W00201

NOAA FORM 76-35A

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

DESCRIPTIVE REPORT

Type of Survey: **Benthic Habitat and Hydrographic**

Registry Number: **W00201**

LOCALITY

State: **N/A**

General Locality: **Navassa National Wildlife Refuge**

Sub-locality: **35 mi West of Haiti**

2006

CHIEF OF PARTY
Greg Piniak

LIBRARY & ARCHIVES

DATE

NOAA FORM 77-28 (11-72) U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	REGISTRY NUMBER:
HYDROGRAPHIC TITLE SHEET	**W00201**

INSTRUCTIONS: The Hydrographic Sheet should be accompanied by this form, filled in as completely as possible, when the sheet is forwarded to the Office.

State:	**N/A**		
General Locality:	**Navassa National Wildlife Refuge**		
Sub-Locality:	**35 miles West of Haiti**		
Scale:	**1:15,000**	Date of Survey:	**4/18/2006 to 5/1/2006**
Instructions Dated:	**05/01/06**	Project Number:	**NF-06-05-NAVAS**
Change No.3 Dated:	**17 April 2006**		
Change No.2 Dated:	**N/A**		
Vessel:	**NOAA Ship *Nancy Foster*, R-352**		
Chief of Party:	**Greg Piniak, NOS/CCFHR/AERRB**		
Surveyed by:	**NOAA Ship *Nancy Foster* Personnel**		
Soundings by:	**Kongsberg Simrad EM 1002**		
Graphic record checked by:	**N/A**		
Protracted by:	**N/A**	Automated Plot:	**N/A**
Verification by:	**Atlantic Hydrographic Branch Personnel**		
Soundings in:	**Meters at MLLW**		

Remarks:
1) All Times are UTC.
2) This is a Basic Navigable Area Hydrographic Survey.
3) Projection is UTM Zone 18.

Data Acquisition & Processing Report

Type of Survey: Benthic Habitat and Hydrographic

Project No. NF-06-05-NAVAS

Time Frame: April 18 – May 1, 2006

Localities

Navassa National Wildlife Refuge

35 miles West of Haiti

2006

Chief Scientist

Greg Piniak

Lead Hydrograher

Mike L. Stecher

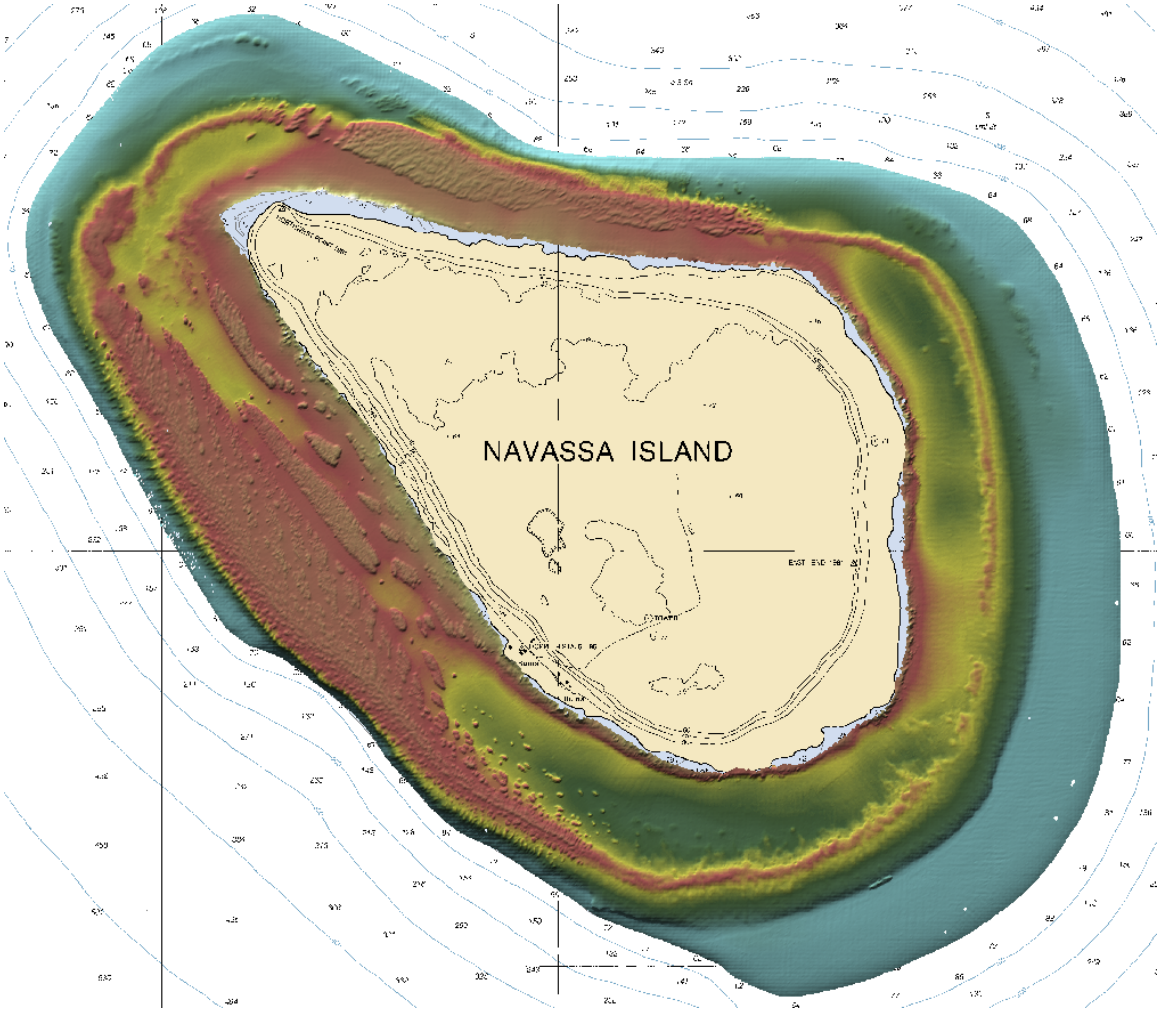
Data Acquisition & Processing Report

NF-06-05-NAVAS

April 18 – May 1, 2006

Navassa National Wildlife Refuge

NOAA Ship NANCY FOSTER



Chief Scientist

Greg Piniak

Lead Hydrograher

Mike L. Stecher

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Appendices

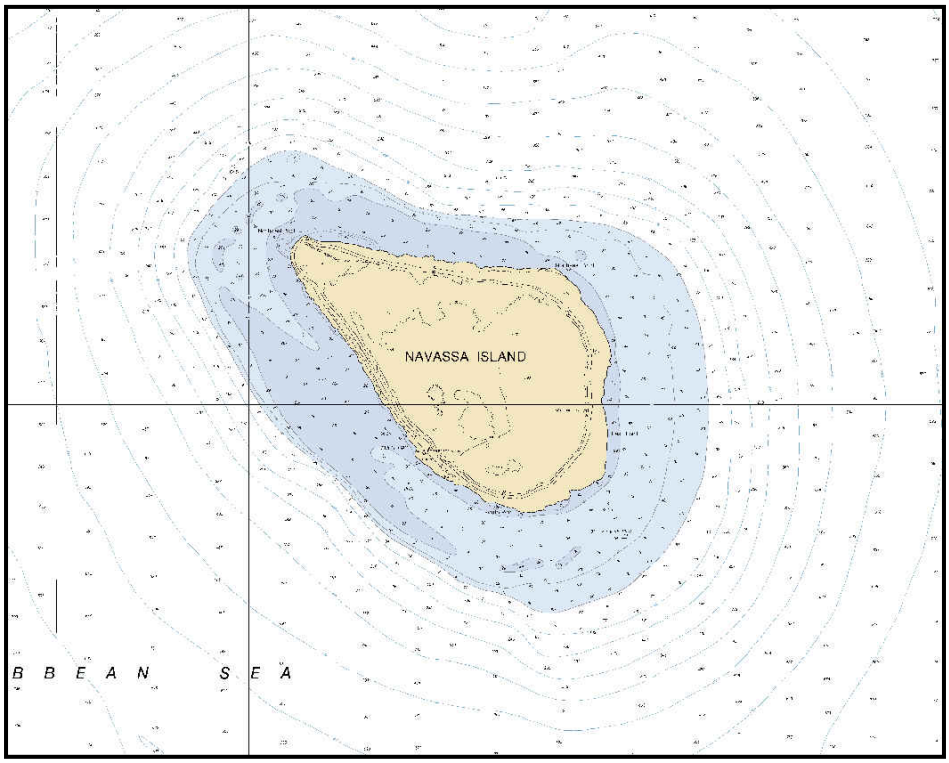
I. Background

In 1999, Navassa Island was designated as a National Wildlife Refuge under the jurisdiction of U.S. Fish and Wildlife Service (USFWS). Navassa is a small (5 km^2) uninhabited island west of Haiti, largely inaccessible except for a small and precarious landing at Lulu Bay. Navassa Island has a very energetic coastal wave environment, particularly the exposed east coast. Possibly intense, but largely unquantified artisanal fishing pressure from nearby Haiti may be affecting the biodiversity and reducing the fish stocks. Much of the coral reefs of Navassa Island on the deep slopes below 30 meters are as yet unexplored. The National Oceanic and Atmospheric Administration's (NOAA) Center for Coastal Fisheries and Habitat Research Team conducted the scientific research mission on board the NOAA ship NANCY FOSTER from April 18 to May 1, 2006. The purpose of this cruise is to support the benthic characterization of coral reef habitat in the Navassa Island National Wildlife Refuge

II. Area

The mission surveyed and mapped moderate depth bathymetry (30 – 1000 meters) with the NANCY FOSTER's Simrad EM1002 multibeam system for natural resource management and seafloor characterization in the immediate proximity of Navassa Island. Multibeam bathymetry and backscatter was collected along with diver surveys. Although multibeam data was collected to conform to IHO Order 1 (<100m) and Order 2 (>100m) accuracy standards, the was data was not corrected for tidal influences and is therefore not in complete compliance with IHO standards. The figure below identifies the priority survey area for 2006. The coordinates bounding the area at Navassa Island are 18°43'N - 75°05'W to the northwest, and 18°37'N - 74°57'W to the southeast and encompass approximately 102 square kilometers, or 40 square miles. ***See Evaluation Report.***

Fig 1: 2006 Priority Project Area – Navassa Island



III. Equipment

Vessel

The NOAA Ship NANCY FOSTER (R352) is 57 meters in length, has a beam of 12 meters and draws approximately 3 meters of water. During the Charleston, South Carolina drydock period in November of 2005, numerous survey hardware and software installations were implemented by NOAA's Aviation and Marine Operations division (NMAO) to make multibeam data acquisition a more integral component of the ship's research support. NMAO funded the permanent installation of a Simrad EM1002 multibeam sonar, an Applanix POS/MV positioning system and other ancillary sensors and support equipment. A Sea Acceptance Test (SAT) was performed prior to the NF-06-03 cruise by representatives from Kongsberg and the Office of Coast Survey. For more details on the performance review of the multibeam system please refer to the Hydrographic Systems Readiness Review (HSRR) for the NOAA Ship Nancy Foster, 2006. The NF-06-05-NAVAS cruise was the second research mission to implement the Nancy Foster's multibeam system. ***Concur.***

Sonar System

The Simrad EM1002 multibeam echosounder is permanently hull-mounted between two fiberglass hydrodynamic fittings starboard of the keel line, aft of the bow. The EM1002 is a 95-kHz system with a 150° swath consisting of 111 individually formed, electronically roll-stabilized 2° beams, at a maximum ping rate of 10Hz, depending on water depth. The EM1002 has three different automatically adjusted pulse lengths to maximize coverage in deeper waters at 0.2, 0.7 and 2 milliseconds respectively. A combination of phase and amplitude detection is used, resulting in measurement accuracy practically independent of beam angle. The system is compensated in real-time for sound velocity changes at the transducer array, to assist in the electronic beam steering capabilities of the EM1002.

