

NOAA FORM 76-35A  <b>U.S. DEPARTMENT of COMMERCE</b> NATIONAL OCEANIC and ATMOSPHERIC ADMINISTRATION NATIONAL OCEAN SERVICE  <b>Vertical and Horizontal Control Report</b>
<i>Type of Survey:</i> <u>Multibeam and Side Scan Sonar</u>  <i>Project No.</i> <u>OPR-C303-KR-05</u>  <i>Time Frame:</i> <u>10 July 2005 – 24 May 2006</u>
<b>LOCALITY</b>  <i>State:</i> <u>New Jersey</u>  <i>General Locality:</i> <u>Atlantic Ocean</u>  <u>2005 - 2006</u>  <b>CHIEF of PARTY</b>  <u>GARY R. DAVIS</u>  <u>Science Applications International Corporation</u>
<b>LIBRARY &amp; ARCHIVES</b>  <b>DATE:</b> _____



*Table of Contents*

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	Page
<b>A. VERTICAL CONTROL .....</b>	<b>1</b>
<b>B. HORIZONTAL CONTROL.....</b>	<b>4</b>
<b>C. APPROVAL SHEET .....</b>	<b>10</b>

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*List of Tables*

---

	Page
TABLE A-1. SUMMARY OF VERIFIED TIDE CORRECTORS AT ZONE BOUNDARIES FOR ATLANTIC CITY (8534720).....	2
TABLE A-2. WATER LEVEL ZONING PARAMETERS APPLIED ON SHEET H11455.....	2
TABLE A-3. PRELIMINARY TIDE ZONE PARAMETERS FROM STATEMENT OF WORK FOR OPR-C303-KR-05 FOR SANDY HOOK (8531680) AND DRAFT STATEMENT OF WORK FOR OPR-C303-KR-06 FOR ATLANTIC CITY (8534720) .....	2
TABLE A-4. COMPARISON OF WATER LEVEL CORRECTORS WITH ZONING PARAMETERS FOR STATIONS 8534720 AND 8531680.....	3
TABLE A-5. WATER LEVEL ZONING PARAMETERS APPLIED ON SHEET H11456.....	3
TABLE A-6. WATER LEVEL ZONING PARAMETERS APPLIED ON SHEET H11495.....	4
TABLE B-1. 2005 <i>M/V ATLANTIC SURVEYOR</i> ANTENNA AND TRANSDUCER LOCATIONS (MEASUREMENTS IN METERS).....	4
TABLE B-2. 2006 <i>M/V ATLANTIC SURVEYOR</i> ANTENNA AND TRANSDUCER OFFSETS RELATIVE TO THE POS/MV IMU VESSEL REFERENCE POINT, MEASUREMENTS IN METERS .....	7
TABLE B-3. POSITIONAL DIFFERENCE BETWEEN THE POS/MV AND TRIMBLE 7400 ON THE <i>M/V ATLANTIC SURVEYOR</i> .....	8

*List of Tables*

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	Page
FIGURE B-1. 2005 CONFIGURATION OF <i>M/V ATLANTIC SURVEYOR</i> DURING SURVEY OPERATIONS(MEASUREMENTS IN METERS).....	5
FIGURE B-2. 2006 CONFIGURATION AND OFFSETS OF <i>R/V ATLANTIC SURVEYOR</i> SENSORS (MEASUREMENTS IN METERS).....	6

## A. VERTICAL CONTROL

For H11455, H11456, and H11495, the NOAA tide station in Atlantic City, NJ (8534720) was the source for verified water level heights for the Mid-Atlantic Corridor, Coast of New Jersey surveys. All preliminary and verified tides obtained for the 2005 survey season were downloaded from the National Oceanic and Atmospheric (NOAA) CO-OPS web site (<http://www.co-ops.nos.noaa.gov/>). All preliminary and verified tides obtained for the 2006 survey season were downloaded from the new CO-OPS Tides and Currents website (<http://tidesandcurrents.noaa.gov/>). All tide data were annotated with Universal Time Coordinated (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 relative to Mean Lower Low Water 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 **Apply Tides** program within the **SABER** software. When this program updated the tide correctors, it removed the previous tide corrector and then applied the new corrector. Each time the program was run on a multibeam GSF data file, a history record was appended to the end of the GSF file specifying that a new water level corrector has been applied and the source of the new corrector. For quality assurance, all multibeam GSF files are run through the **Check Tides** program to read the history records and confirm that the appropriate water level corrector had been applied to each ping in the GSF file.

