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

# Data Acquisition & Processing Report

| | |
|---|---|
| *Type of Survey* | **Navigable Area** |
| *Project No.* | **S-C919-FH-12** |
| *Registry No.* | **H12490, H12491** |
| *Time Frame* | **21 June 2012 - 24 June 2012** |

## LOCALITY

| | |
|---|---|
| *State* | **New Jersey, New York** |
| *General Locality* | **North Atlantic Ocean** |

**2012**

CHIEF OF PARTY

**LCDR Benjamin K. Evans, NOAA**

## LIBRARY & ARCHIVES

DATE ______________________

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# Data Acquisition and Processing Report

**NOAA Ship *Ferdinand R. Hassler***
Chief of Party: LCDR Benjamin K. Evans, NOAA
Year: 2012
Version: 1.0
Publish Date: 2012-06-29

# A Equipment

## A.1 Survey Vessels

### A.1.1 NOAA Ship FERDINAND R. HASSLER

| | | |
|---|---|---|
| *Name* | NOAA Ship FERDINAND R. HASSLER | |
| *Hull Number* | S250 | |
| *Description* | FERDINAND R. HASSLER is a small waterplane area, twin-hull coastal mapping vessel. | |
| *Utilization* | Survey | |
| *Dimensions* | *LOA* | 37.7 meters |
| | *Beam* | 18.5 meters |
| | *Max Draft* | 3.85 meters |
| *Most Recent Full Static Survey* | *Date* | 2009-11-04 |
| | *Performed By* | Raymond C. Impastato, Professional Land Surveyor |
| | *Discussion* | This survey was provided by the shipbuilder, V.T. Halter Marine, and performed in the shipyard prior to delivery. |
| *Most Recent Partial Static Survey* | *Date* | 2012-06-12 |
| | *Performed By* | Kevin Jordan, NGS |
| | *Discussion* | This survey was performed after the POS/MV antenna mounts were reconfigured to newly fabricated mounts; ties the POS antennae into benchmarks on the 03 deck. |

| | | |
|---|---|---|
| *Most Recent Full Offset Verification* | Full offset verification was not performed. | |
| *Most Recent Partial Offset Verification* | Partial offset verification was not performed. | |
| *Most Recent Static Draft Determination* | *Date* | 2011-07-12 |
| | *Method Used* | Calculation from design waterline and measured offsets |
| | *Discussion* | Design waterline of 3.85 meters and measured offsets to IMU were used to determine static draft of reference point. Draft of ship is operationally managed with ballast to achieve design draft. Uncertainty is estimated at 0.05 meters. |
| *Most Recent Dynamic Draft Determination* | *Date* | 2011-07-12 |
| | *Method Used* | Ellipsoid referenced dynamic draft measurement (ERDDM) |
| | *Discussion* | Data were acquired with canards 15 degrees up, 15 degrees down, and at zero trim angle. The zero trim angle results are used for the dynamic draft table in the Caris HVF files. During all survey operations, the canards are set to zero trim angle. An ERDDM for 2012 has yet to be run due to time and locality constraints. No new modifications have been made to the ship that would cause any change from the 2011 values. |

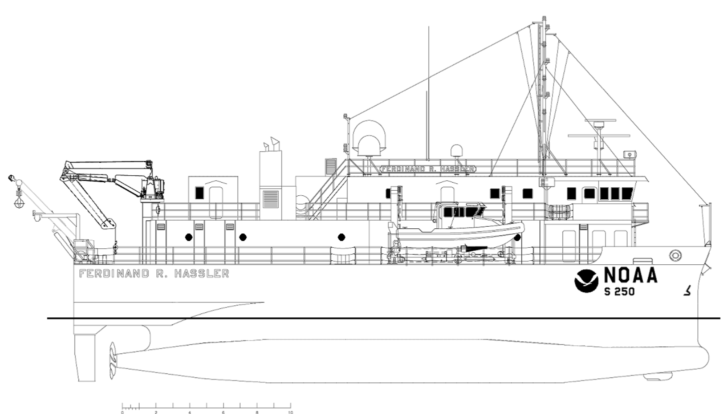


*Figure 1: NOAA Ship FERDINAND R. HASSLER, Starboard View*

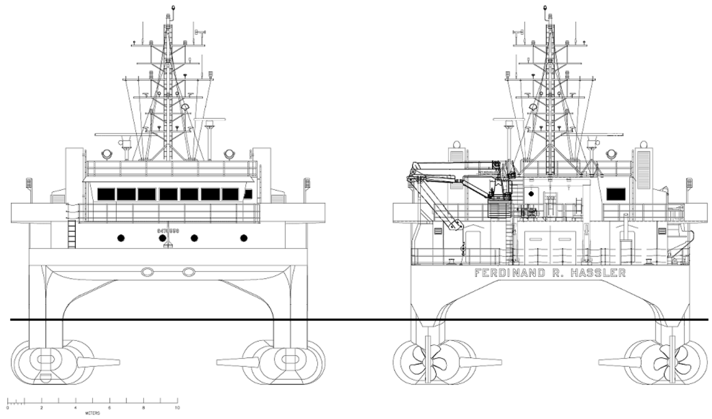


*Figure 2: NOAA Ship FERDINAND R. HASSLER, Bow and Hull View*

## A.2 Echo Sounding Equipment

### A.2.1 Side Scan Sonars

No side scan sonars were utilized for data acquisition.

### A.2.2 Multibeam Echosounders

#### A.2.2.1 Reson 7125

| | |
|---|---|
| *Manufacturer* | Reson |
| *Model* | 7125 |
| *Description* | Port system of a dual head configuration.  This sonar is mounted in the port hull with a 4.5 degree outboard tilt.  For this project, the dual head configuration offered little advantage because of the great water depth and the port head was used exclusively in a continuous wave (CW), single head mode.  The starboard head was not used for data acquisition on this project.  The projector is a single, broadband transducer capable of transmitting efficiently between 180-420 kHz.  This receiver is capable of operating at a center frequency of either 396 or 200 kHz.  For this project, both frequency bands were used. |

| | | | | | |
|---|---|---|---|---|---|
| | The starboard 7125 was not used for data acquisition on this project. | | | | |
| *Serial Numbers* | *Vessel Installed On* | S250 | | | |
| | *Processor s/n* | 18210412051 | | | |
| | *Transceiver s/n* | 212036 | | | |
| | *Transducer s/n* | n/a | | | |
| | *Receiver s/n* | 808052 | | | |
| | *Projector 1 s/n* | 506078 | | | |
| | *Projector 2 s/n* | 506078 | | | |
| *Specifications* | *Frequency* | 400 kilohertz | | 200 kilohertz | |
| | *Beamwidth* | *Along Track* | 1.0 degrees | *Along Track* | 2 degrees |
| | | *Across Track* | 0.5 degrees | *Across Track* | 1 degrees |
| | *Max Ping Rate* | 50 hertz | | 50 hertz | |
| | *Beam Spacing* | *Beam Spacing Mode* | Equidistant | *Beam Spacing Mode* | Equidistant |
| | | *Number of Beams* | 512 | *Number of Beams* | 320 |
| | *Max Swath Width* | 140 degrees | | 140 degrees | |
| | *Depth Resolution* | 6 millimeters | | 6 millimeters | |
| | *Depth Rating* | *Manufacturer Specified* | 150 meters | *Manufacturer Specified* | 400 meters |
| | | *Ship Usage* | 100 meters | *Ship Usage* | 250 meters |
| *Manufacturer Calibrations* | Manufacturer calibration was not performed. | | | | |
| *System Accuracy Tests* | *Vessel Installed On* | S250 | | | |
| | *Methods* | Reference surface comparison | | | |
| | *Results* | A reference surface comparison was performed on May 30, 2012 (Dn151). Tidally corrected surfaces were generated for the port and starboard 7125 systems and the surfaces differenced. On average, depths from the starboard 7125 were deeper than depths from the port 7125 by 0.04 meters. The differences were Gaussian distributed with a standard deviation of 0.04 meters. The distribution is shown in Figure 4. These differences are well under the specified error allowance. | | | |
| *Snippets* | Sonar has snippets logging capability. | | | | |