Fig 2: EM1002 transducer fairing

Fig 3: EM1002 transducer

The EM1002 sonar system is controlled with a UNIX based operator system (SUN Solaris 8) that utilizes the Common Desktop Environment and Kongsberg's MERLIN V 5.2.2 acquisition and control program. Before surveying commenced and periodically thereafter, the EM1002 system self-test (BIST test) was performed to confirm the sonar's operating status. Sonar errors were not observed during the survey. As per advice from the Kongsberg representative during the SAT, the automatic and default parameters were used to control the sonar during data acquisition. The EM1002 backscatter default options were verified with Adel Sterling and the Hawaii Mapping Resource Group who have extensive experience aquiring backscatter imagery with the EM1002 system onboard the R/V KILO MOANA. The equidistant beam spacing mode was chosen to give a uniform distribution of soundings on the seafloor. The ping rate was set by the system and was automatically adjusted according to the depth below the transducer. Only limited runtime parameters changed during the survey including the maximum port and starboard angles, which did not exceed 55°. Sound velocity profiles were acquired approximately every four hours throughout the survey. See *Appendix A* for the EM1002 Runtime & Installation Parameters Reports. Versions of all hardware and software used for this survey can be found in *Appendix B*. ***Concur.***

Motion Reference Unit

The Applanix Model POS/MV Model 320 V4 (POS) is a GPS-aided inertial measurement unit (IMU) that generates attitude data in three axes. Measurements of roll, pitch and heading are all accurate to ± 0.02° or better, regardless of the vessel latitude. Heave measurements supplied by POS maintain an accuracy of 5% of the measured vertical displacement or ± 5cm (whichever is the larger) for periods of 20 seconds or less. The accuracy and stability of measurements delivered by the system remain unaffected by vessel turns, changes of speed, wave-induced motion, or other dynamic maneuvers. The IMU is located on the Hold Deck in the Forepeak Void; refer to Appendix H for vessel diagram. Position and motion data were supplied from the POS system via serial communications to the Processing Unit (PU). Com Port 2 was configured to supply motion data at an update frequency of 100 Hz to the EM1002 sonar for real-time motion compensation. The heave bandwidth was set to 18.0 seconds with a dampening ration of .707. Roll, pitch, and heave positive sense were port up, bow up, and heave up respectively. The multipath was set to low, due to the ideal placement of the two GPS antennae. The POS/MV software settings are documented in *Appendix C*. ***Concur.***

Fig 4: Inertial Measurement Unit

Positioning System

The POS/MV Model 320 V4 obtains its positions from two identical dual frequency Trimble Zephyr GPS antennae. An ancillary Trimble DSM 132 DGPS system provided an RTCM data stream to the POS. The two POS antenna are located above the bridge deck on the starboard side; refer to Appendix H for vessel diagram. The DSM 132 received Omnistar differential GPS service on the frequency designated for South America and Asia at (1535.1375 kHz). The POS also provided the pulse per second (PPS) strobe that EM1002 uses to continually synchronize the internal system clock to UTC time. The POS computes GPS heading by performing carrier phase differential measurements between the two GPS antennae. Position updates were supplied from the POS/MV to the PU of the EM1002 system via serial communications at a frequency of 10 Hz. ***Concur.***

Fig 5: GPS Antenna configuration

Sound Velocity

The NANCY FOSTER is equipped with a hull-mounted SBE 45 thermosalinograph (TSG), near the EM1002 transducer. The TSG measures near-surface conductivity and temperature in order to calculate sound velocity in real-time. The data from the TSG streamed to the EM1002's MERLIN acquisition and control software to aid in electronic beam steering. The primary instrument for determining sound velocity throughout the entire water column was a Seabird Electronics SBE-911 CTD instrument. An auxiliary SBE-19 was used for calibration verification and could be deployed in the event of a primary system failure. Sound velocity casts were deployed approximately every four hours during survey operations. Sound velocity casts were processed with NOAA's Velocwin V8.80 software. Processed casts were converted to Simrad format (*.asvp) and uploaded to the MERLIN acquisition and control software. The NANCY FOSTER's hydraulic winch was rigged through the block of a J-Frame davit, which provided a consistent rate of descent for acquisition of the sound velocity data. Calibration reports from SEA-BIRD Electronics are documented in *Appendix D.* ***Concur.***

Acquisition System

The Kongsberg MERLIN V5.2.2 acquisition and control system is based on the Sun Microsystems Solaris 8 UNIX operating system. The MERLIN system integrated the auxiliary sensors with the sounding data from the PU to create "datagrams". The datagrams combine the positioning, attitude, sound velocity and sounding data. The data was logged in the *.all format. Coastal Oceanographics Hypack Max V.4.3A provided the navigation information to the helms display and was used to create line plans for the surveyed areas. Coverage BASE surfaces were created from 3m to 10m resolutions, depending on depth, in CARIS's 6.0 HIPS and SIPS (SP1 HF1-18) during data

acquisition to verify coverage. The BASE surfaces were then exported in GEOTIFF format to the HYPACK PC to create holiday line plans and additional lines. ***Concur.***

IV. Quality Control

The Simrad raw multibeam format (*.ALL) combines positioning data, attitude data, sound velocity correctors, sonar offset values, and is corrected for the outer beam angle offset. The HIPS Conversion Wizard uses the Simrad format to convert the multibeam data into HDCS data files. During the conversion process a depth limit of 1000m was applied to reject any soundings that exceeded the depth rating of the EM1002. The vessel configuration used for the survey area data conversion was the R352_MB.hvf file. This file included the patch test results (Obtained from the previous cruise NF-06-03), dynamic draft, waterline and the Total Propagated Error (TPE) values (HVF & TPE Report, *Appendix E*). The Navassa Island data was projected to the North American Datum of 1983, Universal Transmercator Zone 18, Northern Hemisphere (NAD83 UTM18N). All the acquired data was converted and preliminary processing occurred in the field. ***Concur.***

Preliminary data processing consisted of: Application of zero tides, navigation editing, attitude editing, swath data editing and subset editing. Navigation edits included reviewing for time jumps greater than 0.2 seconds and removing data in vessel turns. Attitude data was reviewed for gaps, and none were identified. Swath filtering occurred prior to editing and was used to eliminate large outliers in the water column with a depth filter, minimum and maximum filter depths varied by survey area. If the there was adequate coverage from neighboring swaths, then across track filters were used to limit the swath's outer beams. During processing of the data in Swath Edit mode, soundings were removed from down-sloping beams where the survey lines crossed over the reef escarpment providing unreliable soundings. ***Concur.***

The Hips Subset Editor was the second phase of editing. Subset editing enabled the hydrographer to evaluate each swath against its neighboring swath while identifying sounding artifacts. The verification of features from adjacent lines as well as feature alignment also confirms the sensor offsets. BASE surface were created to identify systematic errors or artifacts within the data set that could be further investigated with the swath or subset editor. The Bathymetry Associated with Statistical Error (BASE) surfaces created from the merged and TPE calculated soundings are georeferenced images of a multi-attributed, weighted mean surface. The BASE surface uses a combination of range, uncertainty and swath angle weights to assign nodes depth values for creating the seabed surface. The BASE surface images were reviewed with multiple resolutions, sun angles, sun azimuths and vertical exaggerations. The BASE surface routine produced images identifying depth, shoal-biased depth, deep-biased depths, mean depths, standard deviation, sounding density, and depth uncertainty. During acquisition in the field, editing steps were expedited to create BASE surface to confirm adequate multibeam coverage for the survey area. The contract Lead Hydrographer completed final processing of the datasets after the completion of field operations.

Refer to *Appendix F* for a multibeam processing flow chart. The following image depicts the areas surveyed by the Depth BASE surface. ***Concur. See Evaluation Report.***

Fig 6: Completed 2006 bathymetry coverage, shown as 10m grid, Navassa Island.

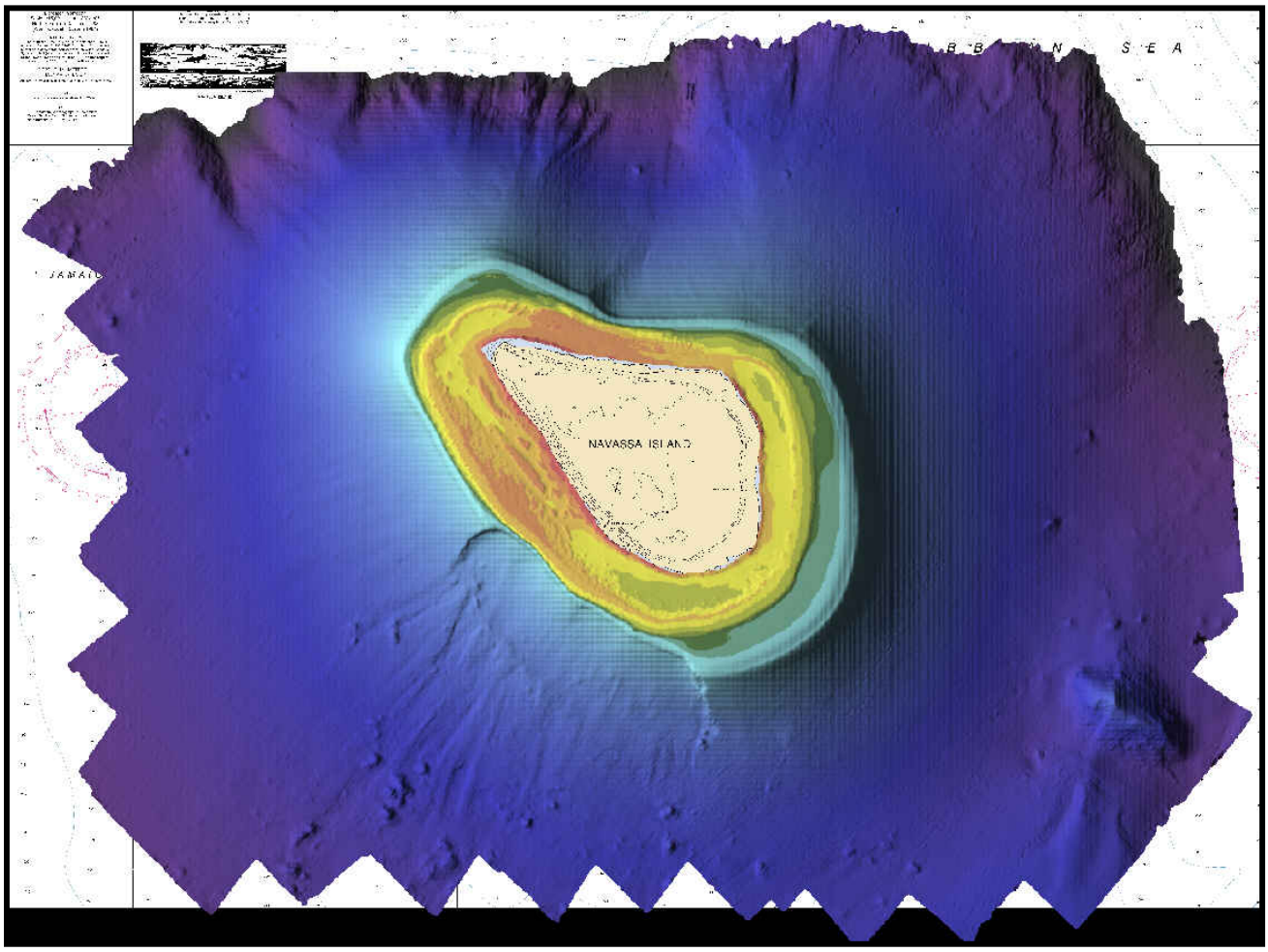


Image resolutions were built to measure the success of achieving multibeam coverage for the survey areas according to section 5.2.3 in the NOAA Specs and Deliverables:

Table 1: BASE Surface Resolutions and Depth Ranges

Resolution (meters)	Depth Ranges (meters)
3m (resolution mapped in field)	29m to 60m
5m	59m to 150m
10m	Deeper than 149m

Multiple BASE surfaces were created for each survey area to demonstrate multibeam coverage according to the previously mentioned section 5.2.3. Final BASE surfaces were generated by weighting the sounding's grazing angle with the seabed. The Hips Export Wizard produced 24-bit sun-illuminated geo-referenced images of the BASE depth

surfaces and ASCII XYZ text exports, at resolutions in accordance with the depth limits for each survey area. ***See Evaluation Report.***

V. Corrections to Echo Soundings

Instrument corrections

An initial leadline confidence check was measured against the multibeam echosounder prior to the start of field operations on April 18, 2006 at the United States Coast Guard Pier in San Juan, Puerto Rico. The purpose of this check was to verify the system during static conditions by confirming that the digital depths being recorded reflected the actual depths. A sound velocity cast was performed at the site and uploaded to the EM1002. The leadline was performed approximately 3 meters starboard of the EM1002. The sonar's MERLIN acquisition system was logging data while the leadline was performed. The CARIS Swath Editor was then used to verify the EM1002 depth soundings. Soundings were queried approximately 3-4 meters to starboard of the nadir beam with values ranging from 6.2m to 6.4m. The average of four leadline depths returned a value of 6.2m. No instrument correction was applied because of insufficient evidence of systematic error. ***Concur.***

Sensor Offsets

On the February 7th, 2006 the NOAA Ship NANCY FOSTER had her sensor offsets surveyed by the Power & Control Systems Group of L3 Communications. The IMU, GPS antennas, EM1002 transducer and the center of motion were surveyed with respect to the RP of the vessel. The values obtained from the survey are documented in *Appendix G & H*. These offsets were entered into the MERLIN acquisition software, POS/MV software and into the TPE section of the Vessel Configuration File during the SAT trials in March of 2006. These values were also checked and verified prior to data acquisition for this cruise. The offsets used for the positioning system and sonar are documented in the POS/MV Configuration Report and the EM1002 Installation Parameters report (*Appendix A & C*). ***Concur.***

Static and Dynamic Draft Corrections

Static draft values were obtained from visual observations of the Projection Draft marks on the starboard side of the NANCY FOSTER. The static draft correction recorded on April 18, 2006 was 12.1ft while tied up at the United States Coast Guard facility in San Juan, Puerto Rico. Subtracting the initial draft value of 12.1ft from the fixed offset (1.68m) for the Reference Point to the EM1002 gives the final draft reading of -2.01m, which was entered into the MELIN software and confirmed with the leadline procedure previously discussed. On May 1st 2006, while tied up at the pier facility in Puerto Plata, Dominican Republic, the static draft was recorded at 11.4ft. Over the fourteen days underway, a total of 0.7 tenths of a foot of draft was lost to water and fuel consumption. This information was entered into the R352_MB vessel configuration file under "waterline height", as 0.015m per day of draft change.

