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-08*

Time Frame: *16 July 2008 – 19 December 2008*

LOCALITY

State: *Maryland*

General Locality: *Atlantic Ocean*

2008

CHIEF of PARTY

Deborah M. Smith

Science Applications International Corporation

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DATE:

NOAA FORM 77-28 (11-72)	U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	REGISTRY NO.
	HYDROGRAPHIC TITLE SHEET	**H11872** **H11873** **H11874** **H11992**
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. **G, H, J, K**

State: Maryland

General Locality: Atlantic Ocean

Locality: *Southeast of Ocean City (H11872); 13 NM East Southeast of Ocean City (H11873); East of Assateague Island (H11874); 13 NM East of Assateague Island (H11992)*

Scale: 1:20,000 Dates of Survey: *16 July 2008 - 19 December 2008*

Instructions Dated: 21 March 2008 & 29 July 2008 Project No.: OPR-D302-SA-08

Vessel: *M/V Atlantic Surveyor*, D582365

Chief of Party: Deborah M. Smith

Surveyed by: *Alex Bernier, Brian Biggert, Dan Burgo, Jeff Burns, Gary Davis, Paul Donaldson, Chuck Holloway, Jason Infantino, Colette Lebeau, Rick Nadeau, Gary Parker, Chris Pinero, Evan Robertson, Jeremy Shambaugh, Deb Smith, Jenn Stone, and Tom Waddington.*

Soundings taken by (echosounder,) hand lead, pole: MULTIBEAM RESON SEABAT 8101

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:** DG-133C-05-CQ-1088
Contractor: Science Applications International Corp., 221 Third Street; Newport, RI 02840 USA
Subcontractors: Williamson & Associates, 1124 NW 53rd Street, Seattle WA 98107; 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 with which to update the nautical charts of the assigned areas: Sheet G (H11872), Sheet H (H11873), Sheet J (H11874), and Sheet K (H11992) in the Mid-Atlantic Corridor, Coast of Maryland.

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Science Applications International Corporation (SAIC) warrants only that the survey data acquired by SAIC and delivered to NOAA under Contract DG-133C-05-CQ-1088 reflects the state of the sea floor in existence on the day and at the time the survey was conducted.

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A. VERTICAL CONTROL

For H11872, H11873, H11874, and H11992, the NOAA tide station 8651370 in 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 2008 survey season were downloaded from the National Oceanic and Atmospheric Administration (NOAA) Tides and Currents website. All tide data are 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 then 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 files, a history record detailing the routine was appended to the end of the GSF file in order to track all processes performed on the files. For quality assurance, the **SABER Check Tides** program was run on all GSF files to confirm that the appropriate water level correctors 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 correctors. 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
SA24	-6	1.08	8651370
SA26A	0	1.08	8651370
SA45	0	1.05	8651370
SA45A	+6	1.02	8651370
SA47	-6	1.02	8651370
SA45B	+6	0.96	8651370
SA46A	0	1.08	8651370

A.1. FINAL TIDE NOTE

The surveys for H11872, H11873, H11874, and H11992 were contained entirely within the preliminary water level zones (SA24, SA26A, SA45, SA45A, SA45B, SA46A and SA47) for the Duck, NC tide station, 8651370. Analysis of the multibeam data from all four surveys in **MVE** and in depth grids revealed minimal depth jumps across the junction of the zones. A spreadsheet analysis of the correctors at the boundary between adjacent zones (summarized in Table A-2) also confirmed the adequacy of the supplied zoning correctors based on Duck, NC (8651370). For the analysis, observed verified water levels from the dates of survey, 16 July 2008 through 19 December 2008, were entered into the spreadsheet. Correctors were computed at 6-minute intervals for each zone and the 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 used to create the water level files that were applied to all multibeam data for H11872, H11873, H11874, and H11992.