*Figure 3: 7125 Housing flush mounted on hull*

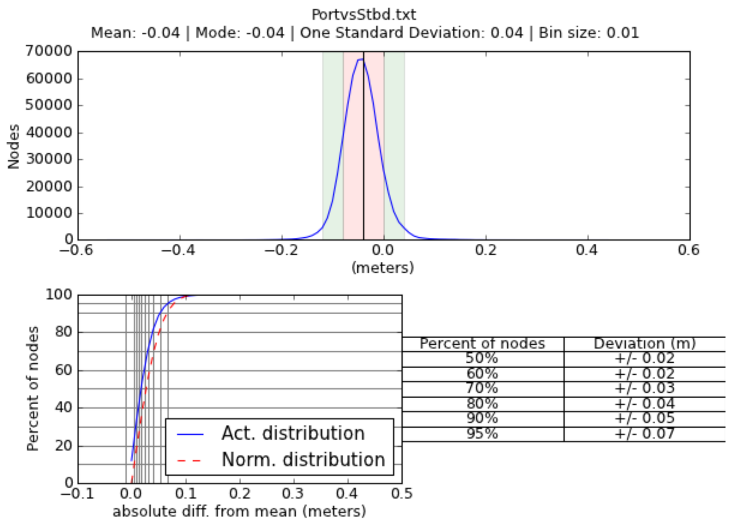


*Figure 4: Statistics of differenced surface between S250's two 7125 systems*

### A.2.2.2 Reson 7125

| | |
|---|---|
| *Manufacturer* | Reson |
| *Model* | 7125 |
| *Description* | Starboard system of a dual head configuration. This sonar is mounted in the starboard hull with a 4.5 degree outboard tilt. For this project, the dual head configuration offered little advantage because of the great water depth and the port head was used exclusively in a continuous wave (CW), single head mode. The starboard receiver does not have the ability to receive 200kHz signals and was not used for data acquisition on this project. It is included here because it was used in the validation of the port 7125 and 7111 systems. |

| | | | |
|---|---|---|---|
| *Serial Numbers* | *Vessel Installed On* | S250 | |
| | *Processor s/n* | 18215011048 | |
| | *Transceiver s/n* | 212035 | |
| | *Transducer s/n* | n/a | |
| | *Receiver s/n* | 2405277 | |
| | *Projector 1 s/n* | 107060030 | |
| | *Projector 2 s/n* | 107060030 | |
| *Specifications* | *Frequency* | 400 kilohertz | |
| | *Beamwidth* | *Along Track* | 1 degrees |
| | | *Across Track* | 0.5 degrees |
| | *Max Ping Rate* | 50 hertz | |
| | *Beam Spacing* | *Beam Spacing Mode* | Equidistant |
| | | *Number of Beams* | 512 |
| | *Max Swath Width* | 140 degrees | |
| | *Depth Resolution* | 6 millimeters | |
| | *Depth Rating* | *Manufacturer Specified* | 150 meters |
| | | *Ship Usage* | 100 meters |
| *Manufacturer Calibrations* | Manufacturer calibration was not performed. | | |

| | | |
|---|---|---|
| *System Accuracy Tests* | *Vessel Installed On* | S250 |
| | *Methods* | Lead line comparison and reference surface |
| | *Results* | On July 26, 2011 (Dn207) a static lead line comparison was performed relative to the waterline. These tests have not been run for 2012 to date but will be completed when time allows. While the ship was alongside a pier, a leadline was lowered to the sea floor in the field of view of the sonar while logging sounding data. Because the leadline was visible in the water column display, the beams at the leadline measurement location could be identified. The logged data was processed through CARIS using standard methods with zero-tide applied to yield a waterline referenced measurement. The leadline was marked at the water and measured with a fiberglass survey tape. The leadline agreed with the sonar derived measurement with an average difference of 0.00 m and an estimated error of 0.03 m. On July 27, 2011 (Dn208) a static leadline comparison was performed relative to the ellipsoid using similar techniques as described above. An ellipsoid height was obtained on a fixed mark ashore using static GPS observations. The observed ellipsoid height was transferred to the suspended leadline using differential leveling. The logged sonar data was processed through CARIS using standard ellipsoid methods to yield an ellipsoid referenced measurement. The ellipsoid referenced leadline measurement was shallower than the sonar data by an average of 0.07 m with an uncertainty of 0.06 m. A reference surface comparison was performed on May 30, 2012 (Dn151). The comparison of the port and starboard 7125 head is discussed in the previous section and shown in Figure 5. Tidally corrected surfaces were generated for the 7111 and dual head 7125 systems and the surfaces differenced. The depths from the 7111 were shallower than the 7125 by an average of 0.16 meters. This difference is thought to arise from a known artifact in the 7111 bottom detection algorithm and is discussed in the following section. |
| *Snippets* | Sonar has snippets logging capability. | |

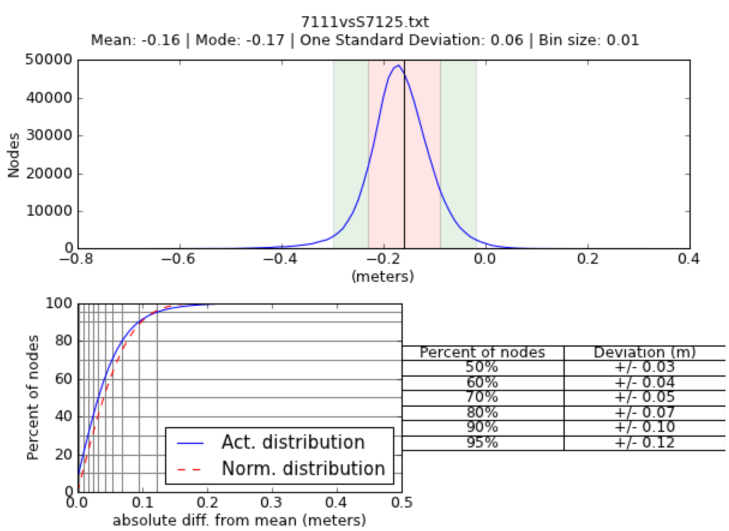


*Figure 5: Statistics of differenced surface between S250s 7111 and starboard 7125 systems*

### A.2.2.3 Reson 7111

<table>
<tr><td>Manufacturer</td><td colspan="3">Reson</td></tr>
<tr><td>Model</td><td colspan="3">7111</td></tr>
<tr><td>Description</td><td colspan="3">This sonar is mid-water, 100 kHz system mounted in a blister fairing forward on the starboard hull. The receive array is cylindrical.</td></tr>
<tr><td rowspan="7">Serial Numbers</td><td>Vessel Installed On</td><td colspan="2">S250</td></tr>
<tr><td>Processor s/n</td><td colspan="2">1908005</td></tr>
<tr><td>Transceiver s/n</td><td colspan="2">n/a</td></tr>
<tr><td>Transducer s/n</td><td colspan="2">n/a</td></tr>
<tr><td>Receiver s/n</td><td colspan="2">1409098</td></tr>
<tr><td>Projector 1 s/n</td><td colspan="2">4506285</td></tr>
<tr><td>Projector 2 s/n</td><td colspan="2">None</td></tr>
<tr><td rowspan="10">Specifications</td><td>Frequency</td><td colspan="2">100 kilohertz</td></tr>
<tr><td rowspan="2">Beamwidth</td><td>Along Track</td><td>1.9 degrees</td></tr>
<tr><td>Across Track</td><td>1.5 degrees</td></tr>
<tr><td>Max Ping Rate</td><td colspan="2">20 hertz</td></tr>
<tr><td rowspan="2">Beam Spacing</td><td>Beam Spacing Mode</td><td>Equidistant</td></tr>
<tr><td>Number of Beams</td><td>301</td></tr>
<tr><td>Max Swath Width</td><td colspan="2">150 degrees</td></tr>
<tr><td>Depth Resolution</td><td colspan="2">3 centimeters</td></tr>
<tr><td rowspan="2">Depth Rating</td><td>Manufacturer Specified</td><td>1000 meters</td></tr>
<tr><td>Ship Usage</td><td>500 meters</td></tr>
<tr><td>Manufacturer Calibrations</td><td colspan="3">Manufacturer calibration was not performed.</td></tr>
</table>

| | | |
|---|---|---|
| *System Accuracy Tests* | *Vessel Installed On* | S250 |
| | *Methods* | Lead line comparison and reference surface. |
| | *Results* | The 7111 was compared with both ellipsoid and waterline referenced leadline measurements as described above. These tests have not been run for 2012 to date but will be completed when time allows. The comparisons were done on August 5, 2011 (Dn217). The depths from the 7111 were 0.44 m deeper than the ellipsoid referenced leadline (0.08 m uncertainty) and 0.33 m deeper than the waterline referenced leadline (0.08 m uncertainty). A reference surface comparison was performed on May 30, 2012 (Dn151). Tidally corrected surfaces were generated for the 7111 and starboard 7125 system and the surfaces differenced. This result is shown in Figure 5. Depths from the 7111 were shallower than from the 7125 by 0.16 meters on average. Another reference surface comparison was performed on May 31, 2012 (Dn151) in deeper water (~ 80 meters) in the vicinity of Norfolk Canyon with the 7111 and port 200 kHz 7125. Depths from the 7111 were shallower than the 7125 depth by 0.17 meters on average. This is shown in Figure 7. This depth invariant bias is thought to arise from a known artifact in the 7111 bottom detection algorithm. Reson has issued an updated firmware version to address this issue, but this was not installed for this project because of insufficient validation. For this survey the water depth was deep enough that this bias is insignificant. |
| *Snippets* | Sonar has snippets logging capability. | |

*Figure 6: 7111 mount and fairing. Sonar is located forward on the starboard hull.*

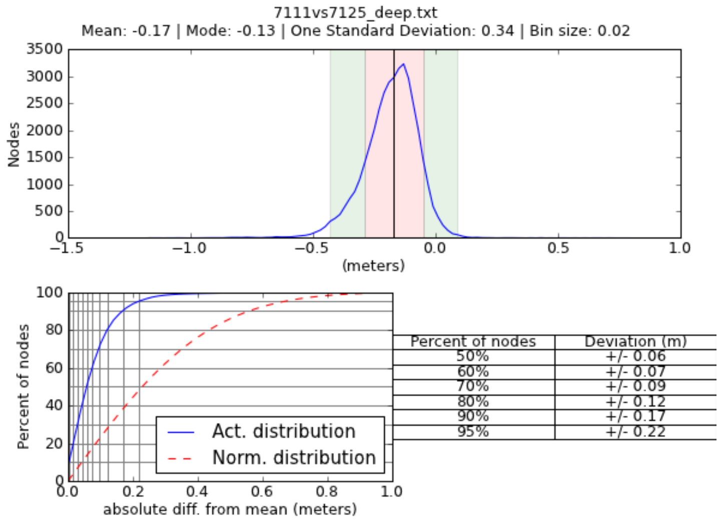


*Figure 7: Statistics of differenced surface between S250s 7111 and port 7125 - 200kHz systems*

## A.2.3 Single Beam Echosounders

No single beam echosounders were utilized for data acquisition.