The primary means for analyzing the adequacy of the tidal zoning was to look for significant depth changes across a zone boundary by viewing each multibeam GSF file in the navigated swath editor, SAIC's **Multi-View Editor (MVE)**. Coverage grids were also used to analyze the adequacy of zoning. Grids were displayed using various depth color change intervals and sun illumination parameters (elevation and azimuth). Grid display color change intervals were set to enhance any significant changes in depth across zone boundaries due to water level correction errors resulting from incorrect zoning parameters or weather events. The sun illumination enhanced the junctions of the cross line data with the main scheme data.

The H11455 survey was entirely within the water level zones for Atlantic City, NJ (8534720). Analysis of the H11455 multibeam data in the SABER Multi-View Editor and in depth grids revealed minimal depth jumps across the zone boundaries. A spreadsheet analysis of the correctors for each zone confirmed the adequacy of zoning correctors based on Atlantic City, NJ (8534720). Observed verified water levels from 01 August 2005 through 30 November 2005 for station Atlantic City, NJ (8534720) were entered in the spreadsheet. Correctors were computed at 6-minute intervals for each zone and the differences between zones computed as shown in Table A-1. As a result, the NOAA provided preliminary zone boundaries and zoning parameters for Atlantic City (8534720) were accepted as final and applied to all multibeam data for H11455. The zoning parameters applied on sheet H11455 are presented in Table A-2.

**Table A-1. Summary of Verified Tide Correctors at Zone Boundaries for Atlantic City (8534720)**

Zones	17-18	16-17	15-16	14-15	13-14
Maximum	0.173	0.005	0.019	0.177	0.104
Minimum	-0.226	-0.021	-0.083	-0.154	-0.024
Average	-0.031	-0.008	-0.031	-0.008	0.039
Standard Deviation	0.018	0.048	0.018	0.030	0.075

**Table A-2. Water Level Zoning Parameters Applied on Sheet H11455**

Zone	Time Corrector (minutes)	Range Ratio	Reference Station
SA17	0	1.01	8534720
SA18	+12	0.97	8534720
SA21	0	0.97	8534720
SA22	-12	0.97	8534720

Analysis of the H11456 multibeam data in the SABER Multi-View Editor and in depth grids revealed significant depth jumps across the junction of zones based on Atlantic City, NJ (8534720) and the zones based on Sandy Hook, NJ (8531680).

The Draft Statement of Work for OPR-C303-KR-06 provided new NOAA zoning correctors for zones SA13, SA14, SA15, and SA16 with correctors based on Atlantic City, NJ (8534720) instead of Sandy Hook (8531680) as shown in Table A-3.

**Table A-3. Preliminary Tide Zone Parameters from Statement of Work for OPR-C303-KR-05 for Sandy Hook (8531680) and Draft Statement of Work for OPR-C303-KR-06 for Atlantic City (8534720)**

Zone	Statement of work	Time Corrector (Minutes)	Range Ratio	Reference Station
SA13	OPR-C303-KR-05	-36	0.87	8531680
	OPR-C303-KR-06	-12	1.02	8534720
SA14	OPR-C303-KR-05	-36	0.91	8531680
	OPR-C303-KR-06	-6	1.07	8534720
SA15	OPR-C303-KR-05	-36	0.91	8531680
	OPR-C303-KR-06	0	1.06	8534720
SA16	OPR-C303-KR-05	-30	0.88	8531680
	OPR-C303-KR-06	0	1.02	8534720

A spreadsheet was constructed to compare the two sets of NOAA preliminary zoning parameters. Verified water levels from 01 August 2005 through 30 November 2005 for

stations at Sandy Hook, NJ (8531680) and Atlantic City, NJ (8534720) were entered in the spreadsheet. Correctors were computed at 6-minute intervals for each zone. Differences were computed for each zone on Atlantic City, NJ (8534720) compared to the same zones computed on Sandy Hook, NJ (8531680). In addition, the differences between zones 17 computed on Atlantic City, NJ (8534720) and 16 computed on Sandy Hook, NJ (8531680) were made. The results are shown in Table A-4.