The dynamic draft survey was performed during the Sea Acceptance Test (SAT) offshore of Charleston, South Carolina in March of 2006. Representatives from the NOAA Aviation and Marine Operations (NMAO) performed the survey and evaluated the results. The dynamic draft was determined using the reference surface method as per the NOS Field Procedures Manual. Results of the dynamic draft survey were entered into the CARIS vessel configuration file, R352_MB.hvf. Refer to *Appendix I* for further information on draft corrections. ***Concur.***

System Alignment and Calibrations

System Alignment and calibration procedures are fully documented in *Appendix I*, the NF-06-03 Multibeam Calibration Procedures & Patch Test Report. The Lead Hydrographer was onboard for both of the cruises NF-06-03, & NF-06-05-NAVAS. The cruise in which the patch test procedure was performed (NF-06-03) was two weeks prior to the NF-06-05-NAVAS cruise. The Lead Hydrographer confirmed that no instrumentation or mounting configurations were changed during the interim with the resident Survey Technician, Dan Boles. The calculated patch test values for roll, pitch and yaw were entered into the R352_MB vessel configuration file. ***See Evaluation Report.***

Tide Corrections

Due to the remoteness of Navassa Island from existing water level stations, tidal data was not supplied by NOAA CO-OPS. It was determined that any tidal zoning would be inaccurate, and may have caused more data artifacts than they would have resolved. Utilizing Real-Time Kinematic GPS techniques was discussed for vertical control, but restricted access to the island and project time limitations deemed tidal control impossible. ***Concur.***

VI. Statement of Accuracy and Suitability for Charting

There is no tidal control for the multibeam data collected on this cruise, official use of the data for charting is not recommended. The data should primary be used as a tool for researchers to understand the surrounding bathymetry of Navassa Island. If it is determined that the use of this bathymetry should supersede data that is used for the Navassa Island chart, it should be used with caution. ***See Evaluation Report.***

Assessment of horizontal control

Positioning equipment and methods

The horizontal datums for this project is the North American Datum of 1983 Universal Transmercator Zone 18, Northern Hemisphere (NAD83 UTM18N). Differential GPS (Omnistar) corrected positions were supplied to both the POS/MV and HYPACK systems. Both systems have visual alarms to notify the operator if the DGPS fix is lost or if HDOP values of 4.0 are exceeded; none were observed. Differential corrections were received from Omnistar at a frequency of 1535.1375 kHz with the Trimble DMS 132 receiver. ***Concur.***

Quality control

A position check between two independent DGPS systems was observed and recorded with HYPACK on April 18, 2006 while docked at the USCG Pier facility in San Juan, Puerto Rico. The Trimble DMS 132 was logged as a raw DGPS positions with no offsets applied. The POS/MV DGPS data was logged with the offsets positioning the vessel at the Reference Point (RP). Both system's DGPS data were collected for at least one minute. The distance measured between the two averaged DGPS positions was approximately 7.0m. The distance calculated from the PacOrd survey was 7.15m. The consistent positioning between the two systems falls well within DGPS positioning standards. ***Concur.***

Statement of accuracy and compliance with HSSDM

Based on a combination of the positioning system confidence check, real-time tolerance monitoring and seafloor feature alignment, the Hydrographer feels that the Horizontal Control should be considered adequate for the purposes of this survey. ***Concur.***

Assessment of vertical control

As stated previously, there is no tidal data available for this bathymetric survey. ***Concur.***

Assessment of sensors

Ancillary sensors

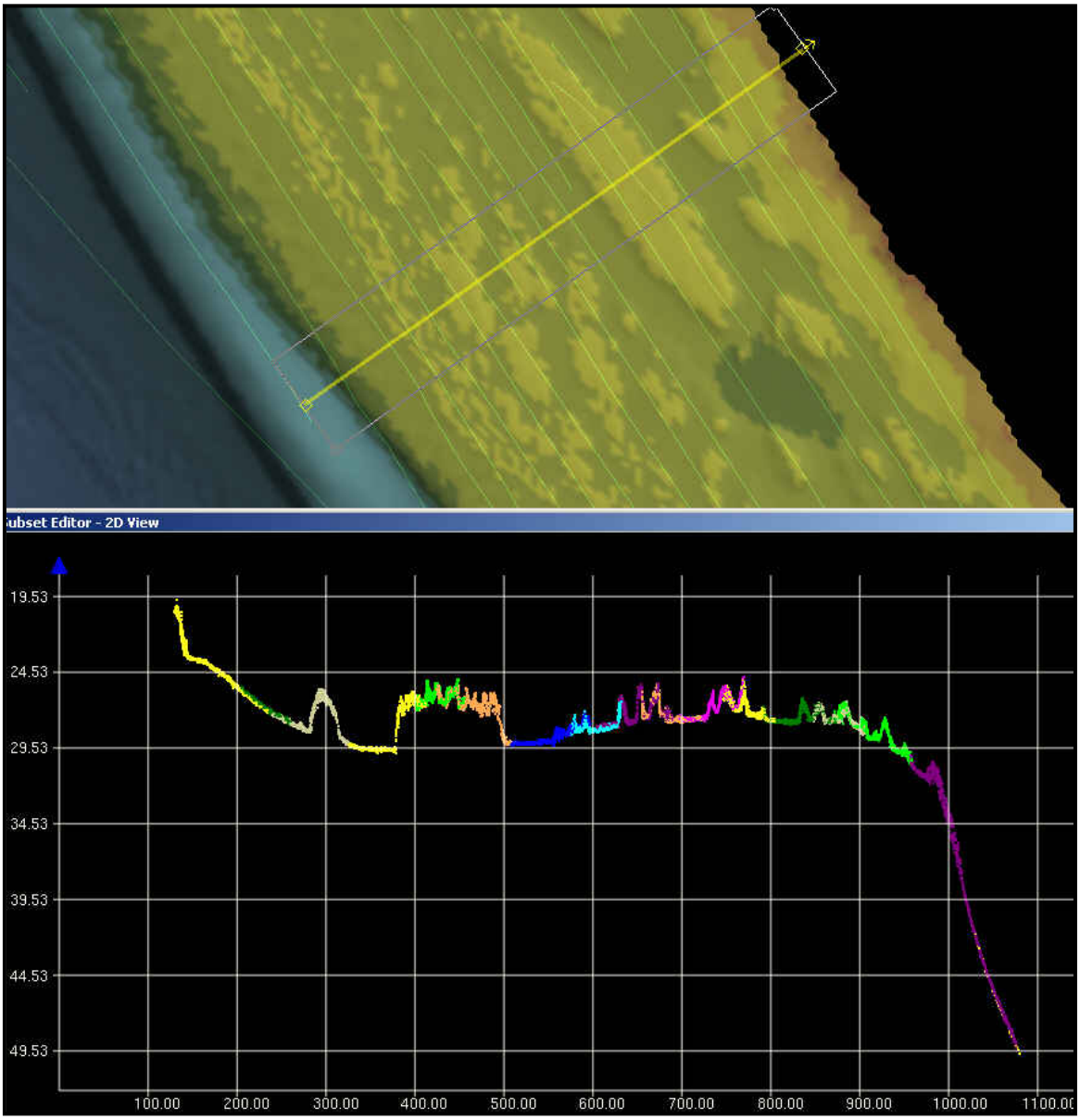
Sound velocity profiles were acquired using the NANCY FOSTER'S SeaBird Electronics SBE911 Conductivity, Temperature, and Depth (CTD) profiler (S/N 9P32146-0731). A back-up SBE 19 (S/N 192472-0285) was used to verify the calibration coefficients of the primary sound velocity profiler. Raw CTD data was processed using NOAA's Velocwin V8.8 software, which generated the sound velocity profiles required for real-time corrections in the MERLIN acquisition system. Casts were recorded to the full depth of the area being surveyed.

The speed of sound through the water was determined by a minimum of one cast every four hours during multibeam acquisition. In general the CTD casts showed the water column to be well mixed both spatially and temporally. Periodic comparisons between recent cast data were observed during the survey using Excel software. The primary CTD was calibrated against the backup unit prior to the commencement of survey operations. Each unit had been calibrated prior to use for this survey; refer to Appendix D for the SBE calibration reports. ***Concur.***

Assessment of Patch Test and Results

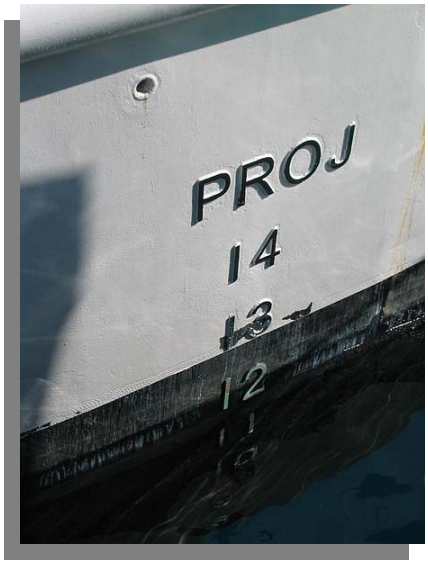
The Hydrographer believes that the values of the latency, pitch, roll and gyro offsets in both a shallow water and deep water setting, coupled with a thorough review of the patch test lines in Caris HIPS HDCS editor, adequately meet the requirements for the patch test. The Hydrographer is confident in the values derived from the patch test for sensor alignment. The following image represents an area of feature alignment that was collected with six lines of multibeam data. ***Concur.***

Fig 10: Features mapped with the EM1002 multibeam



Assessment of Dynamic and Static Draft

Dynamic draft values for the NANCY FOSTER were performed during the Sea Acceptance Test (SAT) offshore of Charleston, South Carolina in March of 2006. Representatives from the NOAA Aviation and Marine Operations (NMAO) performed the survey and evaluated the results. Four-RPM levels were used to determine the dynamic draft: 790, 1000, 1300 and 1600. The observed changes in draft were negligible, with a maximum corrector of 0.041m. The values of the dynamic draft were entered into the R352_MB.hvf and were applied during the merge process in CARIS.



Static draft (waterline) observations were made from the pier the day of departure from San Juan under full load and from the pier at the end of the cruise in Puerto Plata. Subtracting the RP from the projection draft markings on the starboard side of the NANCY FOSTER gave the draft to be used in the MERLIN software (-2.01m). A total loss of .213m was observed during the cruise, this value was divided into the 13 days of underway time (0.015m/day) and entered into the R352_MB.hvf vessel configuration file. The initial draft value was verified with a lead line observation while tied up in San Jaun, Puerto Rico. Appendix D includes detailed information regarding the dynamic, static and leadline values. The Lead Hydrographer feels that the dynamic and static draft corrections are adequate for this survey. ***Concur.***

Fig 12: Projection Draft markings

Assessment of Horizontal and Vertical offsets

Sensor Offsets

The Power & Control Systems Group (PacOrd) surveyed the offsets to a maximum error of +/-5cm, with most of the critical offsets measured to within +/-0.5cm. Maximum errors of the angles surveyed did not exceed +/-1.0°. During the Sea Acceptance Trials (SAT), Chuck Hoeing (Kongsberg Rep), Nick Forfinski from NMAO and the Lead Hydrographer verified the sensor offset inputs for the EM1002, POS/MV and the CARIS R352_MB vessel configuration file. Refer to the 2006 Hydrographic Systems Readiness Review (HSSR) for the NANCY FOSTER for more information. ***Concur.***

Assessment of Sensor Calibrations

Each sensor associated with this survey underwent one form of calibration prior to commencement of survey operations. The multibeam sonar and offsets were calibrated with a leadline and position checked while docked at the USCG Pier San Juan, Puerto Rico. This data was digitally recorded to verify that the proper offsets and draft corrections were being applied to the multibeam data. The offsets to these systems were accurately measured during the PacOrd offset survey and verified by the Lead Hydrographer as well as participating hydrographers. The position checked well within DGPS position standards of +/-10meters. The CTD was verified against the backup unit and both received calibrations by the manufacturer within the previous year. The calibration for all systems including mounting angle offsets for the sonar system (Patch Test), occurred during the SAT trials, and were confirmed again with the documented NF-03-06 cruise calibration procedures. Based on these results the Lead Hydrographer feels that all the systems are adequately calibrated for the purpose of this survey. ***Concur.***

Assessment of Object Detection

The EM1002 system's sonar ping rates are controlled automatically and are dependent on water depths. During acquisition, outer beam overlap was planned at 10%. The goals of the survey were to meet object detection requirements that satisfy IHO Order 1 in waters shoaler than 100m and IHO Order 2 deeper than 100m. ***Concur.***