## A.2.4 Phase Measuring Bathymetric Sonars

No phase measuring bathymetric sonars were utilized for data acquisition.

## A.2.5 Other Echosounders

No additional echosounders were utilized for data acquisition.

**Additional Discussion**

Side scan and single beam not used for this project.

## A.3 Manual Sounding Equipment

### A.3.1 Diver Depth Gauges

No diver depth gauges were utilized for data acquisition.

### A.3.2 Lead Lines

<table>
<tr><td>Manufacturer</td><td>Unknown</td></tr>
<tr><td>Model</td><td>Traditional</td></tr>
<tr><td>Description</td><td>FERDINAND R. HASSLER is equipped with two lead lines. Lead lines are used for measurements near shore over submerged shoals and for echosounder depth comparisons. For all lead line to sonar comparisons the markings on the lead line were not used. The lead line was marked and measured with a fiberglass tape.</td></tr>
<tr><td>Serial Numbers</td><td><table><tr><td>RA6S</td></tr><tr><td>7</td></tr></table></td></tr>
<tr><td>Calibrations</td><td>No calibrations were performed.</td></tr>
<tr><td>Accuracy Checks</td><td><table>
<tr><td>Serial Number</td><td>RA6S</td><td>7</td></tr>
<tr><td>Date</td><td>2012-05-23</td><td>2012-05-23</td></tr>
<tr><td>Procedures</td><td>The wet lead line was stretched on relatively flat ground and compared with a fiberglass survey tape.</td><td>The wet lead line was stretched on relatively flat ground and compared with a fiberglass survey tape.</td></tr>
</table></td></tr>
<tr><td>Correctors</td><td>From the table of values obtained during the accuracy checks a table of correctors was calculated for both lead lines. This table is stored locally aboard the FERDINAND R. HASSLER and referenced when appropriate.</td></tr>
<tr><td>Non-Standard Procedures</td><td>Non-standard procedures were not utilized.</td></tr>
</table>

*Figure 8: FERDINAND R. HASSLER Leadline RA6S fitted with a mud-shoe for soft bottom measurements*

### A.3.3 Sounding Poles

No sounding poles were utilized for data acquisition.

### A.3.4 Other Manual Sounding Equipment

No additional manual sounding equipment was utilized for data acquisition.

## A.4 Positioning and Attitude Equipment

### A.4.1 Applanix POS/MV

| | |
|---|---|
| *Manufacturer* | Applanix |
| *Model* | POS/MV 320 V4 |
| *Description* | Tightly coupled GPS and inertial positioning and attitude sensing system for port hull. Inertial motion unit (IMU) is located below water line close to the port side 7125 wet end. GPS antennae are located on flying bridge of S250. |

| | | | | |
|---|---|---|---|---|
| *PCS* | *Manufacturer* | Applanix | | |
| | *Model* | POS/MV 320 V4 | | |
| | *Description* | Rack mounted POS control system located in charting lab. | | |
| | *Firmware Version* | 3.37 | | |
| | *Software Version* | 5.1.0.2 | | |
| | *Serial Numbers* | *Vessel Installed On* | S250 (port hull) | |
| | | *PCS s/n* | 3187 | |
| *IMU* | *Manufacturer* | Applanix | | |
| | *Model* | LN200 | | |
| | *Description* | Inertial measurement system consisting of three orthogonal accelerometers and three orthogonal fiber-optic gyroscopes. Located in the port hull near 7125 wet end. | | |
| | *Serial Numbers* | *Vessel Installed On* | S250 (port hull) | |
| | | *IMU s/n* | 804 | |
| | *Certification* | *IMU s/n* | 804 | |
| | | *Certification Date* | 2011-05-18 | |
| *Antennas* | *Manufacturer* | Trimble | | |
| | *Model* | Zepher I | | |
| | *Description* | GPS antennae are used for position input as well as aiding the heading solution. The antennae pair for the port system is the forward and aft pair on the port side. The separation distance between these two antennae is approximately 2 meters. | | |
| | *Serial Numbers* | *Vessel Installed On* | S250 Port Fwd | S250 Port Aft |
| | | *Antenna s/n* | 60240385 | 60244128 |
| | | *Port or Starboard* | Port | Port |
| | | *Primary or Secondary* | Primary | Secondary |
| *GAMS Calibration* | *Vessel* | S250 | | |
| | *Calibration Date* | 2012-05-29 | | |
| *Configuration Reports* | *Vessel* | S250 | | |
| | *Report Date* | 2011-05-18 | | |

<table>
<tr><td>Manufacturer</td><td colspan="3">Applanix</td></tr>
<tr><td>Model</td><td colspan="3">POS MV Version 4</td></tr>
<tr><td>Description</td><td colspan="3">Tightly coupled GPS and inertial positioning and attitude sensing system for starboard hull. Inertial motion unit (IMU) is located below water line close to the starboard side 7125 wet end. GPS antennae are located on flying bridge of S250.</td></tr>
<tr><td rowspan="7">PCS</td><td>Manufacturer</td><td colspan="2">Applanix</td></tr>
<tr><td>Model</td><td colspan="2">POS MV Version 4</td></tr>
<tr><td>Description</td><td colspan="2">Rack mounted POS control system located in charting lab.</td></tr>
<tr><td>Firmware Version</td><td colspan="2">3.37</td></tr>
<tr><td>Software Version</td><td colspan="2">5.1.0.2</td></tr>
<tr><td rowspan="2">Serial Numbers</td><td>Vessel Installed On</td><td>S250 (starboard hull)</td></tr>
<tr><td>PCS s/n</td><td>3189</td></tr>
<tr><td rowspan="7">IMU</td><td>Manufacturer</td><td colspan="2">Applanix</td></tr>
<tr><td>Model</td><td colspan="2">LN200</td></tr>
<tr><td>Description</td><td colspan="2">Inertial measurement system consisting of three orthogonal accelerometers and three orthogonal fiber-optic gyroscopes. Located in starboard hull near 7125 wet end.</td></tr>
<tr><td rowspan="2">Serial Numbers</td><td>Vessel Installed On</td><td>S250 (starboard hull)</td></tr>
<tr><td>IMU s/n</td><td>803</td></tr>
<tr><td rowspan="2">Certification</td><td>IMU s/n</td><td>803</td></tr>
<tr><td>Certification Date</td><td>2011-09-26</td></tr>
</table>

<table>
<tr><td rowspan="7">Antennas</td><td>Manufacturer</td><td colspan="3">Trimble</td></tr>
<tr><td>Model</td><td colspan="3">Zepher I</td></tr>
<tr><td>Description</td><td colspan="3">GPS antennae are used for position input as well as aiding the heading solution. The antennae pair for the starboard system is the forward and aft pair on the starboard side. The separation distance between the antennae is approximately 2 meters.</td></tr>
<tr><td rowspan="4">Serial Numbers</td><td>Vessel Installed On</td><td>S250 Stbd Fwd</td><td>S250 Stbd Aft</td></tr>
<tr><td>Antenna s/n</td><td>60243047</td><td>60243869</td></tr>
<tr><td>Port or Starboard</td><td>Starboard</td><td>Starboard</td></tr>
<tr><td>Primary or Secondary</td><td>Primary</td><td>Secondary</td></tr>
<tr><td rowspan="2">GAMS Calibration</td><td>Vessel</td><td colspan="3">S250 Starboard</td></tr>
<tr><td>Calibration Date</td><td colspan="3">2012-05-29</td></tr>
<tr><td rowspan="2">Configuration Reports</td><td>Vessel</td><td colspan="3">S250</td></tr>
<tr><td>Report Date</td><td colspan="3">2011-09-26</td></tr>
</table>

## A.4.2 DGPS

<table>
<tr><td>Description</td><td colspan="3">Hemisphere PGS MBX Kit</td></tr>
<tr><td rowspan="5">Antennas</td><td>Manufacturer</td><td colspan="2">Hemisphere</td></tr>
<tr><td>Model</td><td colspan="2">MBX-4</td></tr>
<tr><td>Description</td><td colspan="2"></td></tr>
<tr><td rowspan="2">Serial Numbers</td><td>Vessel Installed On</td><td>S250</td></tr>
<tr><td>Antenna s/n</td><td>1113139440044</td></tr>
</table>

<table>
<tr><td rowspan="6">Receivers</td><td>Manufacturer</td><td colspan="2">Hemisphere</td></tr>
<tr><td>Model</td><td colspan="2">MBX-4</td></tr>
<tr><td>Description</td><td colspan="2"></td></tr>
<tr><td>Firmware Version</td><td colspan="2">1.0</td></tr>
<tr><td rowspan="2">Serial Numbers</td><td>Vessel Installed On</td><td>S250</td></tr>
<tr><td>Antenna s/n</td><td>1118144550001</td></tr>
</table>

## A.4.3 Trimble Backpacks

Trimble backpack equipment was not utilized for data acquisition.

