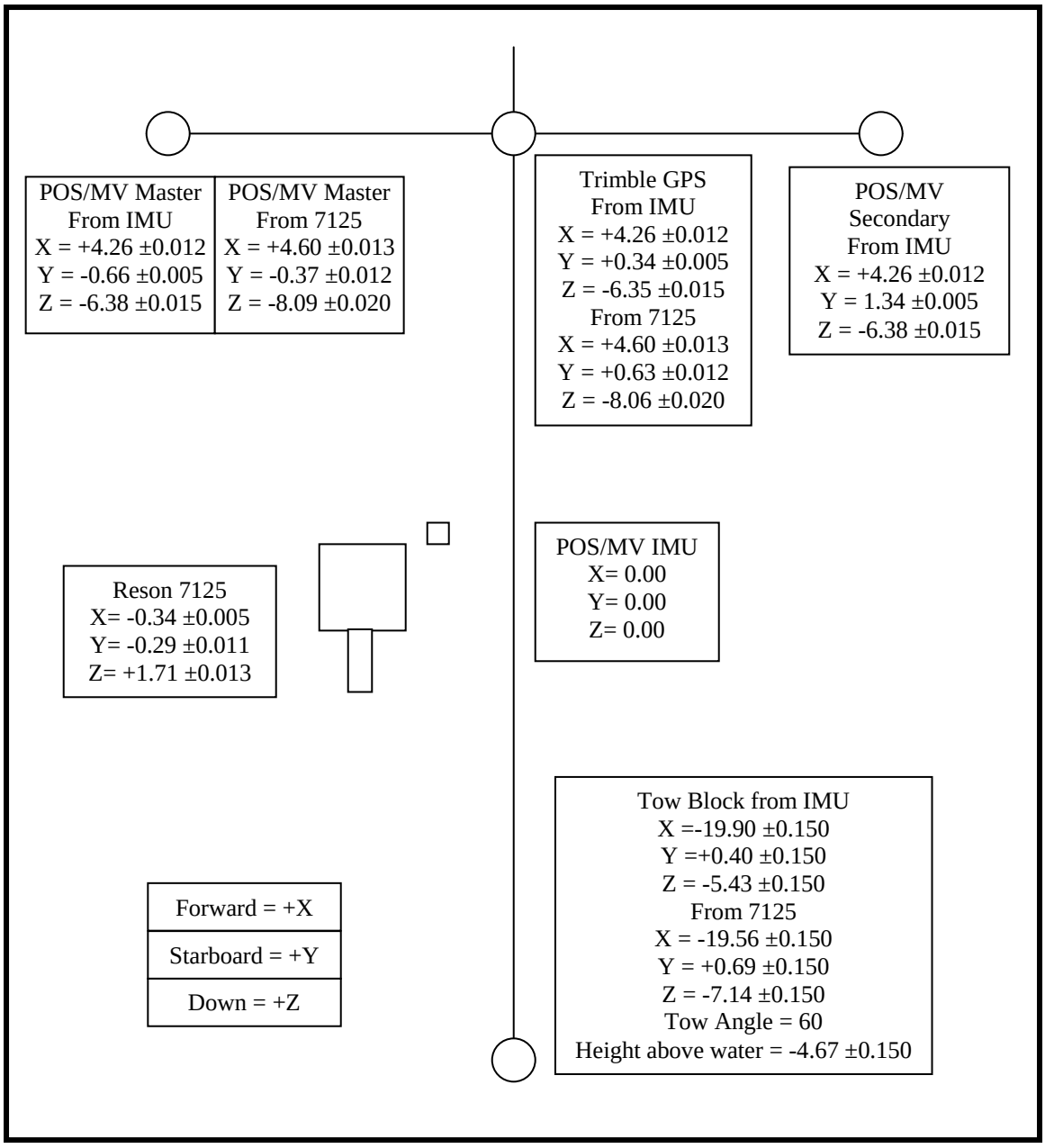

Figure B-1. Configuration and Offsets of *M/V Atlantic Surveyor* Sensors (measurements in meters with 68% CI measurement errors)

Daily position confidence checks were conducted using an independent Trimble DGPS system. A real-time **ISS-2000** survey monitor also raised an alarm to alert the survey watch stander if the position differences exceeded the maximum allowable distance. All positioning confidence checks, as shown in Table B-2, were within the 10 meter limit specified in section 5.1.4.2 of the April 2009 "*NOS Hydrographic Surveys Specifications and Deliverables*".