Bottom Coverage and Line Spacing

The survey lines are typically planned parallel to the general contours of the survey area. Line spacing was determined by depth using 10% overlap with 45° cutoff angles, port and starboard, for the majority of the areas surveyed. While surveying the shelf areas a 55° swath limit was used for the port and starboard beams to maximize coverage. Holiday lines were planned according to BASE surfaces created in the field. The resolutions for creating holiday plans were 3m for the shelf regions and 10m for depths generally greater than 100m. Preliminary review of the data in the field by the Lead Hydrographer determined that the bottom coverage and line spacing were considered adequate for the purposes of this survey. During final evaluation of the 3m BASE surface during post processing, several small areas of holidays were identified in the Navassa Island shelf regions from insignificant overlap from neighboring swaths. ***See Evaluation Report.***

Vessel speed

Survey operations were primarily conducted at a vessel speed of approximately 4.5 knots for deep water and approximately 6 knots for the shallow shelf regions of Navassa Island. The Field Operations Officer (FOO) of the NOAA ship THOMAS JEFFERSON, which also operates an EM1002 echosounder, supplied speed and ping rate tables for the EM1002. This table was designed to meet the requirement of the NOAA Specs and Deliverables section 5.2.2: "The hydrographer shall ensure that the vessel speed is adjusted so than no less than 3.2 beam foot prints, center-to-center, fall within 3 m, or a distance equal to 10 percent of the depth, whichever is greater, in the along track direction". Vessel speeds were adjusted to follow this table and to meet project requirements. Additionally, survey speeds were decreased during periods of heavy seas. In the opinion of the Lead Hydrographer, the vessel speeds and the sonar parameters used in this survey adequately ensonified the seafloor. ***Concur.***

Assessment of IHO Compliance and Quality Control Report

Crosslines totaling approximately 5% of mainscheme were surveyed for the Navassa Island region. The CARIS generated Quality Control Report compares the crosslines for each project against the 10m Depth BASE surface. The graphs in *Appendix J* are a cumulative representation of the IHO compliance of all the crosslines run for each region against the BASE surface. The results of the QC report are based on individual HDCS soundings from the crosslines, to a BASE surface created from the mainscheme data. Comparing HDCS crossline data to a mainscheme BASE surface may introduce, or reduce, errors, depending on results of comparisons between surfaces and individual soundings. As of the date of this document creation, the Rob Hare error model has not been created for the NANCY FOSTER. ***Concur.***

VII. Summary Of Submitted Data:

The following documentation and data will accompany this survey upon completion:

Data

- Raw multibeam sonar sounding files in ALL format
- Processed multibeam sounding files in CARIS HDCS format
- Raw and processed sound velocity data files
- XYZ files
- Sun-Illuminated GeoTiffs
- CARIS Hydrographic Vessel File (HVF)
- CARIS Session Files
- CARIS Fieldsheets

Approval Sheet (Separate Signed Document Verifying DAPR information)
APPROVAL

As Lead Hydrographer, I have ensured that standard field surveying and processing procedures were followed during this project in accordance with the Hydrographic Manual, Fourth Edition; Hydrographic Survey Guidelines; Field Procedures Manual, and the NOS Hydrographic Surveys Specifications and Deliverables Manual, as updated for 2003.

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

Approved and Forwarded: _____

APPENDIX A:

EM1002 Installation and Runtime Parameters

EM1002 installation parameters NOAA SHIP NANCY FOSTER Cruise# NF-06-05-NAVAS

```
Software:
---------
SPTX : 1.0.6 991014
SPRX : 1.0.6 991014
BSP  : 1.5.5 050809
PU   : 2.2.1 031031
Hull Unit Included: No

Motion Sensor:
----------------
Source = Attitude Sensor, Port 2
Starboard Pos. = 0.00
Forward Pos.   = 0.00
DownwardPos.   = 0.00
Sensor Delay   = 0
Roll Offset    = 0.00
PitchOffset    = 0.00
Heading Offset = 0.00
Roll Ref. Plane= Pitch-Roll Axis Plane

Waterlevel:
-------------
Downward Pos.  = -2.01

Transducer:
--------------
Forward Pos.   = 0.81
Starboard Pos. = 1.86
Downward Pos.  = 1.68
Heading Re Bow = 0.03
Roll           = -0.01
Pitch          = 0.05

Heading:
--------
Source          = Attitude Sensor
Offset          = 0.00
Format          = NMEA HDT
1PPS            = In Use
Clock Offset (s)= 0

# Serial port no. 1
--------------------
Port will read: GGA ZDA
Baud Rate   = 19200 baud
Data Bits   = 8 bits
Stop Bits   = 1 bits
Parity      = None

# Serial port no. 2
--------------------
Port will read: Attitude
Baud Rate   = 19200 baud
Data Bits   = 8 bits
Stop Bits   = 1 bits
Parity      = None

# Serial port no. 3
--------------------
Port will read: None
Baud Rate   = 9600 baud
Data Bits   = 8 bits
Stop Bits   = 1 bits
Parity      = None
```

```
# Serial port no. 4
--------------------
Port will read: None
Baud Rate   = 9600 baud
Data Bits   = 8 bits
Stop Bits   = 1 bits
Parity      = None

# Ethernet
--------------------
Port will read: None

# Clock Synchronization:
-----------------------
Sync. To: External Clock

Active Pos. Sys. on Port 1

# Positioning System on Port 1
------------------------------
Motion Correction = Enabled
Geoid         = WGS_84
Forward Pos.  = 0.00
Starboard Pos.= 0.00
Downward Pos .= 0.00
Pos.Delay     = 0.0
Time To Use   = From Datagram

# Positioning System on Port 3
------------------------------
Motion Correction = Disabled
Geoid         = WGS_84
Forward Pos.  = 0.00
Starboard Pos.= 0.00
Downward Pos .= 0.00
Pos.Delay     = 0.0
Time To Use   = From System

# Positioning System on Port 4
------------------------------
Motion Correction = Disabled
Geoid         = WGS_84
Forward Pos.  = 0.00
Starboard Pos.= 0.00
Downward Pos .= 0.00
Pos.Delay     = 0.0
Time To Use   = From System

# Positioning System on Ethernet
------------------------------
Motion Correction = Disabled
Geoid         = WGS_84
Forward Pos.  = 0.00
Starboard Pos.= 0.00
Downward Pos .= 0.00
Pos.Delay     = 0.0
Time To Use   = From System
```

EM1002 runtime parameters NOAA SHIP NANCY FOSTER
Cruise# NF-06-05-NAVAS

```
# Sounder Main:
---------------
Sounder Mode          = Off
Ping Mode             = Auto

# Sounder Depth is supposed to be within:
-----------------------------------------
Min. Depth             = 1 m
Max. Depth             = 1200 m

# Sector / Beams:
-----------------
Max Port Angle         = 45 deg
Max Starboard Angle    = 45 deg
Max Port Coverage      = 600 deg
Max Starboard Coverage = 600 m

Beam Spacing           = Equidistant
Angular Coverare       = Automatic

Tracking               = Auto

Depth To Normal Incidence    = 60m
Normal Incidence Backscatter = -25dB
Oblique Backscatter          = -25dB

# Sound Speed:
--------------
Sound Speed Profile    = 00011_06069183.98.asvp
Tx Sound Speed         = 1538.7 m/s
Sound Sensor Offset    = 0.0 m
Sound Speed Source     = Probe

# Seabed Imaging:
-----------------
TVG Law Crossover Angle= 25 deg.

# Gain:
------
Absorbtion Coeff.      = 30.00 dB
Range Gate             = Normal

# Filtering:
------------
Slope Filter           = Active
Sector Tracking Filter = Active

# Manual Control:
-----------------
Tx Power               = -10 dB
Fixed Gain             = 30 dB

# Simulator:
------------
Min. Depth             = 50 m
Max. Depth             = 50 m
Slant X                = 0 deg
Slant Y                = 0 deg
```

APPENDIX B:

Hydrographic Hardware/Software Inventory

Systems Inventory	Cruise# NF-06-05-NAVAS			HARDWARE
Equipment type	Manufacturer	Model	Serial #	Firmware
Transducer	Kongsberg/Simrad	EM1002	288	N/A
Transceiver Unit	Kongsberg/Simrad	EM1002	303	N/A
Inertial GPS PCS	Applanix	POS/MV 320 V4	2249	N/A
IMU	Applanix	LN 200	447	N/A
DGPS	Trimble	DSM 132	224096283	3.0
Acquisition PC	Sun MicroSystems	Solaris 8	TT32220431	N/A
SVP	SBE	SBE 911	9P32146-0731	N/A
SVP	SBE	SBE 19	O285	N/A

Systems Inventory	Cruise# NF-06-05-NAVAS		SOFTWARE
Equipment type	Manufacturer	Model	Software Version
Inertial GPS PCS	Applanix	POS/MV 320 V4	3.2
Navigation	Coastal Oceanographics	N/A	4.3A
Acquisition	Kongsberg/Simrad	MERLIN	5.2 V2
Processing	NOAA	Velocwin	8.8
Processing	CARIS	HIPS & SIPS	6.0 SP1 HF 1-18

APPENDIX C:

POS/MV 320 V4 Configuration Report

Input/Output Ports Set-up

COM1
Baud Rate=19200
Parity=None
Data Bits=8 Bits
Stop Bits=1 Bit
Flow Control=None
Output Select=NMEA

NMEA Output=GGA,ZDA,VTG Update Rate=10 Hz Talker ID=IN
Roll Positive Sense=Port UpPitch Positive Sense=Bow UpHeave Positive Sense=Heave Up
Input Select=None

COM2
Baud Rate=19200
Parity=None
Data Bits=8 Bits
Stop Bits=1 Bit
Flow Control
Output Select=Binary

Binary Output Update Rate=100 Hz Frame=Sensor 1 Formula Select=SIMRAD 1000 (Tate-Bryant) Roll Positive Sense=Port UpPitch Positive Sense=Bow UpHeave Positive Sense=Heave Up Input Select=None

COM3
Baud Rate=19200
Parity=None
Data Bits=8 Bits
Stop Bits=1 Bit
Flow Control=None
Output Select=None
Input Select=Base 1 GPS
Base GPS Input

Input Type=RTCM 1 or 9Line=Serial

Ethernet Logging ControlLogging Group Select=111,113 Logging Control
Output Rate (groups 1, 102, 103)=20 Hz

Ethernet Realtime Output ControlOutput Group Select=1,22,3,7,10,111,113 Output Control
Output Rate (groups 1,102, 103)=2 Hz

Events Event 1=Positive Edge Trigger
Event 2=Positive Edge Trigger

GAMS Parameter Setup
Two Antenna Separation (m)=2.253Heading Calibration Threshold (deg)=0.700Heading Correction (deg)=0.000 Baseline Vector

X Component (m)=-2.253 Y Component (m)=0.027 Z Component (m)=0.011

Heave Filter
Heave Bandwith (sec)=18.000
Damping Ratio=0.707

Lever Arms & Mounting AnglesLever Arms & Mounting Angles
Ref. to IMU Lever Arm X (m)=0.737 Y (m)=0.001 Z (m)=-0.125
IMU Frame w.r.t. Ref. Frame X (deg)= -0.009 Y (deg)=-0.006 Z (deg)=0.057
Ref. to Primary GPS Lever Arm X (m)=6.571 Y (m)=-4.740 Z (m)=-16.308
Ref. to Vessel Lever Arm X (m)=0.000 Y (m)=0.000 Z (m)=0.000
Ref. to Centre of Rotation Lever Arm X (m)=-12.295 Y (m)=0.000 Z (m)=-1.965
Sensor Mounting
Ref. to Aux. 1 GPS Lever Arm X (m)=0.000 Y (m)=0.000 Z (m)=0.000
Ref. to Aux. 2 GPS Lever Arm X (m)=0.000 Y (m)=0.000 Z (m)=0.000
Ref. to Sensor 1 Lever Arm X (m)=0.000 Y (m)=0.000 Z (m)=0.000
Sensor 1 Frame w.r.t. Ref. Frame
X (deg)=0.000
Y (deg)=0.000
Z (deg)=0.000
Ref. to Sensor 2 Lever Arm
X (m)=0.000
Y (m)=0.000
Z (m)=0.000
Sensor 2 Frame w.r.t. Ref. Frame
X (deg)=0.000
Y (deg)=0.000
Z (deg)=0.000

Tags, Multipath & AutoStart
Time Tag 1=UTC Time
Time Tag 2=GPS Time
AutoStart=Enabled
Multipath=Low

Statistics POS Version= MV-320,VER4,S/N2249,HW2.7-7,SW03.22-Feb08/06,ICD03.17,OS425B14,IMU2,PGPS13,SGPS13,RTK-0,THV-0,DPW-0
GPS Receivers Primary Receiver=BD950;SN:4520A58693,v.00211,channels:24 Secondary Receiver=BD950:SN:4520A58705,v.00211,channels:24

Statistics
Total Hours=1238.4
Total Runs=31
Average Run (hours)=39.9
Longest Run (hours)=623.0
Current Run (hours)=111.8

Navigator ConfigurationFrame Contol=User Frame Auxiliary GPS Position=NormalPrimary GPS

Measurement=NormalGAMS=unchecked Disable GAMS Solution

POS Internet Address POS Internate Address=010.048.002.012 Subnet Mask=255.000.00.000

Gps Receiver ConfiguratioinPrimary GPS Receiver Primary GPS GPS Output Rate=1 Hz

GPS 1 Port
Baud Rate=9600
Parity=None
Data Bits=8 Bits
Stop Bits=1 Bit

Auto Configuration
Enabled
Secondary GPS Receiver
Secondary GPS
GPS Output Rate=1 Hz
GPS 2 Port
Baud Rate=9600

Parity=None Data Bits=8 Bits Stop Bits=1 Bit
Auto Configuratiion
Enabled

User Parameter Accuracy
RMS Accuracy
Attitude (deg)=0.050
Headinig (deg)=0.050
Position (m)=2.000
Velocity (m/s)=0.500

APPENDIX D:

SBE Calibration Reports

SEA-BIRD ELECTRONICS, INC.