## A.4.4 Laser Rangefinders

No laser rangefinders were utilized for data acquisition.

## A.4.5 Other Positioning and Attitude Equipment

No additional positioning and attitude equipment was utilized for data acquisition.

## A.5 Sound Speed Equipment

## A.5.1 Sound Speed Profiles

### A.5.1.1 CTD Profilers

#### A.5.1.1.1 Sea-Bird SeaCat 19-02, 19plus 350 meter and 19plus 3500 meter

| | |
|---|---|
| *Manufacturer* | Sea-Bird |
| *Model* | SeaCat 19-02, 19plus 350 meter and 19plus 3500 meter |

| | |
|---|---|
| *Description* | Internal logging conductivity, temperature, and depth measuring devices. |

*Serial Numbers*

| | | | | |
|---|---|---|---|---|
| *Vessel Installed On* | S250 | S250 | S250 | S250 |
| *CTD s/n* | 196093-1060 | 19P65591-6918 | 19P32914-4480 | 19P36399-4642 |

*Calibrations*

| | | | | |
|---|---|---|---|---|
| *CTD s/n* | 1060 | 6918 | 4480 | 4642 |
| *Date* | 2011-03-28 | 2011-10-17 | 2012-04-03 | 2012-04-10 |
| *Procedures* | Routine calibration service | Initial Calibration for new equipment | Routine calibration service | Routine calibration service |

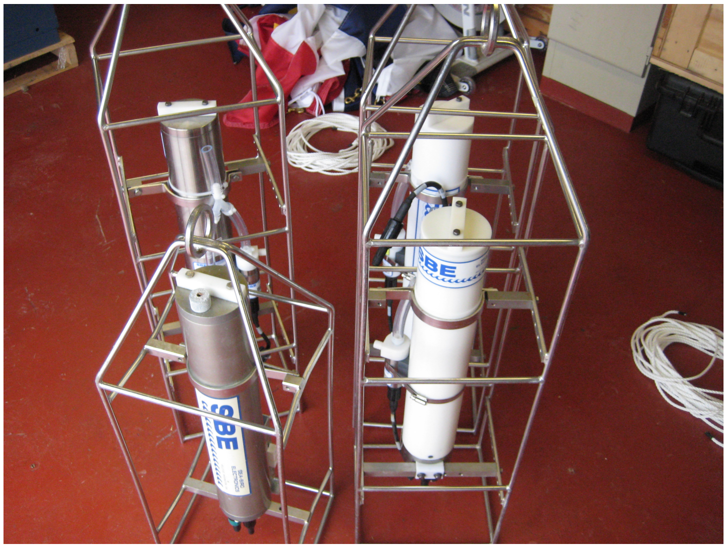

*Figure 9: Ferdinand R. Hassler CTD inventory*

### A.5.1.2 Sound Speed Profilers

#### A.5.1.2.1 Brooke Ocean MVP-30

| | |
|---|---|
| *Manufacturer* | Brooke Ocean |
| *Model* | MVP-30 |
| *Description* | Moving vessel profiler equipped with a AML Micro-CTD in a single sensor free fall fish. |

| | | |
|---|---|---|
| *Serial Numbers* | *Vessel Installed On* | S250 |
| | *Sound Speed Profiler s/n* | 10796 |
| *Calibrations* | *Sound Speed Profiler s/n* | 007760 |
| | *Date* | 2012-04-04 |
| | *Procedures* | Routine calibration service |


*Figure 10: MVP control station & winch*

*Figure 11: MVP 'fish'*

## A.5.2 Surface Sound Speed

### A.5.2.1 Sea-Bird 45 MicroTSG

| | |
|---|---|
| *Manufacturer* | Sea-Bird |
| *Model* | 45 MicroTSG |
| *Description* | Two SBE-45 thermosalinographs are installed to determine the sound velocity of the water at the sonar transducers. This data is used to aid beam steering of the multibeam sonar systems. One is located in the starboard engine room, the other in the port. Both units draw sampling water from the main cooling water line of the respective main engine. A SBE-38 remote temperature sensor is integrated with each device. However, the SBE-38's are located in forward vent tubes that do not have water flow and do not accurately reflect the ambient water temperature. The SBE-45 are configured to use their internal temperature sensors and disregard the data from the remote temperature sensors. Both units are insulated with foam to ensure accurate temperature readings. These devices calculate the sound speed from the measured salinity and temperature (using the Chen-Millero equation) of the sampled water. A serial broadcast device sends the sound speed message from the SBE-45 to the port and starboard 7125 systems and the 7111. |

| | | | |
|---|---|---|---|
| *Serial Numbers* | *Vessel Installed On* | S250 Port | S250 Stbd |
| | *Sound Speed Sensor s/n* | 4553332-0276 | 4553332-0277 |
| *Calibrations* | *Sound Speed Sensor s/n* | 4553332-0276 | 4553332-0277 |
| | *Date* | 2012-04-11 | 2012-04-11 |
| | *Procedures* | Routine calibration service | Routine calibration service |

## A.6 Horizontal and Vertical Control Equipment

### A.6.1 Horizontal Control Equipment

No horizontal control equipment was utilized for data acquisition.

### A.6.2 Vertical Control Equipment

No vertical control equipment was utilized for data acquisition.

## A.7 Computer Hardware and Software

### A.7.1 Computer Hardware

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Manufacturer* | Dell | | | | | | |
| *Model* | T3400 | | | | | | |
| *Description* | Processing and Acquisition Computers | | | | | | |
| *Serial Numbers* | *Computer s/n* | FH-PROC1 Service Tag # 1PKVTK1 | FH-PROC2 Service Tag # 3PSUTK1 | FH-PROC3 Service Tag # 4P5VTK1 | FH-PROC4 Service Tag # 2P5VPK1 | FH-ACQ1 Service Tag # 101WTK1 | FH-ACQ2 Service Tag # 201WTK1 |
| | *Operating System* | Windows XP | Windows XP | Windows XP | Windows XP | Windows XP | Windows XP |
| | *Use* | Processing | Processing | Processing | Processing | Acquisition | Acquisition |

| | |
|---|---|
| *Manufacturer* | Cybertron PC |
| *Model* | Generic |
| *Description* | Processing Computer |

| | | |
|---|---|---|
| *Serial Numbers* | *Computer s/n* | FH-PROC5 Service Tag # FQC-00765 |
| | *Operating System* | Windows 7 |
| | *Use* | Processing |

## A.7.2 Computer Software

| | |
|---|---|
| *Manufacturer* | CARIS |
| *Software Name* | HIPS/SIPS |
| *Version* | 7.1 |
| *Service Pack* | 1 |
| *Hotfix* | 1 |
| *Installation Date* | 2012-04-02 |
| *Use* | Processing |
| *Description* | Data processing |

| | |
|---|---|
| *Manufacturer* | CARIS |
| *Software Name* | Bathy Data Base Editor |
| *Version* | 3.2 |
| *Service Pack* | 2 |
| *Hotfix* | 4 |
| *Installation Date* | 2012-05-11 |
| *Use* | Processing |
| *Description* | Data analysis and feature management |

| | |
|---|---|
| *Manufacturer* | CARIS |
| *Software Name* | Plot Composer |
| *Version* | 5.2 |
| *Service Pack* | |
| *Hotfix* | |
| *Installation Date* | 2012-06-01 |
| *Use* | Processing |
| *Description* | Mapping and plotting software |

| | |
|---|---|
| *Manufacturer* | Applanix |
| *Software Name* | POSPac |

| | |
|---|---|
| *Version* | 5.4 |
| *Service Pack* | 1 |
| *Hotfix* | |
| *Installation Date* | 2012-04-02 |
| *Use* | Acquisition and Processing |
| *Description* | Position and Attitude processing software |

| | |
|---|---|
| *Manufacturer* | NOAA |
| *Software Name* | Pydro |
| *Version* | 12.3 |
| *Service Pack* | r3864 |
| *Hotfix* | |
| *Installation Date* | 2012-05-11 |
| *Use* | Processing |
| *Description* | Feature management, correlation, and report generator |