Table A-2. Comparison of the Zone Boundary Differences of the Water Level Correctors Created from Station 8651370 using Preliminary Zoning Parameters

Zone Boundary	SA26A – SA45	SA45 – SA45A	SA45A – SA45B	SA45 – SA46A	SA45 – SA47
Minimum Difference (m)	-0.010	-0.109	-0.020	-0.050	-0.128
Maximum Difference (m)	0.050	0.162	0.100	0.010	0.152
Average Difference (m)	0.018	0.018	0.036	-0.018	0.018
Standard Deviation (m)	0.011	0.026	0.023	0.011	0.026

B. HORIZONTAL CONTROL

The survey data for sheets H11872, H11873, H11874, and H11992 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, Serial Number 2575
- Trimble 4000 DSi GPS Receiver, Serial Number 3504A09516

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 8101 transducer were then computed from these measurements. The POS/MV Reference to Vessel offsets are the same as the Reference to Reson 8101 transducer offsets 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 8101 transducer. Tow Block Z is entered as height above the water for use in computing the tow fish layback. During the remobilization of the *M/V Atlantic Surveyor* in 2008, all antenna and transducer offsets were remeasured. The 2008 results are depicted in Table B-1 and Figure B-1.

Table B-1. 2008 *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 8101 Transducer Hull Mount From IMU (Ref to Sensor 1 lever arm)			X	-0.34 ±0.01
			Y	-0.12 ±0.01
			Z	+1.64 ±0.01
Reference to Heave (Ref to IMU lever arm)			X	0.00
			Y	0.00
			Z	0.00
Reference to Vessel (Ref to vessel lever arm)			X	-0.34 ±0.01
			Y	-0.12 ±0.01
			Z	+1.64 ±0.01
POS/MV GPS Master Antenna From IMU (Ref to primary GPS lever arm)			X	+4.26 ±0.012
			Y	-0.66 ±0.005
			Z	-6.38 ±0.011
Trimble GPS Antenna From Transducer	X	+4.60 ±0.012		
	Y	+0.46 ±0.005		
	Z	-8.00 ±0.011		
A-Frame Tow Block From Transducer (Z = Height above the Water)	X	-19.56 ±0.15		
	Y	+0.52 ±0.15		
	Z	-4.87 ±0.15		