1808 136th Place N.E., Bellevue, Washington, 98005 USA

Phone: (425) 643 - 9866 Fax (425) 643 - 9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 0731
CALIBRATION DATE: 28-Nov-05

SBE9plus PRESSURE CALIBRATION DATA
10000 psia S/N 89936

DIGIQUARTZ COEFFICIENTS:

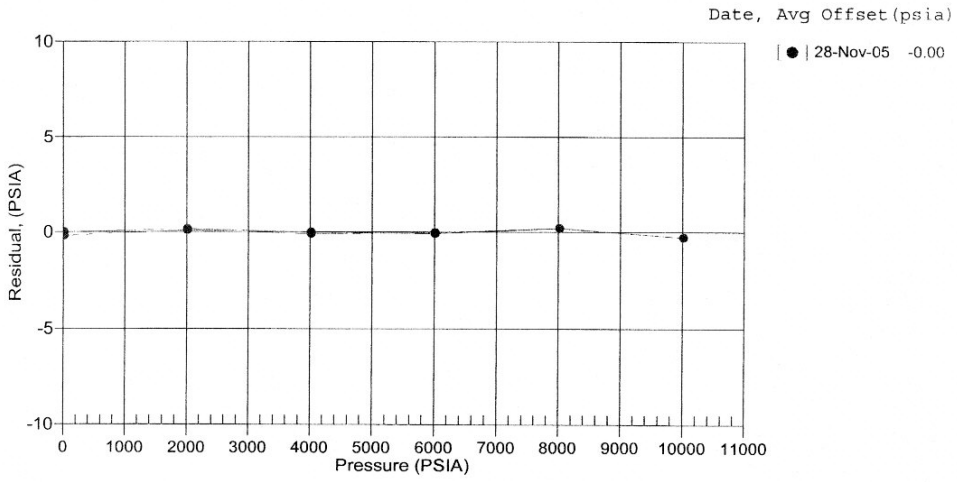
C1 = -4.767972e+004
C2 = -5.006157e-001
C3 = 1.084620e-002
D1 = 3.613800e-002
D2 = 0.000000e+000
T1 = 3.031386e+001
T2 = -5.277072e-004
T3 = 3.790810e-006
T4 = 6.671000e-010
T5 = 0.000000e+000

AD590M, AD590B, SLOPE AND OFFSET:

AD590M = 1.30208e-002
AD590B = -9.65521e+000
Slope = 1.00003
Offset = 0.0170 (dbars)

PRESSURE (PSIA)	INST OUTPUT(Hz)	INST TEMP(C)	INST OUTPUT (PSIA)	CORRECTED INST OUTPUT (PSIA)	RESIDUAL (PSIA)
14.687	33002.25	17.9	14.658	14.682	-0.005
2015.057	33686.17	18.0	2015.137	2015.219	0.162
4015.411	34354.35	18.0	4015.262	4015.400	-0.011
6015.659	35007.84	18.1	6015.382	6015.578	-0.081
8016.122	35647.65	18.1	8016.069	8016.322	0.200
10016.954	36274.20	18.1	10016.373	10016.683	-0.271
8016.052	35647.65	18.2	8016.007	8016.260	0.208
6015.286	35007.79	18.2	6015.062	6015.258	-0.028
4015.240	34354.34	18.2	4015.012	4015.150	-0.090
2014.934	33686.20	18.2	2014.948	2015.030	0.096
14.682	33002.32	18.3	14.478	14.503	-0.179

Residual = corrected instrument pressure - reference pressure



SEA-BIRD ELECTRONICS, INC.

1808 136th Place N.E., Bellevue, Washington, 98005 USA

Phone: (425) 643 - 9866 Fax (425) 643 - 9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 4175
CALIBRATION DATE: 18-Nov-05

SBE3 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPRATURE SCALE

ITS-90 COEFFICIENTS

g = 4.39920964e-003
h = 6.44548622e-004
i = 2.30059501e-005
j = 2.09050383e-006
f0 = 1000.0

ITS-68 COEFFICIENTS

a = 3.68121923e-003
b = 5.99863609e-004
c = 1.57790803e-005
d = 2.09200441e-006
f0 = 3179.379

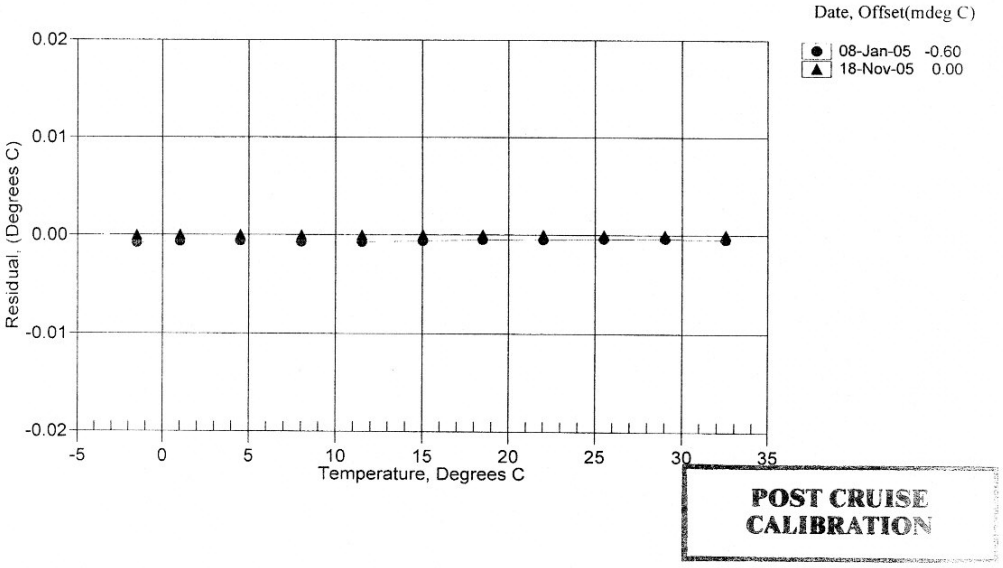
BATH TEMP (ITS-90)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
-1.5005	3179.379	-1.5005	-0.00001
0.9996	3362.706	0.9996	0.00002
4.4996	3632.034	4.4996	0.00001
7.9996	3916.539	7.9996	-0.00003
11.4996	4216.638	11.4996	-0.00001
14.9996	4532.727	14.9996	0.00001
18.4996	4865.194	18.4996	0.00003
21.9996	5214.409	21.9996	0.00001
25.4996	5580.739	25.4996	-0.00002
28.9996	5964.533	28.9996	-0.00003
32.4996	6366.131	32.4996	0.00002

Temperature ITS-90 = $1/\{g + h[ln(f_0/f)] + i[ln^2(f_0/f)] + j[ln^3(f_0/f)]\} - 273.15$ (°C)

Temperature ITS-68 = $1/\{a + b[ln(f_0/f)] + c[ln^2(f_0/f)] + d[ln^3(f_0/f)]\} - 273.15$ (°C)

Following the recommendation of JPOTS: T_{68} is assumed to be 1.00024 * T_{90} (-2 to 35 °C)

Residual = instrument temperature - bath temperature



POST CRUISE CALIBRATION

SEA-BIRD ELECTRONICS, INC.

1808 136th Place N.E., Bellevue, Washington, 98005 USA
Phone: (425) 643 - 9866 Fax (425) 643 - 9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 2767
CALIBRATION DATE: 18-Nov-05

SBE4 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Seimens/meter

GHIJ COEFFICIENTS

g = -1.01807883e+001
h = 1.55538498e+000
i = -1.41895967e-003
j = 2.05900222e-004
CPcor = -9.5700e-008 (nominal)
CTcor = 3.2500e-006 (nominal)

ABCDM COEFFICIENTS

a = 6.35690683e-006
b = 1.55212901e+000
c = -1.01752988e+001
d = -8.69789130e-005
m = 5.2
CPcor = -9.5700e-008 (nominal)

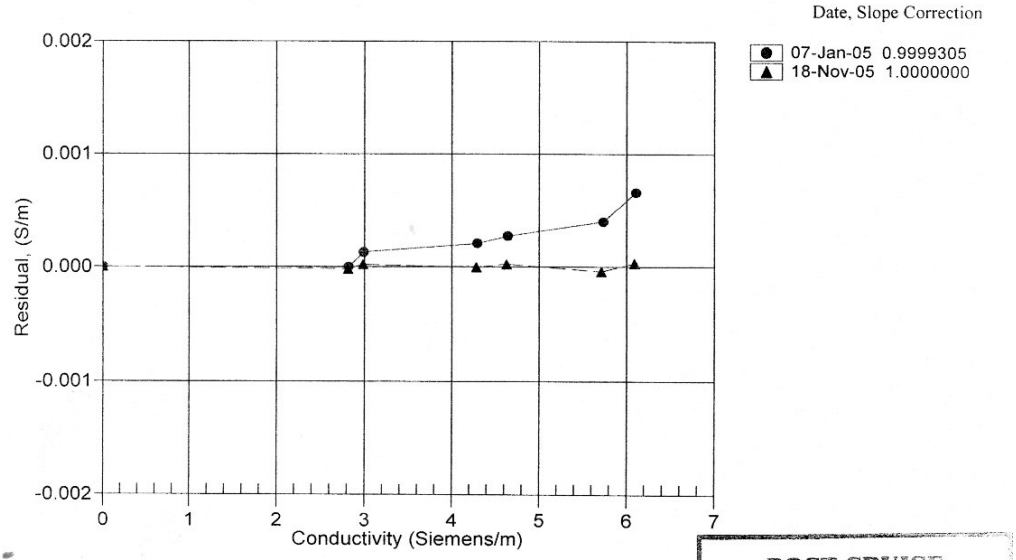
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
0.0000	0.0000	0.00000	2.56030	0.00000	0.00000
-1.0001	34.8847	2.80956	4.96387	2.80954	-0.00002
1.0018	34.8852	2.98145	5.07402	2.98147	0.00002
14.9999	34.8853	4.27917	5.83837	4.27916	-0.00001
18.4999	34.8840	4.62637	6.02634	4.62639	0.00002
28.9999	34.8815	5.71178	6.57899	5.71174	-0.00004
32.4999	34.8746	6.08499	6.75850	6.08502	0.00003

Conductivity = $(g + hf^2 + if^3 + jf^4) / 10(1 + \delta t + \varepsilon p)$ Siemens/meter

Conductivity = $(af^m + bf^2 + c + dt) / [10 (1 + \varepsilon p)$ Siemens/meter

t = temperature[°C]; p = pressure[decibars]; δ = CTcor; ε = CPcor;

Residual = (instrument conductivity - bath conductivity) using g, h, i, j coefficients



POST CRUISE CALIBRATION

SEA-BIRD ELECTRONICS, INC.

1808 136th Place N.E., Bellevue, Washington, 98005 USA

Phone: (425) 643 - 9866 Fax (425) 643 - 9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 0285
CALIBRATION DATE: 06-Dec-05

SBE19 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPRATURE SCALE

ITS-90 COEFFICIENTS

g = 4.12533706e-003
h = 5.76088078e-004
i = -1.71029034e-007
j = -2.89832532e-006
f0 = 1000.0

ITS-68 COEFFICIENTS

a = 3.64763850e-003
b = 5.70491163e-004
c = 7.08541505e-006
d = -2.89821095e-006
f0 = 2297.672

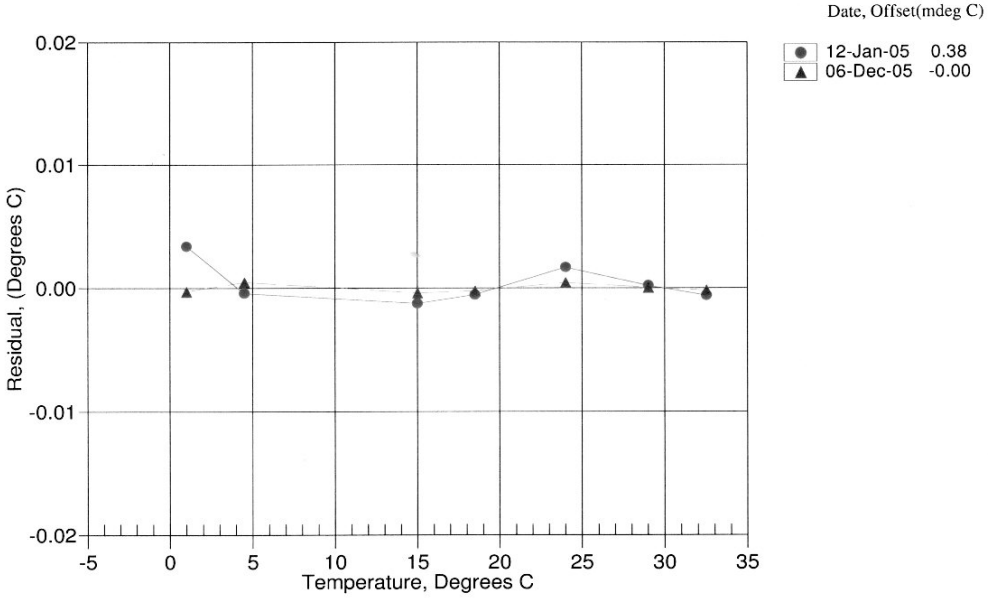
BATH TEMP (ITS-90)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
1.0000	2297.672	0.9997	-0.00027
4.5000	2490.830	4.5005	0.00049
15.0000	3139.237	14.9996	-0.00038
18.5000	3379.673	18.4998	-0.00020
23.9999	3783.445	24.0003	0.00045
29.0000	4179.021	29.0001	0.00007
32.5000	4472.721	32.4998	-0.00017

Temperature ITS-90 = $1/\{g + h[ln(f_0/f)] + i[ln^2(f_0/f)] + j[ln^3(f_0/f)]\} - 273.15$ (°C)

Temperature ITS-68 = $1/\{a + b[ln(f_0/f)] + c[ln^2(f_0/f)] + d[ln^3(f_0/f)]\} - 273.15$ (°C)

Following the recommendation of JPOTS: T_{68} is assumed to be 1.00024 * T_{90} (-2 to 35 °C)

Residual = instrument temperature - bath temperature



SEA-BIRD ELECTRONICS, INC.