| | |
|---|---|
| *Manufacturer* | NOAA |
| *Software Name* | Velocipy |
| *Version* | 12.3 |
| *Service Pack* | r3864 |
| *Hotfix* | |
| *Installation Date* | 2012-05-11 |
| *Use* | Acquisition and Processing |
| *Description* | Sound velocity download and processing software |

| | |
|---|---|
| *Manufacturer* | Pitney Bowes |
| *Software Name* | MapInfo |
| *Version* | 10.5 |
| *Service Pack* | |
| *Hotfix* | |
| *Installation Date* | 2011-08-24 |
| *Use* | Acquisition and Processing |
| *Description* | GIS software |

| | |
|---|---|
| *Manufacturer* | IVS 3D |

| | |
|---|---|
| *Software Name* | Fledermaus |
| *Version* | 7.3 |
| *Service Pack* | 0a |
| *Hotfix* | |
| *Installation Date* | 2011-08-08 |
| *Use* | Processing |
| *Description* | Data modeling |

| | |
|---|---|
| *Manufacturer* | Hypack |
| *Software Name* | Hypack/Hysweep |
| *Version* | 11 |
| *Service Pack* | |
| *Hotfix* | |
| *Installation Date* | 2011-03-16 |
| *Use* | Acquisition |
| *Description* | Data logging |

| | |
|---|---|
| *Manufacturer* | Klein |
| *Software Name* | SonarPro |
| *Version* | 12.1 |
| *Service Pack* | |
| *Hotfix* | |
| *Installation Date* | 2012-05-11 |
| *Use* | Acquisition |
| *Description* | Side Scan control |

| | |
|---|---|
| *Manufacturer* | Applanix |
| *Software Name* | POSView |
| *Version* | 5.1.0.2 |
| *Service Pack* | |
| *Hotfix* | |
| *Installation Date* | 2011-04-05 |
| *Use* | Acquisition |
| *Description* | Positioning |

| | |
|---|---|
| *Manufacturer* | Synergy |
| *Software Name* | Synergy |
| *Version* | 1.3.6 |
| *Service Pack* | |
| *Hotfix* | |
| *Installation Date* | 2011-05-10 |
| *Use* | Acquisition |
| *Description* | Shared mouse and keyboard between acquisition systems |

## A.8 Bottom Sampling Equipment

## A.8.1 Bottom Samplers

### A.8.1.1 Ponar Wildco 1728

| | |
|---|---|
| *Manufacturer* | Ponar Wildco |
| *Model* | 1728 |
| *Description* | Grab sampler triggered by contact with sea floor. |

*Figure 12: Ponar Grab Sampler*

# B Quality Control

## B.1 Data Acquisition

### B.1.1 Bathymetry

#### B.1.1.1 Multibeam Echosounder

Multibeam data are acquired through Hypack/Hyweep in HSX format for bathymetry. Multibeam data are also logged locally on the Reson topside machines in s7k format. The HSX format includes sounding solutions, navigation and attitude data. The s7k format includes sounding solutions, navigation, attitude and backscatter snippet data. This record includes the following Reson datagrams:
1003: Position
1012: Roll, Pitch, Heave
1013: Heading
7000: 7k Sonar Settings
7004: 7k Beam Geometry

7006: 7k Bathymetric Data
7008: 7k Generic Watercolumn Data (snippets backscatter)
7011: 7k Image Data
7503: Remote Control Sonar Settings

The Hypack logged .7k snippet backscatter record is not available for the dual head 7125 configuration. Ship navigation and survey line monitoring are performed with Hypack/Hysweep.

The Reson units are interfaced with the acquisition machines through UDP LAN connections over a dedicated network switch (NetGear ProSafe Gigabit Switch). Position and attitude data is passed from the POS-MV to both the Reson machines and to the acquisition computers through dedicated network switches (NetGear ProSafe Gigabit Switch). There is a dedicated switch for the port and starboard POS systems. Time is passed from the POS to the Reson machines via a RS232 serial connection. The starboard POS is interfaced with the starboard 7125 and the 7111, which is located in the starboard hull. The port POS is interfaced to the port 7125.

Until 1745 on June 21, 2012 (Dn173) surface sound speed from the starboard TSG-45 was fed into all Reson machines via RS232 serial connections. After that time, the port TSG-45 was configured to feed sound speed to all Reson machines.

#### B.1.1.2 Single Beam Echosounder

Single beam echosounder bathymetry was not acquired.

#### B.1.1.3 Phase Measuring Bathymetric Sonar

Phase measuring bathymetric sonar bathymetry was not acquired.

### B.1.2 Imagery

#### B.1.2.1 Side Scan Sonar

Side scan sonar imagery was not acquired.

#### B.1.2.2 Phase Measuring Bathymetric Sonar

Phase measuring bathymetric sonar imagery was not acquired.

### B.1.3 Sound Speed

#### B.1.3.1 Sound Speed Profiles

Seabird SBE 19, 19plus and MVP sound speed profilers are used regularly to collect sound speed data for ray tracing corrections for the multibeam sonar systems. In shallow water, the SBE 19plus is hand deployed from the stern. In deeper water the oceanographic winch is used. Data is retrieved from the Seabird CTDs with a serial connection to a processing computer. Data from both the Seabirds and MVP are processed through the NOAA in-house program Velocipy to give Caris .svp formatted sound velocity profiles. All svp profiles for a survey sheet are concatenated to one master file for a survey.

Casts are taken at least every four hours. Cast frequency is increased in areas with strong sound speed gradients or anticipated sound speed variability. Cast locations are spread through the survey area to best capture the variability, as shown in figure 13, and are typically oversampled when using the MVP.

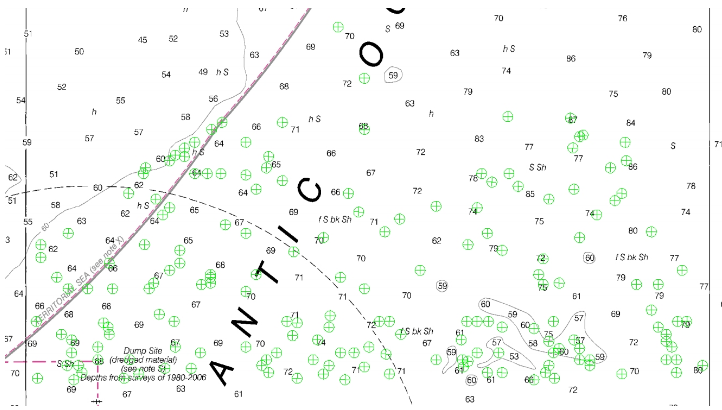


*Figure 13: Example of sound speed samples taken in a survey area*

### B.1.3.2 Surface Sound Speed

Seabird TSG 45 thermosalinograph is used for determination of sea surface conductivity and temperature. From these measurements salinity and sound velocity can be computed. The sound speed is then output to the Reson 7111 and both 7125 processing units.

## B.1.4 Horizontal and Vertical Control

### B.1.4.1 Horizontal Control

Applanix POS/MV files are logged internally which contain attitude, heading, position and velocity data as stated in section 3.4.1 of the FPM. During acquisition, the navigation solution status is constantly monitored by the acquisition watch stander.

These internally logged files are size limited, therefore files submitted typically start with the .000 extension and increment upwards (e.g. .001, .002, .003, ...). There are approximately 240 files generated during 24 hours of acquisition.

Real-time USCG DGPS correctors are used for all acquisition. Specific DGPS stations are noted in the DR accompanying each survey.

#### B.1.4.2 Vertical Control

Preliminary, observed and verified water levels are downloaded using FetchTides and applied to the data using CARIS HIPS Load Tide function. Refer to individual sheet DRs and/or HVCR for additional information.

### B.1.5 Feature Verification

Feature verification followed guidelines set forth in section 3.5.5 of the FPM. Refer to individual sheet DRs for additional information.

### B.1.6 Bottom Sampling

Bottom Sampling followed guidelines set forth in sections 7.1 of the HSSD and 2.5.4.2.1 of the FPM. Refer to individual sheet DRs for additional information.

### B.1.7 Backscatter

Backscatter is acquired in the 7008 record logged in the .s7k files directly from the Reson 7125 processors. For processing, this record is paired with a GSF file exported from CARIS containing processed depth information. The paired files are imported into QPS Fledermaus Geocoder Toolbox for mosaic processing.

### B.1.8 Other

No additional data were acquired.

**Additional Discussion**

FERDINAND R. HASSLER maintains a continuous manned survey watch during all survey acquisition. The watch stander is in constant communication with the bridge and monitors the performance of all systems. Thresholds set in Hypack/Hysweep, POS view, Reson and Sonar Pro alert the watch stander by displaying alarm messages when error thresholds or tolerances are exceeded. Alarm conditions that may compromise survey data quality are corrected and then noted in acquisition log. Warning messages such as the temporary loss of differential GPS, excessive cross track error, or vessel speed approaching the maximum allowable survey speed are addressed by the watch stander and corrected before further data acquisition occurs.