**Table A-4. Comparison of Water Level Correctors with Zoning Parameters for Stations 8534720 and 8531680**

<b>Zone</b>	<b>16</b>	<b>15</b>	<b>14</b>	<b>13</b>	<b>17-16</b>
Maximum	0.527	0.645	0.610	0.531	0.531
Minimum	-0.639	-0.561	-0.609	-0.633	-0.633
Average	0.005	-0.036	0.108	0.014	0.014
Standard Deviation	0.083	0.088	0.106	0.125	0.108

These results verified the significant depth differences seen in the data at the zone boundaries depending on the stage of the tide and environmental factors (wind, rain). As a result of this analysis the water level zoning correctors based entirely on Atlantic City, NJ (8534720) were applied to all multibeam data for H11456 and H11495. The zoning parameters applied on sheet H11456 are presented in Table A-5.

**Table A-5. Water Level Zoning Parameters Applied on Sheet H11456**

<b>Zone</b>	<b>Time Corrector (minutes)</b>	<b>Range Ratio</b>	<b>Reference Station</b>
SA13	-12	1.02	8534720
SA16	0	1.02	8534720
SA17	0	1.01	8534720
SA18	+12	0.97	8534720
SA21	0	0.97	8534720
SA22	-12	0.97	8534720

Analysis of the H11495 multibeam data in the SABER Multi-View Editor and in depth grids revealed minimal depth jumps across the junction of zones based on Atlantic City, NJ (8534720). A spreadsheet analysis also confirmed the adequacy of zoning correctors based on Atlantic City, NJ (8534720). The water level zoning correctors based entirely on Atlantic City, NJ (8534720) were applied to all multibeam data for H11495. The zoning parameters applied on sheet H11495 are presented in Table A-6.

**Table A-6. Water Level Zoning Parameters Applied on Sheet H11495**

Zone	Time Corrector (minutes)	Range Ratio	Reference Station
SA13	-12	1.02	8534720
SA14	-6	1.07	8534720
SA15	0	1.06	8534720
SA16	0	1.02	8534720

## B. HORIZONTAL CONTROL

The survey data 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*:

- TSS POS/MV, Serial Number 314
- Trimble 7400 DSi GPS Receiver, Serial Number 3815A22469

All antenna and transducer offsets were measured relative to the Position Orientation System/Marine Vessel (POS/MV) Inertial Measurement Unit (IMU). The *M/V Atlantic Surveyor* 2005 survey season vessel offsets are tabulated in Table B-1 and the sensor configuration is depicted in Figure B-1.

During the remobilization of the *M/V Atlantic Surveyor* in 2006, all antenna and transducer offsets were re-measured. The 2006 results are depicted in Figure B-2 and Table B-2.

**Table B-1. 2005 *M/V Atlantic Surveyor* Antenna and Transducer Locations (measurements in meters)**

Sensor	Offset in ISS-2000		Offset in POS/MV	
Multibeam Reson 8101 Transducer Hull Mount			X	-0.34
			Y	-0.12
			Z	+1.64
Reference to Heave (POS/MV IMU)			X	0.00
			Y	0.00
			Z	0.00
POS/MV GPS Master Antenna			X	4.36
			Y	-0.61
			Z	-6.24
Trimble GPS Antenna	X	+4.70		
	Y	+0.51		
	Z	-7.88		
A-Frame Tow Block (Z = Height above the Water)	X	-19.56		
	Y	+0.52		
	Z	-3.77		