1808 136th Place N.E., Bellevue, Washington, 98005 USA
Phone: (425) 643 - 9866 Fax (425) 643 - 9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 0285
CALIBRATION DATE: 08-Dec-05

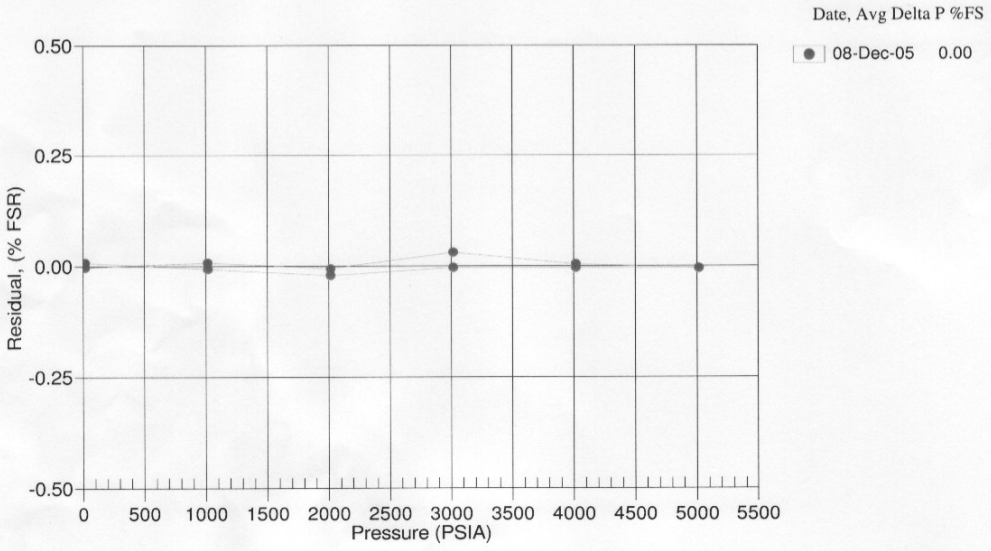
SBE19 PRESSURE CALIBRATION DATA
5000 psia S/N 133807 TCV: -121

QUADRATIC COEFFICIENTS:
PA0 = 2.492695e+003
PA1 = -6.505116e-001
PA2 = -5.432016e-008

STRAIGHT LINE FIT:
M = -6.505347e-001
B = 2.492368e+003

PRESSURE PSIA	INST OUTPUT(N)	COMPUTED PSIA	ERROR %FS	LINEAR PSIA	ERROR %FS
14.79	3807.4	15.16	0.01	15.53	0.01
1014.94	2271.8	1014.60	-0.01	1014.50	-0.01
2014.90	736.1	2013.84	-0.02	2013.53	-0.03
3014.97	-802.6	3014.77	-0.00	3014.49	-0.01
4015.01	-2340.3	4014.79	-0.00	4014.81	-0.00
5015.07	-3878.4	5014.82	-0.01	5015.40	0.01
4014.91	-2340.8	4015.12	0.00	4015.14	0.00
3014.75	-804.9	3016.27	0.03	3016.00	0.02
2014.97	734.8	2014.70	-0.01	2014.38	-0.01
1014.74	2271.0	1015.10	0.01	1015.00	0.01
14.79	3808.1	14.68	-0.00	15.05	0.01

Straight Line Fit:
Pressure (psia) = M * N + B (N = binary output)
Quadratic Fit:
pressure (psia) = PA0 + PA1 * N + PA2 * N^2
Residual = (instrument pressure - true pressure) * 100 / Full Scale Range



SEA-BIRD ELECTRONICS, INC.

1808 136th Place N.E., Bellevue, Washington, 98005 USA
Phone: (425) 643 - 9866 Fax (425) 643 - 9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 0285
CALIBRATION DATE: 06-Dec-05

SBE19 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Seimens/meter

GHIJ COEFFICIENTS

```
g = -4.06615658e+000
h =  4.84869087e-001
i =  1.33004184e-003
j = -2.71256107e-005
CPcor = -9.5700e-008 (nominal)
CTcor =  3.2500e-006 (nominal)
```

ABCDM COEFFICIENTS

```
a =  1.35181566e-002
b =  4.68318054e-001
c = -4.05092941e+000
d = -1.02668100e-004
m =  2.3
CPcor = -9.5700e-008 (nominal)
```

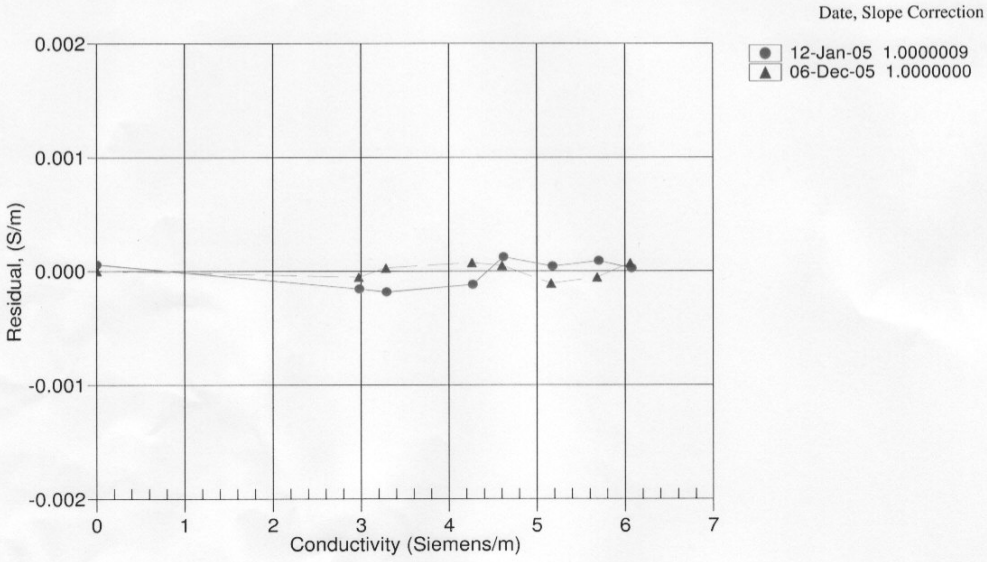
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREO (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2.88516	0.00000	0.00000
1.0000	34.7472	2.97062	8.26817	2.97057	-0.00005
4.5000	34.7271	3.27714	8.63260	3.27716	0.00003
15.0000	34.6842	4.25712	9.70465	4.25719	0.00007
18.5000	34.6754	4.60169	10.05398	4.60174	0.00005
23.9999	34.6662	5.15875	10.59387	5.15864	-0.00011
29.0000	34.6616	5.67983	11.07488	5.67977	-0.00006
32.5000	34.6607	6.05192	11.40582	6.05199	0.00007

Conductivity = $(g + hf^2 + if^3 + jf^4) / 10(1 + \delta t + \varepsilon p)$ Siemens/meter

Conductivity = $(af^m + bf^2 + c + dt) / [10 (1 + \varepsilon p)$ Siemens/meter

t = temperature[°C)]; p = pressure[decibars]; δ = CTcor; ε = CPcor;

Residual = (instrument conductivity - bath conductivity) using g, h, i, j coefficients



APPENDIX E:

R352_MB. hvf & TPE Report

Vessel Name: R352_MB.hvf
Vessel created: April 28, 2006

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2006-064 00:00

Transduer #1:

Pitch Offset: 0.900
Roll Offset: -0.110
Azimuth Offset: -0.200

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer:
Model: em1002
Serial Number:

Navigation Sensor:

Time Stamp: 2006-064 00:00

Comments
Latency 0.000
DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer:
Model:
Serial Number:

Gyro Sensor:

Time Stamp: 2006-064 00:00

Comments (null)
Latency 0.000

Entry 0) Draft: 0.000 Speed: 0.000

Heave Sensor:

Time Stamp: 2006-064 00:00

Comments Caris TechNote - SV Corrections for Simrad.pdf 072303
Apply No
Latency 0.000
DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer: (null)

Model: (null)
Serial Number: (null)

Pitch Sensor:

Time Stamp: 2003-111 00:00

Comments Caris TechNote - SV Corrections for Simrad.pdf 072303
Apply No
Latency 0.000
Pitch offset: 0.000

Manufacturer: (null)
Model: (null)
Serial Number: (null)

Roll Sensor:

Time Stamp: 2006-064 00:00

Comments Caris TechNote - SV Corrections for Simrad.pdf 072303
Apply No
Latency 0.000
Roll offset: 0.000

Manufacturer: (null)
Model: (null)
Serial Number: (null)

Draft Sensor:

Time Stamp: 2006-064 00:00

Apply Yes
Comments (null)
Entry 1) Draft: 0.007 **Speed:** 5.054
Entry 2) Draft: 0.041 **Speed:** 6.143
Entry 3) Draft: 0.002 **Speed:** 7.911
Entry 4) Draft: 0.032 **Speed:** 9.778

TPE

Time Stamp: 2006-064 00:01

Comments
Offsets

Motion sensing unit to the transducer 1
X Head 1 1.855
Y Head 1 0.074
Z Head 1 1.801

Motion sensing unit to the transducer 2
X Head 2 0.000

Y Head 2 0.000
Z Head 2 0.000
Navigation antenna to the transducer 1
X Head 1 5.760
Y Head 1 6.596
Z Head 1 17.984
Navigation antenna to the transducer 2
X Head 2 0.000
Y Head 2 0.000
Z Head 2 0.000

Roll offset of transducer number 1 -0.014
Roll offset of transducer number 2 0.000

Heave Error: 0.060 or 5.000'' of heave amplitude.
Measurement errors: 0.020
Motion sensing unit alignment errors
Gyro:0.000 Pitch:0.000 Roll:0.000
Gyro measurement error: 0.020
Roll measurement error: 0.020
Pitch measurement error: 0.020
Navigation measurement error: 4.000
Transducer timing error: 0.000
Navigation timing error: 0.000
Gyro timing error: 0.010
Heave timing error: 0.010
PitchTimingStdDev: 0.010
Roll timing error: 0.010
Sound Velocity speed measurement error: 0.500
Surface sound speed measurement error: 0.500
Tide measurement error: 0.012
Tide zoning error: 0.100
Speed over ground measurement error: 0.250
Dynamic loading measurement error: 0.000
Static draft measurement error: 0.030
Delta draft measurement error: 0.000

Svp Sensor:

Time Stamp: 2006-064 00:00

Comments (null)
Svp #1:

Pitch Offset: 0.000
Roll Offset: 0.000
Azimuth Offset: 0.000

DeltaX: 0.811
DeltaY: 1.856
DeltaZ: 1.676

SVP #2:

Pitch Offset: 0.000

Roll Offset: 0.000
Azimuth Offset: 0.000

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

WaterLine:

Time Stamp: 2006-064 00:00

Comments
Apply No
WaterLine 0.000

Time Stamp: 2006-080 00:00

Comments
Apply Yes
WaterLine 0.010

Time Stamp: 2006-081 00:00

Comments
Apply Yes
WaterLine 0.010

Time Stamp: 2006-082 00:00

Comments
Apply Yes
WaterLine 0.010

Time Stamp: 2006-083 00:00

Comments
Apply Yes
WaterLine 0.010

Time Stamp: 2006-084 00:00

Comments
Apply Yes
WaterLine 0.010

Time Stamp: 2006-085 00:00

Comments
Apply Yes
WaterLine 0.010

Time Stamp: 2006-086 00:00

Comments
Apply Yes
WaterLine 0.010

Time Stamp: 2006-087 00:00

Comments
Apply Yes
WaterLine 0.010

Time Stamp: 2006-088 00:00

Comments
Apply Yes
WaterLine 0.010

Time Stamp: 2006-089 00:00

Comments
Apply Yes
WaterLine 0.010

Time Stamp: 2006-090 00:00

Comments
Apply Yes
WaterLine 0.010

Time Stamp: 2006-091 00:00

Comments
Apply Yes
WaterLine 0.010

Time Stamp: 2006-092 00:00

Comments
Apply Yes
WaterLine 0.010

Total Propagated Error (TPE) Report

NOAA Ship NANCY FOSTER 2006

Caris HIPS 6.0 has an error model that derives from a sounding's source errors the total propagated error (TPE) for that sounding. The sources of the estimates of the various errors vary from manufacturers' specifications, to theoretical values, to field tested empirical observations. The error estimates (one sigma) are entered into the TPE sensor section of an HVF.