## B.2 Data Processing

## B.2.1 Bathymetry

### B.2.1.1 Multibeam Echosounder

Bathymetry processing follows section 4.2 of the FPM unless otherwise noted.

Raw .s7k multibeam data are converted to CARIS HIPS HDCS format in accordance with the Field Procedures Manual. After TrueHeave, sound speed and water level correctors are applied to all lines, the lines are merged. Total Propagated Uncertainty (TPU) is computed using settings documented for each survey in the Descriptive Report. Default CARIS device models (C:\CARIS\HIPS\71\System\devicemodels.xml) are used during processing.

The general resolution, depth ranges, and Combined Uncertainty and Bathymetric Estimator (CUBE) parameter settings outlined in section 5.2.2.2 of the HSSD and section 4.2.1.1.1.1 of the FPM are used for surface creation and analysis. A detailed listing of the resolutions and the actual depth ranges used during the processing of each survey, along with the corresponding fieldsheet(s), will be provided in the Descriptive Report of each survey.

Multibeam data are reviewed and edited in HIPS swath editor and in subset mode as necessary. The finalized BASE surfaces and CUBE hypotheses are used for directed data editing at the appropriate depth range in subset editor. The surfaces and subset editor view are also used to demonstrate coverage and to check for errors due to tides, sound speed, attitude and timing.

Vessel heading, attitude, and navigation data are reviewed in HIPS navigation editor and attitude editor if deemed necessary upon review of surfaces. Where necessary, fliers or gaps in heading, attitude, or navigation data are manually rejected or interpolated for small periods of time. Any editing of this nature is outlined in the Descriptive Report for the particular survey.

Either the Density or the Density & Locale method for hypothesis disambiguation is typically used. This follows section 4.2.1.1.1 of the FPM as available disambiguation methods. The disambiguation method can be seen in each layer's properties and can be modified if desired.

The surface filtering function in CARIS HIPS is not utilized routinely. If utilized, the Descriptive Report lists the confidence level settings for standard deviation used and discusses the way the surface filter was applied.

In depths less than 20 meters and deeper in areas of navigational significance where the BASE surface does not depict the representative depth for the given area, a designated sounding is selected. Designated soundings are selected as outlined in section 5.2.1.2 of the HSSD.

Vertical uncertainty child layers are created using the following two formulas for IHO_1 and IHO_2 derived specifications, respectively; -Uncertainty/((0.5^2 +((Depth*0.013)^2))^0.5) and -Uncertainty/((1.0^2 +((Depth*0.023)^2))^0.5). IHO_1 is created for all soundings less than 100 meters while IHO_2 is for 100 meters and deeper. This layer is then exported and run through an application which computes statistics. The results are reported and analyzed in each sheets individual DR.

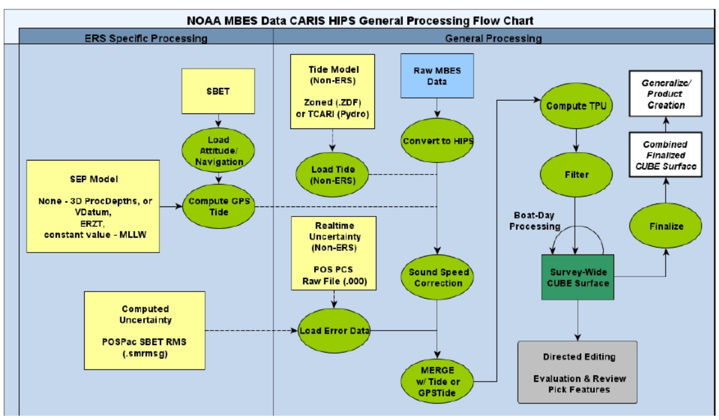


*Figure 14: MBES flow diagram*

### B.2.1.2 Single Beam Echosounder

Single beam echosounder bathymetry was not processed.

### B.2.1.3 Phase Measuring Bathymetric Sonar

Phase measuring bathymetric sonar bathymetry was not processed.

### B.2.1.4 Specific Data Processing Methods

#### B.2.1.4.1 Methods Used to Maintain Data Integrity

Processing logs are used to record and communicate problems from acquisition to final processing.

#### B.2.1.4.2 Methods Used to Generate Bathymetric Grids

All methods used to generate final bathymetric grids are followed as put forth in section 4.2 and all relevant subsections of the FPM.

#### B.2.1.4.3 Methods Used to Derive Final Depths

| | |
|---|---|
| *Methods Used* | Cleaning Filters<br>Gridding Parameters<br>Surface Computation Algorithms |
| *Description* | Filters are used on a case by case basis as determined by the hydrographer, refer to individual sheet DRs for more information. |

## B.2.2 Imagery

### B.2.2.1 Side Scan Sonar

Side scan sonar imagery was not processed.

### B.2.2.2 Phase Measuring Bathymetric Sonar

Phase measuring bathymetric sonar imagery was not processed.

### B.2.2.3 Specific Data Processing Methods

#### B.2.2.3.1 Methods Used to Maintain Data Integrity

n/a

#### B.2.2.3.2 Methods Used to Achieve Object Detection and Accuracy Requirements

n/a

#### B.2.2.3.3 Methods Used to Verify Swath Coverage

n/a

#### B.2.2.3.4 Criteria Used for Contact Selection

n/a

#### B.2.2.3.5 Compression Methods Used for Reviewing Imagery

No compression methods were used for reviewing imagery.

## B.2.3 Sound Speed

### B.2.3.1 Sound Speed Profiles

Daily sound speed profiles from the SBE and MVP profilers are processed with Velocipy after acquisition.

#### B.2.3.1.1 Specific Data Processing Methods

##### B.2.3.1.1.1 Caris SVP File Concatenation Methods

CTD profiles from both the Seabird SBE 19 and the AML Micro-CTD installed in the MVP system are processed using the NOAA developed program Velocipy. From each system, sound speed profiles are extracted and archived as both individual and concatenated CARIS SVP files.

*Figure 99: no figure*

### B.2.3.2 Surface Sound Speed

Surface sound speed data were not processed.

## B.2.4 Horizontal and Vertical Control

### B.2.4.1 Horizontal Control

Fixed USCG DGPS stations are used for all real time horizontal control. If post-processed GPS techniques are used to improve horizontal control, specific information is included in the Descriptive Report and/or the project's Horizontal and Vertical Control Report.

If internally logged TrueHeave files contain IMU data gaps apparent during post processing then externally logged files may be examined and used if free from gaps.  If this is the case the externally logged file will be submitted with the GNSS data.

*Figure 99: no figure*

#### B.2.4.2 Vertical Control

CO-OPS zoned water levels utilizing water level observations from fixed, continuously operating NOAA tide gages are used for reduction of data to MLLW. Predicted water levels are applied during preliminary processing. Before submission, verified water levels are applied to all tidally corrected data. If post processed GPS techniques are used to improve vertical control, specific information is included in the Descriptive Report and/or the project's Horizontal and Vertical Control Report.

*Figure 99: no figure*

### B.2.5 Feature Verification

Features are processed using NOAA's Pydro software and are included with submitted processed data in the survey's final feature file (FFF) in S-57 .000 format.  The FFF includes all features; buoys, rocks, wrecks, bottom samples, etc., addressed within the limits of each individual sheet.

*Figure 99: no figure*

### B.2.6 Backscatter

All backscatter was processed from acquired Reson .s7k or Hypack .7k files. Processed bathymetry is exported from CARIS as a GSF files and saved in the raw data directory with the .s7k/.7k file. The paired files are imported into QPS Fledermaus Geocoder Toolbox and a mosaic calculated with default processing parameters. Reson TVG plugins are used for all processing steps.

*Figure 99: no figure*

## B.2.7 Other

No additional data were processed.

## B.3 Quality Management

Standard operating procedures (SOPs) and checklists are followed by personnel throughout the survey to ensure consistent high quality data and products.

Data is constantly reviewed for quality during acquisition and processing by all personnel. Before any data is to be submitted it is reviewed independently by at least three experienced persons who are signatories to the Descriptive Report.

## B.4 Uncertainty and Error Management

TPU is processed using the following settings.

## B.4.1 Total Propagated Uncertainty (TPU)

### B.4.1.1 TPU Calculation Methods

TPU is calculated in CARIS HIPS using the Compute TPU tool. Project specific values for tide and sound speed are entered and used over the duration of each project. These values are listed in the Descriptive Reports for each survey.

### B.4.1.2 Source of TPU Values

Error values for the multibeam and positioning systems were compiled from manufacturer specifications sheets for each sensor and from values set forth in section 4.2.3.8 and Appendix 4 - CARIS HVF Uncertainty Values of the 2011 FPM.