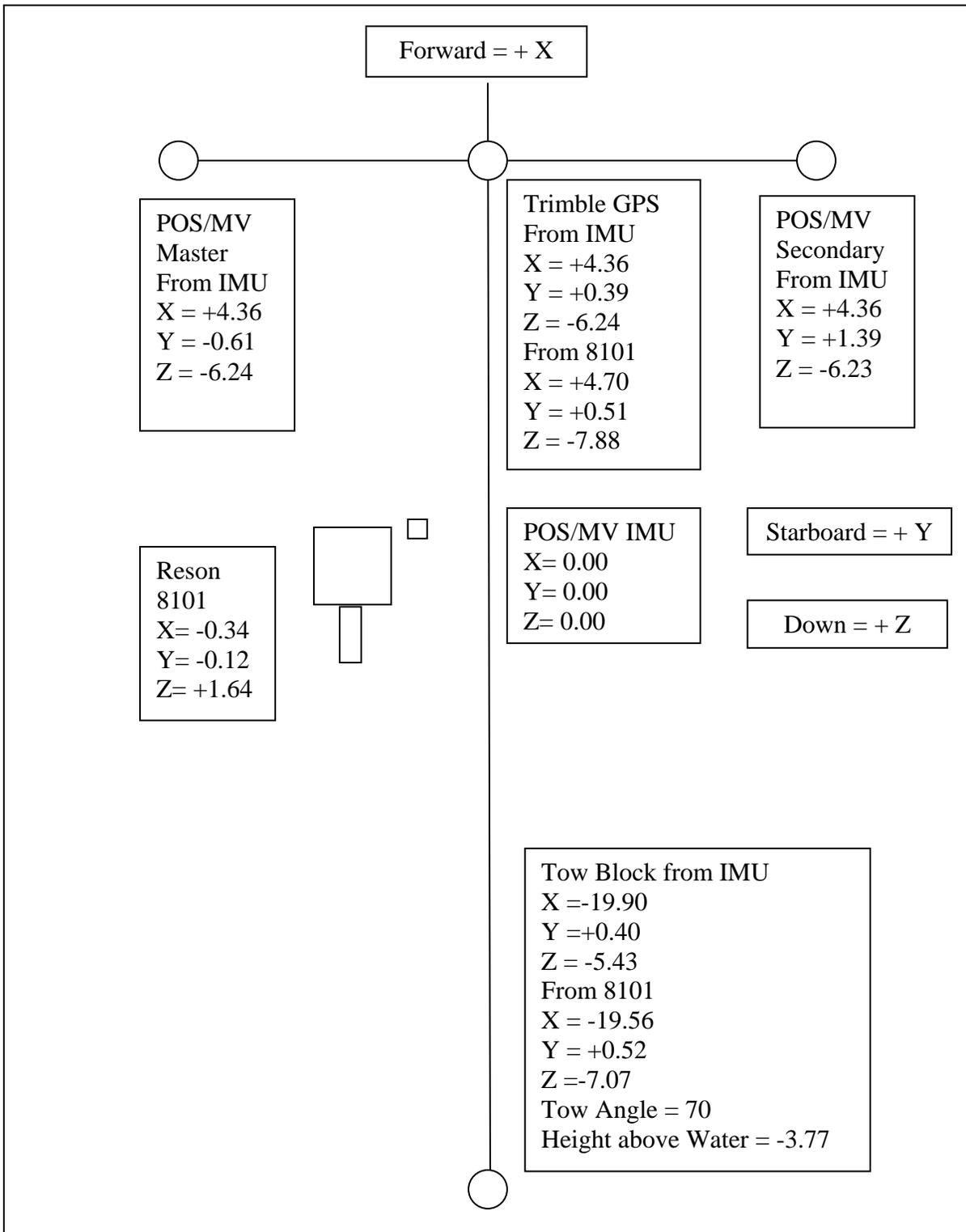


Figure B-1. 2005 Configuration of *M/V Atlantic Surveyor* during Survey Operations (Measurements in meters)