Table B-2. Positional Difference between Vessel Positions Determined by the POS/MV and the Trimble 4000 on the *M/V Atlantic Surveyor*

Year	Julian Day	Sheet ID	Time of Day (UTC)	Positional Difference (m)
2009	193	L	1734	0.54
2009	194	L	0330	1.06
2009	195	L	2001	2.07
2009	196	L, M	0155	0.59
2009	198	M	0435	2.12
2009	199	M	0003	2.15
2009	200	L	1829	2.13
2009	201	L, M	1300	2.49
2009	202	M	1649	2.43
2009	203	M	2008	2.35
2009	204	M	2320	2.89
2009	205	M	0015	2.55
2009	206	M	0250	2.27
2009	207	M	0700	2.79
2009	209	L	0848	1.57
2009	210	L	1421	1.50
2009	213	M	2255	2.47
2009	214	M	1228	3.40
2009	215	M	0808	1.61
2009	216	M	1732	1.88
2009	217	M	0100	2.01
2009	218	M	1004	2.36
2009	219	M	1857	2.01
2009	220	L, M	2115	1.64
2009	221	L	0700	1.27
2009	222	L, M, N	0322	1.76
2009	223	N	0208	2.67
2009	224	N	1855	2.68
2009	225	N	1135	1.87
2009	226	N	1447	3.24
2009	227	N	1700	2.20
2009	228	N	2008	3.38
2009	229	N	0041	2.11
2009	230	N	0241	2.00
2009	231	N	0630	1.93
2009	232	N	0056	3.67
2009	236	N	1850	3.00
2009	237	N	0350	2.99
2009	238	N	0525	2.88
2009	239	N	0749	2.90
2009	240	N	1052	1.80
2009	242	N	2136	2.97
2009	243	N	0430	2.23
2009	244	N	0752	3.00
2009	248	N	1336	2.92
2009	249	N	1756	2.62
2009	250	N	0009	2.73
2009	255	N	2000	2.33
2009	256	N	0403	2.48
2009	257	N	0958	2.55
2009	258	M, N	1035	1.68
2009	259	L, M	0123	2.32
2009	261	L	1405	1.80
2009	281	L	2306	0.92
2009	282	L, M	0336	1.24
2009	284	M	2308	1.47
2009	285	M	0100	2.23
2010	101	M	2220	0.62
2010	102	M, N	0023	0.76
2010	103	N	0017	0.65
2010	104	N	0814	0.68
2010	105	M, N, O	2255	0.67
2010	108	N	2120	0.93

The Trimble Pro Beacon Differential Receivers were set to only receive corrector data from the U.S. Coast Guard Stations at Driver, VA; Reedy Pont, DE; and Annapolis, MD during online data collection for H12001, H12002, and H12003.

C. APPROVAL SHEET

14 July 2010

LETTER OF APPROVAL

REGISTRY NUMBERS: H12001, H12002, and H12003

This Horizontal and Vertical Control Report for project OPR-D302-SA-09, Coast of Maryland and Virginia Project is respectfully submitted.

Field operations and data processing contributing to the accomplishment of this survey, H12001, H12002, and H12003 were conducted under my supervision and that of other SAIC lead hydrographers with frequent personal checks of progress and adequacy. This report has been closely reviewed and is considered complete and adequate as per the Statement of Work.

Reports previously submitted to NOAA for this project include:

Report	Submission Date
Descriptive Report H12001, SAIC Doc 10-TR-001	26 March 2010
Data Acquisition and Processing Report, SAIC Doc 10-TR-007	26 March 2010
Descriptive Report H12002, SAIC Doc 10-TR-002	02 July 2010

Reports concurrently submitted to NOAA for this project include:

Report	Submission Date
Descriptive Report H12003, SAIC Doc 10-TR-003	14 July 2010

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

Paul L. Donaldson

Digitally signed by Paul L. Donaldson
DN: cn=Paul L. Donaldson, o=MSTD, ou=SAIC, email=paul.l.donaldson@saic.com, c=US
Date: 2010.07.08 12:17:29 -04'00'

Paul L. Donaldson
Lead Hydrographer
Science Applications International Corporation
14 July 2010