### B.4.1.3 TPU Values

| | | | |
|---|---|---|---|
| *Vessel* | S250 Port Pontoon | | |
| *Echosounder* | Reson 7125 200 kilohertz | | |
| *TPU Standard Deviation Values* | *Motion* | *Gyro* | 0.020 degrees |
| | | *Heave* | 5 % Amplitude |
| | | | 0.050 meters |
| | | *Pitch* | 0.020 degrees |
| | | *Roll* | 0.020 degrees |
| | *Navigation Position* | | 0.500 meters |
| | *Timing* | *Transducer* | 0.005 seconds |
| | | *Navigation* | 0.005 seconds |
| | | *Gyro* | 0.005 seconds |
| | | *Heave* | 0.005 seconds |
| | | *Pitch* | 0.005 seconds |
| | | *Roll* | 0.005 seconds |
| | *Offsets* | *x* | 0.05 meters |
| | | *y* | 0.050 meters |
| | | *z* | 0.050 meters |
| | *MRU Alignment* | *Gyro* | 0.460 degrees |
| | | *Pitch* | 0.060 degrees |
| | | *Roll* | 0.060 degrees |
| | *Vessel* | *Speed* | 0.050 meters/second |
| | | *Loading* | 0.050 meters |
| | | *Draft* | 0.050 meters |
| | | *Delta Draft* | 0.000 meters |
| *Vessel* | S250 Port Pontoon | | |
| *Echosounder* | Reson 7125 400 kilohertz | | |
| *TPU Standard Deviation Values* | *Motion* | *Gyro* | 0.020 degrees |
| | | *Heave* | 5.000 % Amplitude |
| | | | 0.050 meters |
| | | *Pitch* | 0.020 degrees |
| | | *Roll* | 0.020 degrees |
| | *Navigation Position* | | 0.500 meters |

| | | | |
|---|---|---|---|
| | *Timing* | *Transducer* | 0.005 seconds |
| | | *Navigation* | 0.005 seconds |
| | | *Gyro* | 0.005 seconds |
| | | *Heave* | 0.005 seconds |
| | | *Pitch* | 0.005 seconds |
| | | *Roll* | 0.005 seconds |
| | *Offsets* | *x* | 0.05 meters |
| | | *y* | 0.050 meters |
| | | *z* | 0.050 meters |
| | *MRU Alignment* | *Gyro* | 0.710 degrees |
| | | *Pitch* | 0.100 degrees |
| | | *Roll* | 0.100 degrees |
| | *Vessel* | *Speed* | 0.050 meters/second |
| | | *Loading* | 0.050 meters |
| | | *Draft* | 0.050 meters |
| | | *Delta Draft* | 0.000 meters |
| *Vessel* | S250 Starboard Pontoon | | |
| *Echosounder* | Reson 7111 100 kilohertz | | |
| *TPU Standard Deviation Values* | *Motion* | *Gyro* | 0.020 degrees |
| | | *Heave* | 5.000 % Amplitude |
| | | | 0.050 meters |
| | | *Pitch* | 0.020 degrees |
| | | *Roll* | 0.020 degrees |
| | *Navigation Position* | 1.000 meters | |
| | *Timing* | *Transducer* | 0.005 seconds |
| | | *Navigation* | 0.005 seconds |
| | | *Gyro* | 0.005 seconds |
| | | *Heave* | 0.005 seconds |
| | | *Pitch* | 0.005 seconds |
| | | *Roll* | 0.005 seconds |
| | *Offsets* | *x* | 0.00 meters |
| | | *y* | 0.000 meters |
| | | *z* | 0.000 meters |

| | | | |
|---|---|---|---|
| | *MRU Alignment* | *Gyro* | 0.510 degrees |
| | | *Pitch* | 0.160 degrees |
| | | *Roll* | 0.160 degrees |
| | *Vessel* | *Speed* | 0.030 meters/second |
| | | *Loading* | 0.040 meters |
| | | *Draft* | 0.050 meters |
| | | *Delta Draft* | 0.000 meters |

## B.4.2 Deviations

There were no deviations from the requirement to compute total propagated uncertainty.

# C Corrections To Echo Soundings

## C.1 Vessel Offsets and Layback

## C.1.1 Vessel Offsets

### C.1.1.1 Description of Correctors

### C.1.1.2 Methods and Procedures

Sensor offsets are measured with respect to the vessel's reference point. These offsets are derived from the full survey performed in the shipyard, a partial survey performed by NGS personnel and measurements/ verifications performed by FERDINAND R. HASSLER personnel. All necessary offsets are tracked and updated as needed on a spreadsheet to be submitted with the appendices of this report.

The port IMU serves as the reference point for the port-only 7125 HSX configuration, the port 7125 s7k configuration, and the side scan sonar. For all other vessel configurations the starboard IMU is the reference point.

### C.1.1.3 Vessel Offset Correctors

| | |
|---|---|
| *Vessel* | S250 Port |
| *Echosounder* | Reson 7125 400 kilohertz |
| *Date* | 2011-07-20 |

| | | | |
|---|---|---|---|
| *Offsets* | *MRU to Transducer* | *x* | -1.244 meters |
| | | *y* | 0.362 meters |
| | | *z* | 1.486 meters |
| | | *x2* | |
| | | *y2* | |
| | | *z2* | |
| | *Nav to Transducer* | *x* | -2.324 meters |
| | | *y* | -2.333 meters |
| | | *z* | 14.021 meters |
| | | *x2* | |
| | | *y2* | |
| | | *z2* | |
| | *Transducer Roll* | *Roll* | 4.500 degrees |
| | | *Roll2* | |
| *Vessel* | S250 Starboard | | |
| *Echosounder* | Reson 7125 400 kilohertz | | |
| *Date* | 2011-07-26 | | |
| *Offsets* | *MRU to Transducer* | *x* | 1.424 meters |
| | | *y* | 0.380 meters |
| | | *z* | 1.493 meters |
| | | *x2* | |
| | | *y2* | |
| | | *z2* | |
| | *Nav to Transducer* | *x* | 4.503 meters |
| | | *y* | -2.299 meters |
| | | *z* | 14.015 meters |
| | | *x2* | |
| | | *y2* | |
| | | *z2* | |
| | *Transducer Roll* | *Roll* | -4.5 degrees |
| | | *Roll2* | |
| *Vessel* | S250 | | |
| *Echosounder* | Reson 7111 100 kilohertz | | |
| *Date* | 2011-07-20 | | |

| | | | |
|---|---|---|---|
| *Offsets* | *MRU to Transducer* | *x* | 1.203 meters |
| | | *y* | 11.678 meters |
| | | *z* | 1.180 meters |
| | | *x2* | |
| | | *y2* | |
| | | *z2* | |
| | *Nav to Transducer* | *x* | 4.282 meters |
| | | *y* | 8.999 meters |
| | | *z* | 13.702 meters |
| | | *x2* | |
| | | *y2* | |
| | | *z2* | |
| | *Transducer Roll* | *Roll* | 0.000 degrees |
| | | *Roll2* | |
| *Vessel* | S250 | | |
| *Echosounder* | Odom Echotrac CV200 24 kilohertz | | |
| *Date* | 2012-05-01 | | |
| *Offsets* | *MRU to Transducer* | *x* | -0.455 meters |
| | | *y* | 4.620 meters |
| | | *z* | 1.325 meters |
| | | *x2* | |
| | | *y2* | |
| | | *z2* | |
| | *Nav to Transducer* | *x* | 0.000 meters |
| | | *y* | 0.000 meters |
| | | *z* | 0.000 meters |
| | | *x2* | |
| | | *y2* | |
| | | *z2* | |
| | *Transducer Roll* | *Roll* | 0.000 degrees |
| | | *Roll2* | |

## C.1.2 Layback

### C.1.2.1 Description of Correctors

Layback is calculated in CARIS from the cable-out and fish depth. Cable-out is output from a cable counter and recorded in the .sdf file. The side scan cable is marked at 12 meters. On deployment, the cable is payed out until this mark is at the sheave and the counter is reset to zero. A 12 meter offset is applied in Sonar Pro to account for this set amount of cable out. Thus the cable out value in the .sdf file is the correct value for the cable between the tow point and the towfish.

#### C.1.2.2 Methods and Procedures

Layback was calculated from the side scan calibration performed prior to obtaining data.

#### C.1.2.3 Layback Correctors

<table>
<tr><td>Vessel</td><td colspan="3">S250</td></tr>
<tr><td>Echosounder</td><td colspan="3">Klein 5000 455 kilohertz</td></tr>
<tr><td>Date</td><td colspan="3">2011-05-26</td></tr>
<tr><td rowspan="4">Layback</td><td rowspan="3">Towpoint</td><td>x</td><td>7.161 meters</td></tr>
<tr><td>y</td><td>-26.032 meters</td></tr>
<tr><td>z</td><td>-9.347 meters</td></tr>
<tr><td>Layback Error</td><td colspan="2">0.00 meters</td></tr>
</table>

## C.2 Static and Dynamic Draft

### C.2.1 Static Draft

#### C.2.1.1 Description of Correctors

Because of her SWATH design, FERDINAND R. HASSLER is particularly susceptible to loading and trim. While underway, the ballast is actively managed to maintain the draft at the design draft of 3.85 meters. During typical survey operations, HASSLER burns approximately 4,000 liters of diesel per day. At a density of 0.83 kilograms/ liter this is approximately 3.3 metric tons of fuel per day. At design draft of 3.85 meters, 1.3 metric tons is required to submerge an additional 0.01 meters of the hull in salt water. The daily fuel burn would thus account for 0.03 meters of variation in the draft. Ballast is adjusted daily to account for fuel burn and the levels in other tanks. Uncertainty is conservatively estimated at 0.05 meters.