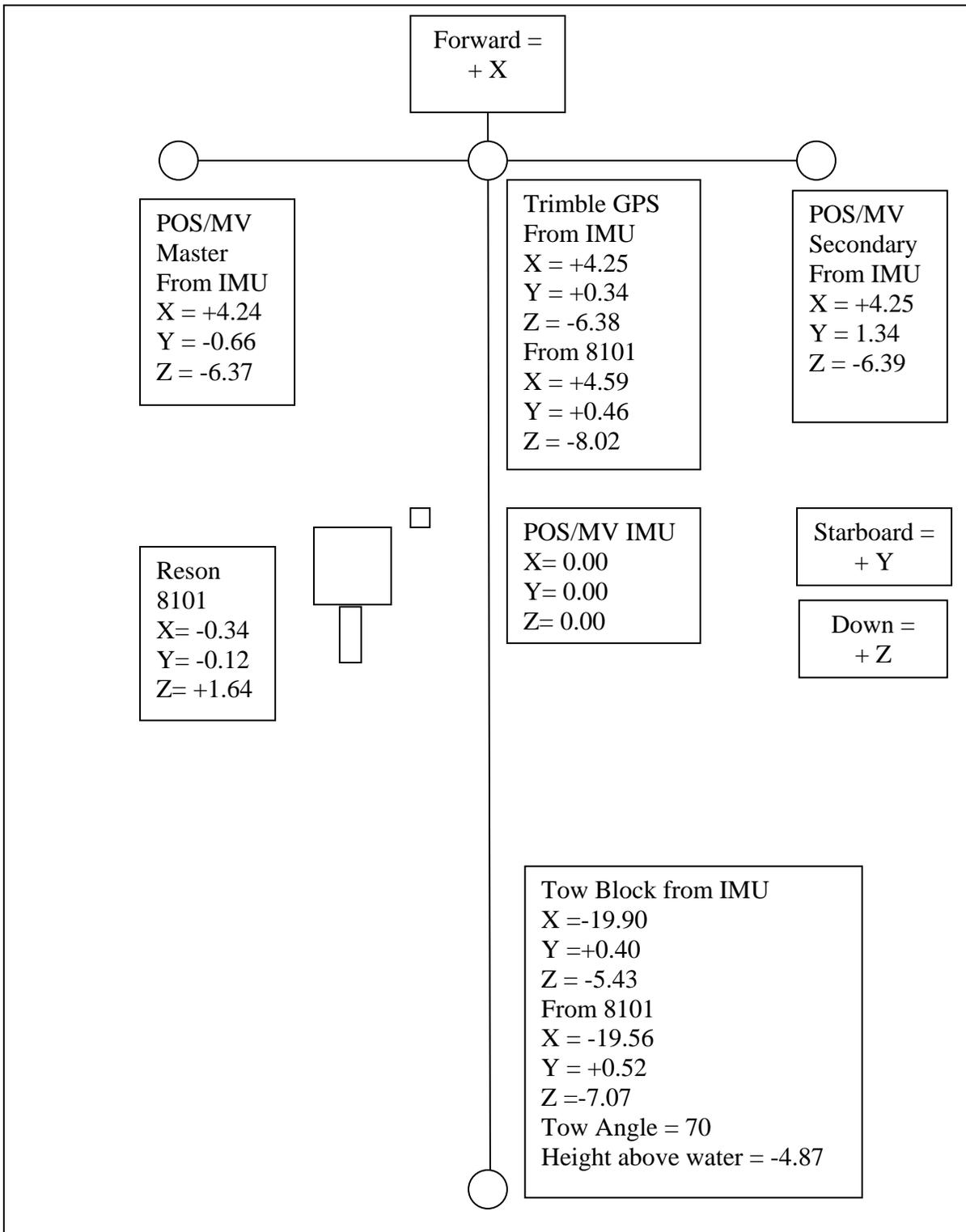


Figure B-2. 2006 Configuration and Offsets of R/V Atlantic Surveyor Sensors (measurements in meters)

**Table B-2. 2006 M/V Atlantic Surveyor Antenna and Transducer Offsets Relative to the POS/MV IMU Vessel Reference Point, measurements in meters**

Sensor	Offset in ISS-2000		Offset in POS/MV	
Multibeam Reson 8101 Transducer Hull Mount			X	-0.34
			Y	-0.12
			Z	+1.64
Reference to Heave			X	0.00
			Y	0.00
			Z	0.00
Reference to Vessel			X	-0.34
			Y	-0.12
			Z	+1.64
POS/MV GPS Master Antenna			X	4.24
			Y	-0.66
			Z	-6.37
Trimble GPS Antenna	X	+4.59		
	Y	+0.46		
	Z	-8.02		
A-Frame Tow Block (Z = Height above the Water)	X	-19.56		
	Y	+0.52		
	Z	-4.87		

For all sheets, daily position confidence checks were made by comparing the DGPS position from the POS/MV with the Trimble DGPS position. A real-time monitor automatically issued an alarm when the two DGPS positions differed by more than 10 meters horizontally. Positioning confidence checks were well within an inverse distance of 5 meters.

Differential correctors used for H11455 online data were from the U.S. Coast Guard Stations at Moriches, NY, Sandy Hook, NJ and Reedy Point, DE.