Below is a table listing various source errors and their estimate, followed by a detailed discussion describing each error estimate.

Error Source	Error Estimate
Heave % Amplitude	5.0
Heave	0.05
Gyro	0.02
Roll	0.02
Pitch	0.02
Navigation	4.0
Timing Transducer	unknown
Navigation Timing	unknown
Gyro Timing	0.01
Heave Timing	0.01
Pitch Timing	0.01
Roll Timing	0.01
Sound Velocity Measured	0.5
Surface	0.5
Tide Measured	0.012
Tide Zoning	0.0 & .03
Offset X	0.02
Offset Y	0.02
Offset Z	0.02
Vessel Speed	0.25
Loading	unknown
Draft	0.03
Delta Draft	unknown

Detailed Discussion of Error Estimates

Heave % Amplitude

Error: 5.0

Definition: *Heave % Amplitude* is an additional heave standard deviation component that is the percentage of the instantaneous heave.

Discussion: See *Heave* discussion below.

Heave

Error: 0.05

Definition: *Heave* is the measurement for standard deviation of the heave data in meters.

Discussion: The POS/MV heave error is given as 0.05 meters + 5% of heave; however, the Caris error model implementation uses *Heave* or *Heave % Amplitude*, whichever is greater (see *Heave* discussion below). Thus a value of 0.06 for *Heave* is used as a compromise

Gyro

Error: 0.02

Definition: *Gyro* is the measurement standard deviation of the heading data in degrees.

Discussion: *Gyro* is based on POS/MV manufacturer specifications

Roll

Error: 0.02

Definition: *Roll* is the measurement standard deviation of the roll data in degrees.

Discussion: *Roll* is based on POS/MV manufacturer specifications.

Pitch

Error: 0.02

Definition: *Gyro* is the measurement standard deviation of the heading data in degrees.

Discussion: *Pitch* is based on POS/MV manufacturer specifications.

Navigation

Error: 4.0

Definition: *Navigation* is the standard deviation associated with the measurement of positions for the vessel in meters.

Discussion: *Navigation* is based on POS/MV manufacturer specifications.

Timing Transducer

Error:	0.0
Definition:	*Timing Transducer* is the standard deviation of transducer time stamp measurements.
Discussion:	*Timing Transducer* is not known and is currently being researched.

Navigation Timing

Error:	0.0
Definition:	*Navigation Timing* is the standard deviation of navigation time stamp measurements.
Discussion:	*Navigation Timing* is not known and is currently being researched.

Gyro Timing

Error:	0.01
Definition:	*Gyro Timing* is the standard deviation of gyro time stamp measurements.
Discussion:	*Gyro Timing* is based on POS/MV manufacturer specifications.

Heave Timing

Error:	0.01
Definition:	*Heave Timing* is the standard deviation of heave time stamp measurements.
Discussion:	*Heave Timing* is based on POS/MV manufacturer specifications.

Pitch Timing

Error:	0.01
Definition:	*Pitch Timing* is the standard deviation of pitch time stamp measurements.
Discussion:	*Pitch Timing* is based on POS/MV manufacturer specifications.

Roll Timing

Error:	0.01
Definition:	*Roll Timing* is the standard deviation of roll time stamp measurements.
Discussion:	*Roll Timing* is based on POS/MV manufacturer specifications.

Sound Velocity Measured

Error: 0.05
Definition: *Sound Velocity Measured* is the standard deviation of the measurement of sound velocity readings in meters/second.
Discussion: *Sound Velocity Measured* is based on SEACAT manufacturer specifications.

Surface

Error: 0.05
Definition: *Surface* is the standard deviation of the measurement of surface sound speed readings in meters/second.
Discussion: This value is currently being researched. In the meantime, NOAA Ship NANCY FOSTER will use 0.05, which is what NOAA Ship THOMAS JEFFERSON used for its Simrad SSVS.

Tide Measured

Error: .012
Definition: *Tide Measured* is the standard deviation of the measured tide values in meters.
Discussion: *Tide Measured* is based on CO-OPS calculations.

Tide Zoning

Error: Buck Island 0.03, La Parguera 0.00
Definition: *Tide Zoning* is the standard deviation of the tide values associated with zoning in meters.
Discussion: *Tide Zoning* is based on general CO-OPS calculations.

Offset X

Error: 0.02
Definition: *Offset X* is the standard deviation of the measured X offsets of the vessel.
Discussion: *Offset X* is the accuracy limit of whatever survey method was used to survey the vessel.

Offset Y

Error: 0.02
Definition: *Offset Y* is the standard deviation of the measured X offsets of the vessel.
Discussion: *Offset Y* is the accuracy limit of whatever survey method was used to survey the vessel.

Offset Z

Error: 0.02

Definition: *Offset Z* is the standard deviation of the measured X offsets of the vessel.

Discussion: *Offset Z* is the accuracy limit of whatever survey method was used to survey the vessel.

Vessel Speed

Error: 0.25

Definition: *Vessel Speed* is the standard deviation for the vessel speed measurements in meters/second.

Discussion: *Vessel Speed* requires further research. In the meantime, NANCY FOSTER is using what THOMAS JEFERSON used in 2005.

Loading

Error: 0

Definition: *Loading* is the measurement standard deviation of the vertical changes during the survey because of fuel consumption, etc. *Loading* corresponds to the Caris waterline measurement error.

Discussion: *Loading* is not currently used. Further investigation is required.

Draft

Error: 0.03

Definition: *Draft* is the standard deviation of the vessel draft measurements in meters.

Discussion: *Draft* is the accuracy limit of the draft measuring method.

Delta Draft

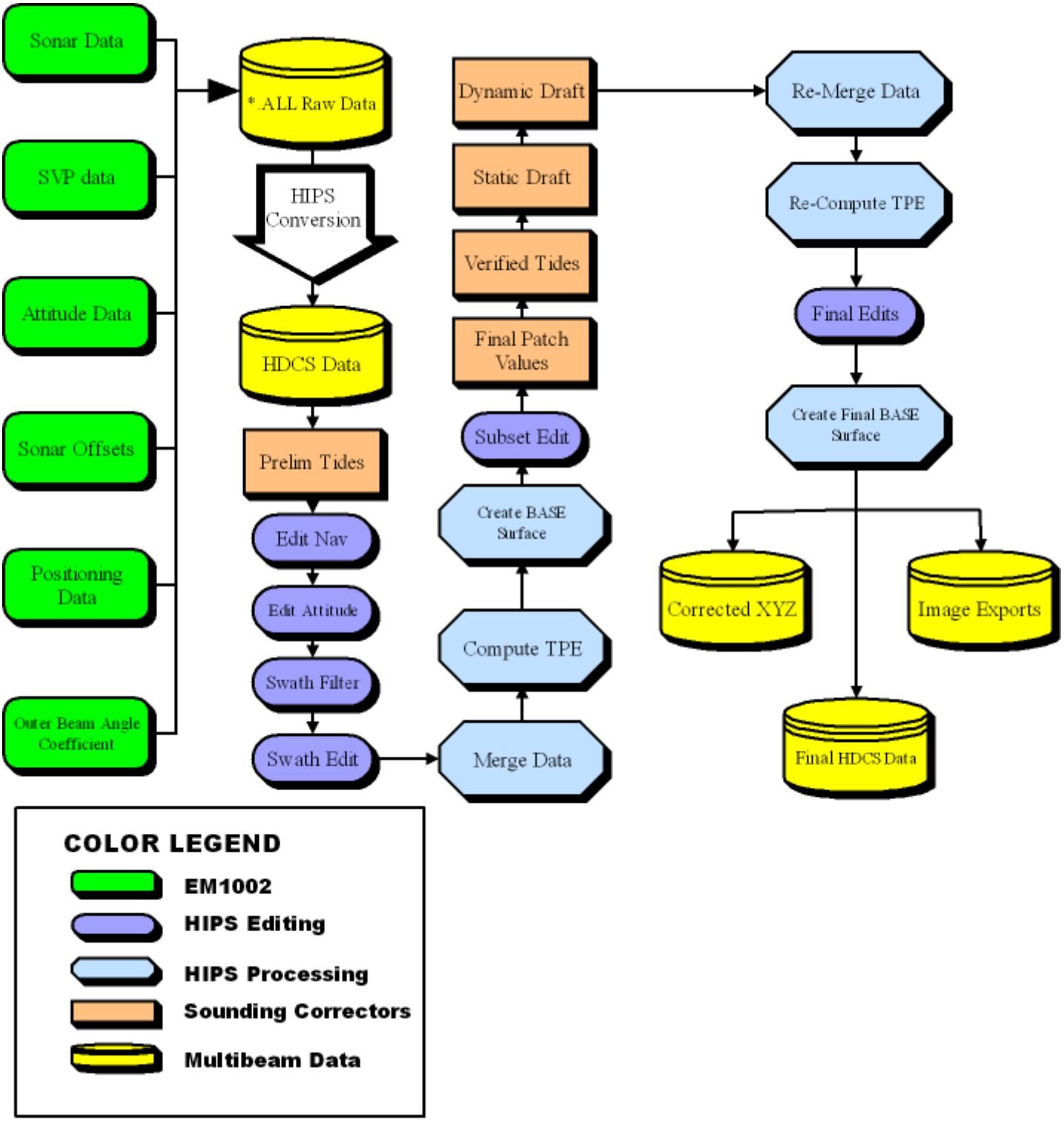
Error: 0

Definition: *Delta Draft* is the standard deviation of the dynamic vessel draft measurements in meters.

Discussion: *Delta Draft* is not currently used. Further investigation is required.

APPENDIX F:

CARIS Processing Flow Chart


Sonar Data
SVP data
Attitude Data
Sonar Offsets
Positioning Data
Outer Beam Angle Coefficient
*.ALL Raw Data
HIPS Conversion
HDCS Data
Prelim Tides
Edit Nav
Edit Attitude
Swath Filter
Swath Edit
Merge Data
Compute TPE
Create BASE Surface
Subset Edit
Final Patch Values
Verified Tides
Static Draft
Dynamic Draft
Re-Merge Data
Re-Compute TPE
Final Edits
Create Final BASE Surface
Corrected XYZ
Image Exports
Final HDCS Data
COLOR LEGEND
EM1002
HIPS Editing
HIPS Processing
Sounding Correctors
Multibeam Data

APPENDIX G:

NOAA Ship NANCY FOSTER Static Offset Report

communications
Power & Control Systems Group
PacOrd

2/8/2006

Subj : NOAA SHIP Nancy Foster Survey

Ref: (a) SW225-AO-MMA-010/OP762/ALIGN THEORY, Theory of Combat System Alignment
(b) Table 1 of ITEM NO. 501

Encl: (1) Foundation Leveling Data Sheets

PacOrd personnel accomplished the survey of the equipment listed in table 1 of work item # 501 on board the NOAA SHIP Nancy Foster.

The granite blocks Roll and Pitch planes were set to the ship's gravity plane. The granite block was then used as the reference for all readings requiring a comparison to the ship's gravity plane.

The ship's centerline was transferred up from the keel, to the granite block 0°-180° reference line through an access cut into the hull of the ship. The granite block reference lines were then used as the reference for all readings requiring centerline reference.

The IMU foundation had to be removed, drilled and tapped for the new style IMU and reset.

The 12KHZ Transducer pitch angle exceeds the ±0.25° allowed by four minutes (reading is +0.3166°), a waiver was received from NOAA for this condition.

All other readings are within tolerance.

The final survey data is summarized in enclosure (1).

Byron K. Dunn
CSA Engineer

3161-3 St. Johns Bluff Rd
Jacksonville, Fl 32246
(904) 641-5442 - Phone
(904) 641-9967 - Fax

communications
PacOrd

SERIAL NO. 00656.001.02-03

INSPECTION/DEFICIENCY REPORT

JOB ORDER NO.

VESSEL NAME: NOAA SHIP NANCY FOSTER

DATE SUBMITTED: 7-Feb-06

WORK ITEM NO: 501

PARAGRAPH: para. 7.5

INSPECTION DATE(S): 11/14/05-02/02/06

TITLE OF WORK ITEM: SURVEY

TYPE OF REPORT

NOTICE ☐ IDR/CFR ☒ REQ REPORT ☐ PCP ☐ INFO ONLY ☐ OTHER

BALANCE REPORT

☐ PRINTS/DWG ☐ CFM/CFE ☐ GFM/GFE ☐ CONFLICTING PRINTS/DWGS SUPPLIED

☐ PRINTS/DWGS DO NOT REFLECT EXISTING SHIPBOARD / SITE CONDITIONS; DWG. NO:

incorrect: ☐ SPECIFICATIONS ☐ COMPARTMENT ☐ LOCATION REFERENCED SYSTEM:

PROBLEM/CONDITION:

Contractor accomplished Alignment Survey.
See attached results.