#### C.2.1.2 Methods and Procedures

The waterline to reference point is calculated from the vessel offset survey and the vessel draft marks.

### C.2.2 Dynamic Draft

#### C.2.2.1 Description of Correctors

#### C.2.2.2 Methods and Procedures

An ellipsoidally referenced dynamic draft measurement (ERDDM) was performed following guidelines put forth in the 2011 FPM. The only 2012 ERDDM yet performed had significant errors due to geoid undulation and will be re-run when time allows. Therefore, 2011 values are being used.

For a complete list of the dynamic draft please refer to attached ERDDM_Summary or appropriate HVF.

#### C.2.2.3 Dynamic Draft Correctors

| | |
|---|---|
| *Vessel* | S250 7111 |
| *Date* | 2011-05-01 |

*Dynamic Draft Table*

| *Speed* | 1.000 meters/second | 2.000 meters/second | 3.000 meters/second | 4.000 meters/second | 5.000 meters/second | 6.000 meters/second | 7.000 meters/second | 7.500 meters/second |
|---|---|---|---|---|---|---|---|---|
| *Draft* | -0.100 meters | -0.150 meters | -0.150 meters | -0.130 meters | -0.100 meters | -0.060 meters | -0.030 meters | -0.030 meters |

| | |
|---|---|
| *Vessel* | S250 7125 |
| *Date* | 2011-05-01 |

*Dynamic Draft Table*

| *Speed* | 1.000 meters/second | 2.000 meters/second | 3.000 meters/second | 4.000 meters/second | 5.000 meters/second | 6.000 meters/second | 7.000 meters/second | 7.500 meters/second |
|---|---|---|---|---|---|---|---|---|
| *Draft* | -0.130 meters | -0.190 meters | -0.200 meters | -0.170 meters | -0.130 meters | -0.090 meters | -0.070 meters | -0.080 meters |

## C.3 System Alignment

#### C.3.1 Description of Correctors

#### C.3.2 Methods and Procedures

Methods and Procedures used follow recommendations given in section 1.5 of the 2011 FPM.

## C.3.3 System Alignment Correctors

| | |
|---|---|
| *Vessel* | S250 |
| *Echosounder* | Reson 7125 Starboard 400 kilohertz |
| *Date* | 2012-05-30 |

| | | |
|---|---|---|
| *Patch Test Values* | *Navigation Time Correction* | 0.00 seconds |
| | *Pitch* | -0.02 degrees |
| | *Roll* | 0.05 degrees |
| | *Yaw* | 2.62 degrees |
| | *Pitch Time Correction* | 0.00 seconds |
| | *Roll Time Correction* | 0.00 seconds |
| | *Yaw Time Correction* | 0.00 seconds |
| | *Heave Time Correction* | 0.00 seconds |
| *Vessel* | S250 | |
| *Echosounder* | Reson 7125 Port 400 kilohertz | |
| *Date* | 2012-05-30 | |
| *Patch Test Values* | *Navigation Time Correction* | 0.00 seconds |
| | *Pitch* | 1.10 degrees |
| | *Roll* | -0.01 degrees |
| | *Yaw* | 2.61 degrees |
| | *Pitch Time Correction* | 0.00 seconds |
| | *Roll Time Correction* | 0.00 seconds |
| | *Yaw Time Correction* | 0.00 seconds |
| | *Heave Time Correction* | 0.00 seconds |
| *Vessel* | S250 | |
| *Echosounder* | Reson 7125 Port 200 kilohertz | |
| *Date* | 2012-05-31 | |
| *Patch Test Values* | *Navigation Time Correction* | 0.00 seconds |
| | *Pitch* | -0.28 degrees |
| | *Roll* | -0.03 degrees |
| | *Yaw* | 1.97 degrees |
| | *Pitch Time Correction* | 0.00 seconds |
| | *Roll Time Correction* | 0.00 seconds |
| | *Yaw Time Correction* | 0.00 seconds |
| | *Heave Time Correction* | 0.00 seconds |
| *Vessel* | S250 | |
| *Echosounder* | Reson 7111 100 kilohertz | |
| *Date* | 2012-05-31 | |

| | | |
|---|---|---|
| *Patch Test Values* | *Navigation Time Correction* | 0.00 seconds |
| | *Pitch* | -0.62 degrees |
| | *Roll* | -0.13 degrees |
| | *Yaw* | 1.58 degrees |
| | *Pitch Time Correction* | 0.00 seconds |
| | *Roll Time Correction* | 0.00 seconds |
| | *Yaw Time Correction* | 0.00 seconds |
| | *Heave Time Correction* | 0.00 seconds |

## C.4 Positioning and Attitude

### C.4.1 Description of Correctors

### C.4.2 Methods and Procedures

Vessel navigation and attitude is measured by the POS/MV and recorded in the Hysweep .hsx file and the Reson .s7k file. Pitch is applied real-time to the Reson 7111. Navigation and attitude measurements not applied in real time are applied during post processing in CARIS HIPS using the attitude data recorded in the .hsx or .s7k file.

The POS/MV TrueHeave data is logged within the POS/MV .000 files and applied in CARIS HIPS during post processing using the "Apply TrueHeave" function. TrueHeave is a forward-backward filtered heave corrector as opposed to the real time heave corrector, and is fully described in section 6 of the POS/MV V4 User Guide 2009.

In most cases, PPK data in the form of SBET files are applied to soundings to increase the accuracy of the kinematic vessel corrections and to allow the ability to reference soundings to the ellipsoid. Standard daily data processing procedures include post processing of POS/MV kinematic .000 files using Applanix POSPac MMS and POSGNSS software using either IN-Fusion SmartBase, IN-Fusion SingleBase or Precise Point Positioning (PPP) processing modes. After processing and quality control analysis of the post-processed SBET files is complete. the SBET and SMRMSG files are applied to the HDCS data in CARIS HIPS using the "Load Attitude/Navigation Data" and "Load Error Data" processing tools, respectively.

## C.5 Tides and Water Levels

### C.5.1 Description of Correctors

### C.5.2 Methods and Procedures

Unless otherwise noted in the survey Descriptive Report (DR) and/or project Horizontal and Vertical Control Report (HVCR), the vertical datum for all soundings and heights is Mean Lower Low Water (MLLW). Predicted, preliminary, and/or verified water level correctors from the primary tide station(s) listed in the Project Instructions may be downloaded from the CO-OPS website and used for water level corrections during the course of the project. These tide station files are collated to include the appropriate days of acquisition and then converted to CARIS .tid file format using FetchTides.

Water level data in the .tid files are applied to HDCS data in CARIS HIPS using the zone definition file (.zdf) or a Tidal Constituent and Residual Interpolation (TCARI) model supplied by CO-OPS. Upon receiving final approved water level data, all data are reduced to MLLW using the final approved water levels as noted in the individual surveys DR.

A complete description of vertical control utilized for a given project can be found in the project specific HVCR, submitted for each project under separate cover when necessary as outlined in section 5.2.3.2.3 of the FPM.

Newer methods for handling vertical control are being developed and, if utilized, will be explained in more detail in the project wide HVCR or survey DR.

## C.6 Sound Speed

## C.6.1 Sound Speed Profiles

### C.6.1.1 Description of Correctors

### C.6.1.2 Methods and Procedures

Seabird .cnv and MVP .bot files are collected when necessary and converted to .svp files using NOAA's Pydro/Velocipy program. These .svp files are concatenated into one vessel specific master file per project which is then applied to HDCS data using a specified method. This method of applying sound speed to data is listed in the sheets processing log included in the Separates submitted with the individual survey.

## C.6.2 Surface Sound Speed

### C.6.2.1 Description of Correctors

Surface sound speed is applied in real time as discussed in the equipment section and is not corrected for in post-processing.

### C.6.2.2 Methods and Procedures

n/a

## D. APPROVAL SHEET

This Data Acquisition and Processing Report for project S-C919-FH-12, IOCM NY Canyon is respectfully submitted.

As Chief of Party, I have ensured that standard field surveying and processing procedures were adhered to during these projects in accordance with the Hydrographic Surveys Specifications and Deliverables (4/2012), Hydrographic Survey Technical Directive HTD 2011-3, 2012-1, 2012-2 and the Field Procedures Manual for Hydrographic Surveying (4/2012).

I acknowledge that all of the information contained in this report is complete and accurate to the best of my knowledge.

This DAPR applies to surveys H12490 and H12491 which was completed in 2012 for Project C919.

Approved and Forwarded:

Samuel Greenaway

Digitally signed by Samuel Greenaway
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Date: 2012.08.24 12:03:00 Z

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LCDR Benjamin K. Evans, NOAA
Chief of Party