Differential correctors used for H11456 online data were from the U.S. Coast Guard Stations at Moriches, NY, Reedy Point, DE and Sandy Hook, NJ. The differential receiver was set to only receive data from these three corrector stations; however the POS/MV reported that it used 2 additional stations during online data collection. Stations 291 (Klamonth Falls, OR) and 768 (Ledyard, IA) were reportedly used by the POS/MV for a total of 257 seconds of online data collection. Position comparisons between the POS/MV reported position and the Trimble 7400 DSi GPS receiver reported position during this 257 seconds showed the positions were within an inverse distance of 5 meters. It is believed that the POS/MV incorrectly reported the station identification it was using for correctors and was indeed using one of the three assigned stations. This has been observed previously with the POS/MV system.

Differential correctors used for H11495 online data were from the U.S. Coast Guard Stations at Moriches, NY, Hudson Falls, NY and Sandy Hook, NJ.

**Table B-3. Positional Difference between the POS/MV and Trimble 7400 on the *M/V Atlantic Surveyor***

<b>Year</b>	<b>Julian Day</b>	<b>Sheet ID</b>	<b>Time of Day (UTC)</b>	<b>Positional Difference (m)</b>
2005	191	H	0103	1.19
2005	192	H	0204	0.97
2005	193	H	0110	0.43
2005	194	H	0004	0.58
2005	195	H	0004	0.61
2005	196	H	0026	0.91
2005	197	H	0750	0.58
2005	198	H	0010	0.57
2005	199	H	0005	0.82
2005	200	H	0007	0.59
2005	202	H	0517	0.9
2005	203	H	0004	0.66
2005	204	H	0018	1.03
2005	205	H	0004	1.15
2005	206	H	0003	1.23
2005	207	H	0259	0.51
2005	208	H	0005	1.23
2005	209	H	0050	0.56
2005	210	H	0050	0.79
2005	211	H	0150	0.76
2005	212	H	0004	1.72
2005	213	H	0400	0.68
2005	214	H	0020	0.81
2005	215	H	0420	1.41
2005	216	H	0058	0.66
2005	216	J	1714	1.5
2005	217	J	0247	1.18
2005	218	J	0000	1.14
2005	219	J	0041	0.91
2005	220	J	0025	1.36
2005	221	J	1510	0.82
2005	222	J	0000	1.12
2005	223	J	0005	1.68
2005	224	J	0101	0.65
2005	225	J	0113	0.98

<b>Year</b>	<b>Julian Day</b>	<b>Sheet ID</b>	<b>Time of Day (UTC)</b>	<b>Positional Difference (m)</b>
2005	307	K	0110	0.42
2005	308	K	0115	1.03
2005	308	J	1011	1.83
2005	309	J	1852	1.97
2005	309	K	0249	1.01
2005	310	K	0105	0.76
2005	311	K	0326	1.79
2005	312	K	0255	1.14
2005	312	J	1301	0.84
2005	313	K	0107	0.75
2005	315	K	2215	1.29
2005	316	K	0113	0.53
2005	317	K	0115	1.6
2005	318	K	1334	0.86
2005	319	K	0110	1.15
2005	322	K	1712	1.37
2005	323	K	0229	2.22
2005	324	K	0106	0.92
2005	325	K	0307	0.92
2006	101	K	1317	0.78
2006	102	K	0011	0.46
2006	105	K	1351	1.77
2006	106	K	0430	0.81
2006	107	K	0000	1.69
2006	108	K	0001	0.69
2006	109	J	0238	0.75
2006	109	K	1806	0.94
2006	110	K	1211	0.67
2006	111	K	0017	0.77
2006	114	K	0853	1.37
2006	115	K	0216	0.51
2006	116	K	0007	0.96
2006	117	K	0408	1.1
2006	117	J	1626	0.86
2006	118	K	0028	2.84
2006	144	K	1325	0.92

**C. APPROVAL SHEET**

20 October 2006

**LETTER OF APPROVAL**

REGISTRY NUMBERS: H11455, H11456, and H11495

This Vertical and Horizontal Control report for project OPR-C303-KR-05, Mid-Atlantic Corridor, Coast of New Jersey Project is respectfully submitted.

Field operations and data processing contributing to the accomplishment of these surveys, H11455, H11456, and H11495 were conducted under my direct supervision 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.

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

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20 October 2006