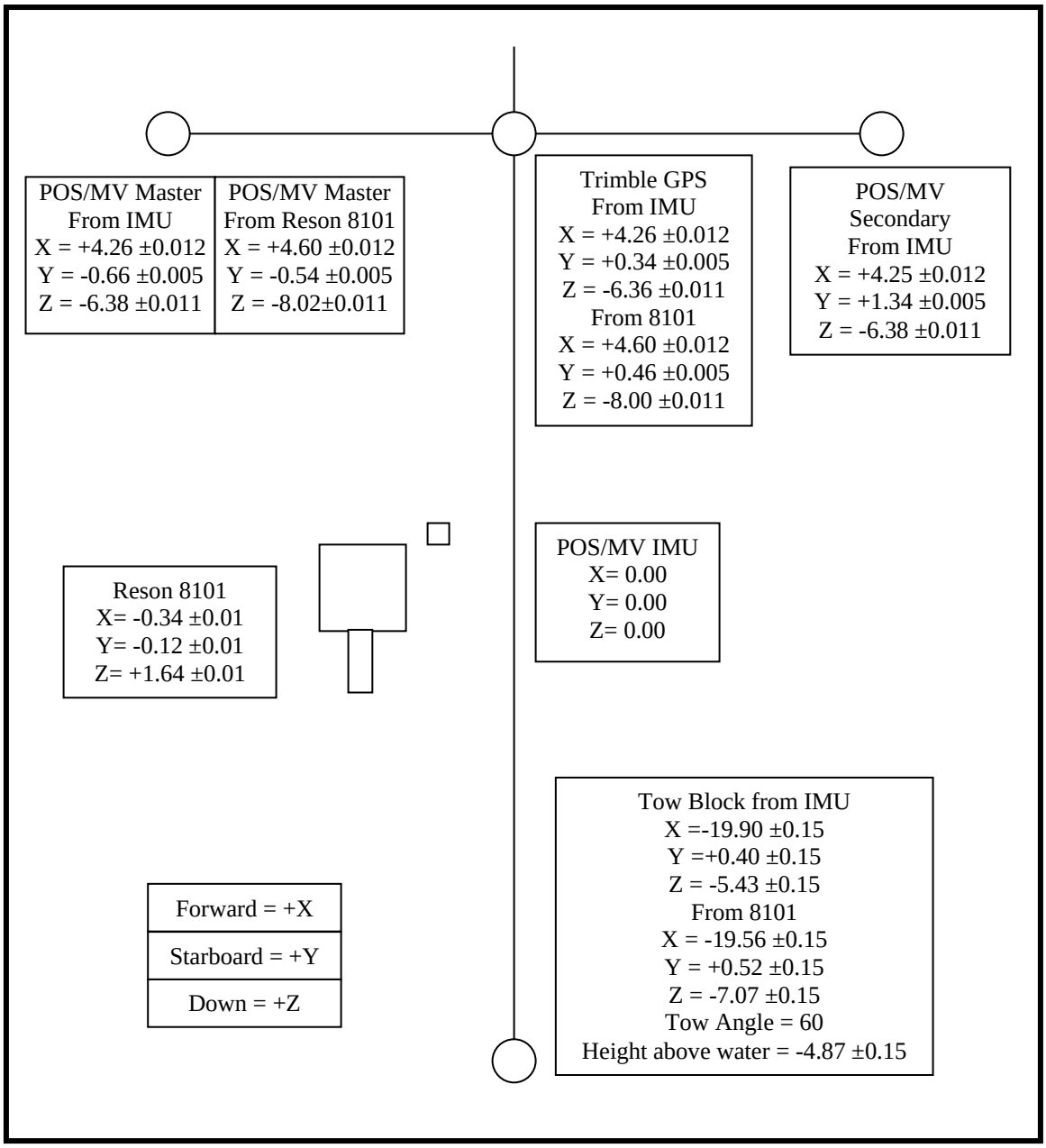

Figure B-1. 2008 Configuration and Offsets of the *M/V Atlantic Surveyor* Sensors (measurements in meters with 68% CI measurement uncertainties)

Daily position confidence checks were made by comparing the DGPS position from the POS/MV to the Trimble DGPS position. A real-time monitor automatically issued an alarm when the two DGPS positions differed by more than 10 meters horizontally. Observed positioning confidence checks were all within an inverse distance of 3.30 meters as shown in Table B-2.

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

Julian Day	Sheet ID	Time of Day (UTC HHMM)	Positional Difference (m)	Julian Day	Sheet ID	Time of Day (UTC HHMM)	Positional Difference (m)
198	G	2214	1.36	261	K	1052	0.13
199	G	0437	0.76	262	K	0005	0.14
200	G	1611	0.34	273	G, J	0027	0.25
201	G	1201	0.38	274	G, J	0441	0.23
202	G	0710	0.52	275	K	2248	0.1
203	G	1425	0.42	276	G, K	1241	0.1
204	G	1058	0.56	277	G, K	1206	0.08
205	G	0429	0.69	278	K	0322	0.07
206	G	2240	0.24	279	K	1515	0.06
207	G	1110	0.36	280	K	0800	0.09
208	G	1036	0.34	283	K	1900	0.35
209	G	1815	0.55	284	K	2245	0.21
210	G	0508	0.42	285	K	0045	0.19
211	G	1109	0.57	286	K	1100	0.22
212	G	1213	0.64	287	H, K	2246	0.12
213	G	1917	0.44	288	H	0814	0.08
214	G	1632	0.48	289	H	0404	0.31
215	G	1828	0.37	290	H	2000	0.14
216	G	1901	0.52	291	H	0001	0.15
217	G	0441	0.52	295	H	1104	0.28
218	G	1554	0.16	298	H	1314	0.21
219	G	1629	0.69	299	H	0815	3.3
220	G	1701	0.49	301	H	1613	0.17
221	G	1324	0.5	304	H	2330	0.17
222	G	1618	0.49	305	H	0613	0.1
223	G, J	1223	0.81	306	H	0944	0.14
224	J	0054	0.64	307	H	1119	0.1
225	J	2255	0.31	308	H	2150	0.72
226	J	1227	0.48	309	H	1704	0.25
227	G, J	1356	0.56	310	H	0049	0.55
228	G, J	0410	0.73	313	H	0528	0.14
229	J	0412	0.34	314	H	1903	0.11
230	J	2309	0.43	315	H	0820	0.29
231	J	1039	0.9	316	H	1606	0.12
232	J	0249	0.71	317	H	2220	0.27
233	J	1925	0.38	318	H	0324	0.18
234	J	0730	0.83	319	H	1128	0.51
235	J	2228	0.29	326	H	0920	0.35
236	J	0400	0.29	327	H	1911	1.09
237	J	1033	0.37	328	H	0600	0.63
238	J	1805	0.18	329	H	0815	0.58
239	J	0630	0.14	330	H	0056	0.68
242	J	2355	0.56	337	H	2313	0.92
243	J	1014	0.79	338	H	1200	0.48
244	J	1850	0.55	339	H	0228	2.63
245	J	0255	0.73	340	H	2041	0.5
246	J	0756	0.87	341	H	1323	0.47

Julian Day	Sheet ID	Time of Day (UTC HHMM)	Positional Difference (m)	Julian Day	Sheet ID	Time of Day (UTC HHMM)	Positional Difference (m)
247	J	1237	0.16	342	H	0016	0.57
251	J	2123	0.22	343	H	1750	0.54
252	J	0104	0.16	344	H	2037	0.36
253	J	0358	0.16	348	H	1615	0.41
255	J	1744	0.56	349	H	0835	0.44
256	J	0806	0.51	350	H	0059	0.46
257	J	1226	0.15	352	H	1942	0.57
258	J	0325	0.18	353	G, H, J, K	1443	0.99
259	J	0719	0.11	354	G, K	0541	0.36
260	J, K	0340	0.08				

Differential correctors used for H11872, H11873, H11874, and H11992 online data were obtained from the U.S. Coast Guard Stations at Reedy Point, DE, Annapolis, MD, and Driver, VA. The differential receiver was set to receive only data from these three corrector stations.

C. APPROVAL SHEET

05 March 2010

LETTER OF APPROVAL

REGISTRY NUMBER: H11872, H11873, H11874, H11992

This Horizontal and Vertical Control Report for project OPR-D302-SA-08, Mid-Atlantic Corridor, Coast of Maryland Project is respectfully submitted.

Field operations and data processing contributing to the accomplishment of these surveys, H11872, H11873, H11874, and H11992, were conducted under supervision of myself and lead hydrographers Paul L. Donaldson, Gary R. Davis, Jason M. Infantino, and Tom Waddington 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
Data Acquisition and Processing Report, SAIC Doc 09-TR-034	30 October 2009
Descriptive Report H11872, SAIC Doc 09-TR-035	30 October 2009
Descriptive Report H11992, SAIC Doc 09-TR-045	22 January 2010
Descriptive Report H11873, SAIC Doc 09-TR-043	12 February 2010

Reports concurrently submitted to NOAA for this project include:

Report	Submission Date
Descriptive Report H11874, SAIC Doc 09-TR-044	05 March 2010

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

Deborah M. Smith

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Deborah M. Smith
Lead Hydrographer
Science Applications International Corporation
05 March 2010