RECOMMEND: ☐ ISSUE A CHANGE ORDER ☒ ACCEPT REQUIRED REPORT ☐ ACCEPT PCP ☐ ACCEPT INFO ☒ SEE ATTACHED

Recommend Supervisor accept required report.

LEAD SHOP/AFFECTED TRADES	SIGNATURE OF ORIGINATOR	PRINT NAME	DATE
PacOrd	Byron K. Dunn	Byron K. Dunn	7-Feb-06

PROGRAM MANAGER/PROJECT SUPERINTENDENT DIRECTIONS

THE ABOVE RECOMMENDATIONS NEED TO BE CONTRACTUALLY INVOKED WITHIN DAYS OF ## TO LIMIT PRODUCTION IMPACT

☐ THIS REPORT EFFECTS CRITICAL PATH ☐ CHARGED TO BASIC ☐ CHANGE TO BE ISSUED ☐ AUTHORIZED TO PROCEED

CUSTOMER /SUPSHIP FINDINGS, RECOMMENDATIONS AND/OR APPROVAL

SIGNATURE	PRINT NAME	DATE

ENCLOSURE 1

communications
Power & Control Systems Group
PacOrd

PacOrd
Jacksonville Division
3161-3 St. Johns Bluff
Jacksonville, FL 32246
Phone:(904) 641-5442
Fax: (904) 641-9967

SYSTEM	All readings are in centimeters Horiz X	Y		Vert Z		All readings are in Degrees Heading Degrees		Pitch Degrees		Roll Degrees	
Granite Block	0.0	0.0		0.0		0.0000	±0.1°	-0.0022	±0.0025°	0.0014	±0.0025°
IMU Foundation	73.7	0.1	±0.5cm	4.3	±0.5cm	0.0573	±0.1°	0.0061	±0.01°	0.0092	±0.01°
IMU To Surface	73.7	0.1	±0.5cm	-12.5	±0.5cm	0.0573	±0.1°	0.0061	±0.01°	0.0092	±0.01°
AFT POS/MV Antenna #2	430.9	-473.7	±0.5cm	-1628.2	±0.5cm	N/A		N/A		N/A	
FWD POS/MV Antenna #1	657.1	-474.0	±0.5cm	-1630.8	±0.5cm	N/A		N/A		N/A	
POS/MV Antenna rel. to each other	226.2	-0.3	±0.5cm	N/A	-	N/A	-	N/A	-	N/A	-
Center of Roll and Pitch	-1229.5	0.0	±5cm	-196.5	±5cm	NA	-	NA	-	NA	-
Ship' Draft Marks Aft Stbd	-3138.5	609.6	±5cm	-289.4	±2cm	NA	-	NA	-	NA	-
Ship' Draft Marks Aft Port	-3138.5	-609.6	±5cm	-289.4	±2cm	NA	-	NA	-	NA	-
Ship' Draft Marks Fwd Stbd	1071.7	350.5	±5cm	-350.4	±2cm	NA	-	NA	-	NA	-
Ship' Draft Marks Fwd Port	1071.7	-350.5	±5cm	-350.4	±2cm	NA	-	NA	-	NA	-
Port Gyro	216.5	0.0	±5cm	-1254.8	±2cm	0.0017	±0.25°	NA	-	NA	-
Stbd Gyro	216.5	43.2	±5cm	-1254.8	±2cm	0.0047	±0.25°	NA	-	NA	-
EM 1002 Multibeam Foundation (Bottom)	81.1	185.6	±1cm	153.7	±1cm	0.0286	±0.1°	0.0500	±0.025°	-0.0139	±0.025°
EM 1002 Multibeam	81.1	185.6	±1cm	167.6	±1cm	0.0286	±0.1°	0.0500	±0.1°	-0.0139	±0.1°
ADCP	-665.5	-157.8	±5cm	154.6	±2cm	45.0750	±0.25°	-0.0750	±0.25°	0.0167	±0.25°
AFT Deck Bench Mark Port	-3783.7	-527.1	±0.5cm	-386.1	±0.5cm	0.0000	±0.1°	NA	±0.05°	NA	±0.05°
AFT Deck Bench Mark Stbd	-3783.7	527.1	±0.5cm	-386.1	±0.5cm	0.0000	±0.1°	NA	±0.05°	NA	±0.05°
AFT Deck Alignment Cube	-3594.5	581.7	±0.5cm	-471.2	±0.5cm	0.0000	±0.1°	0.0555	±0.01°	-0.0083	±0.01°
Moon Pool BM	-2197.7	121.9	±0.5cm	-385.4	±0.5cm	0.0000	±0.1°	NA	±0.05°	NA	±0.05°
Flying Bridge Port BM	469.9	-559.4	±0.5cm	-1419.9	±0.5cm	0.0000	±0.1°	NA	±0.05°	NA	±0.05°
Flying Bridge Stbd BM	469.2	561.4	±0.5cm	-1418.6	±0.5cm	0.0000	±0.1°	NA	±0.05°	NA	±0.05°
Flying Bridge Alignment Cube	648.3	2.5	±0.5cm	-1431.2	±0.5cm	0.0000	±0.1°	0.0333	±0.01°	-0.0333	±0.01°
Dry Lab Fwd Bench Mark	-462.6	313.5	±0.5cm	-589.0	±0.5cm	0.0000	±0.1°	NA	±0.05°	NA	±0.05°
Dry Lab Aft Bench Mark	-993.2	313.5	±0.5cm	-589.4	±0.5cm	0.0000	±0.1°	NA	±0.05°	NA	±0.05°
Dry Lab Alignment Cube	-639.3	102.9	±0.5cm	-588.7	±0.5cm	0.0000	±0.1°	0.0500	±0.01°	0.0083	±0.01°
Computer Lab Fwd Bench Mark	-600.4	-380.9	±0.5cm	-596.7	±0.5cm	0.0667	±0.1°	NA	±0.05°	NA	±0.05°
Computer Lab Aft Bench Mark	-1070.2	-380.8	±0.5cm	-597.8	±0.5cm	0.0667	±0.1°	NA	±0.05°	NA	±0.05°
Computer Lab Alignment Cube	-837.9	-162.2	±0.5cm	-569.7	±0.5cm	0.0000	±0.1°	0.0042	±0.01°	0.0167	±0.01°
IMU AFT Bench Mark	-146.9	16.6	±0.5cm	-19.7	±0.5cm	0.0000	±0.1°	NA	±0.05°	NA	±0.05°

IMU FWD Bench Mark	339.0	17.4	±0.5cm	-19.5	±0.5cm	0.0000	±0.1°	NA	±0.05°	NA	±0.05°	
IMU Alignment Cube	161.1	169.2	±0.5cm	-4.4	±0.5cm	0.0000	±0.1°	-0.0111	±0.01°	-0.0528	±0.01°	
ADCP AFT Bench Mark	-1169.8	-26.7	±0.5cm	-38.4	±0.5cm	0.0000	±0.1°	NA	±0.05°	NA	±0.05°	
ADCP FWD Bench Mark	-148.7	-26.7	±0.5cm	-38.4	±0.5cm	0.0000	±0.1°	NA	±0.05°	NA	±0.05°	
ADCP Alignment Cube	-668.5	-208.0	±0.5cm	18.4	±0.5cm	0.0000	±0.1°	0.0389	±0.01°	0.0444	±0.01°	
Gyro Bench Mark Fwd	216.5	22.4	±0.5cm	-1164.5	±0.5cm	0.0000	±0.1°	NA	±0.05°	NA	±0.05°	
Gyro Bench Mark Aft	-98.5	22.4	±0.5cm	-1156.9	±0.5cm	0.0000	±0.1°	NA	±0.05°	NA	±0.05°	
Keel Bench Mark Fwd	318.6	1.9	±0.5cm	108.3	±0.5cm	0.0000	±0.1°	NA	±0.05°	NA	±0.05°	
Keel Bench Mark Aft	-118.3	1.9	±0.5cm	108.3	±0.5cm	0.0000	±0.1°	NA	±0.05°	NA	±0.05°	
12Khz Stbd	-634.4	-157.8	±5cm	154.6	±2cm	N/A	-	0.3167	±0.25°	-0.1167	±0.25°	
200KHZ Transducer	-236.7	-90.2	±5cm	108.3	±2cm	N/A	-	0.0917	±0.25°	-0.0333	±0.25°	
Moon Pool Adapter	-2248.7	121.3	±5cm	111.8	±2cm	N/A	-	-0.0250	±0.25°	0.1500	±0.25°	

Port Down = Positive

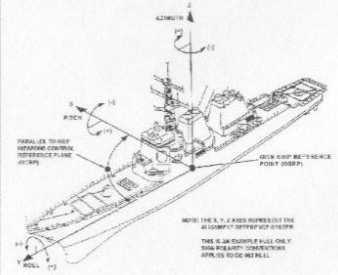
Bow Down = Positive

X dimension readings forward of Granite Block = positive, aft of Granite Block =negative

Y dimension readings starboard of Granite Block = positive, port of Granite Block =negative

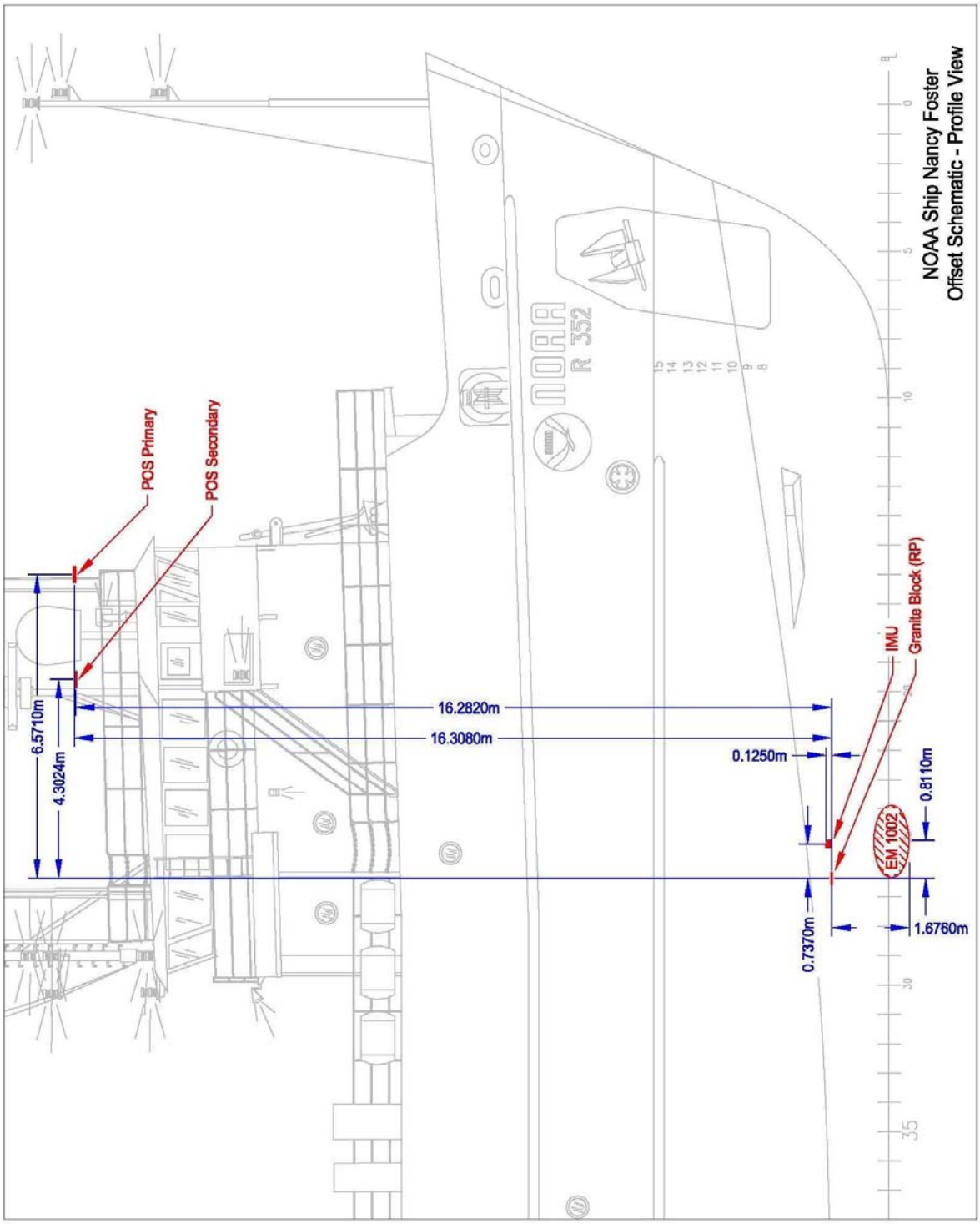
Z dimension readings lower than Granite Block = positive, higher than Granite Block =negative

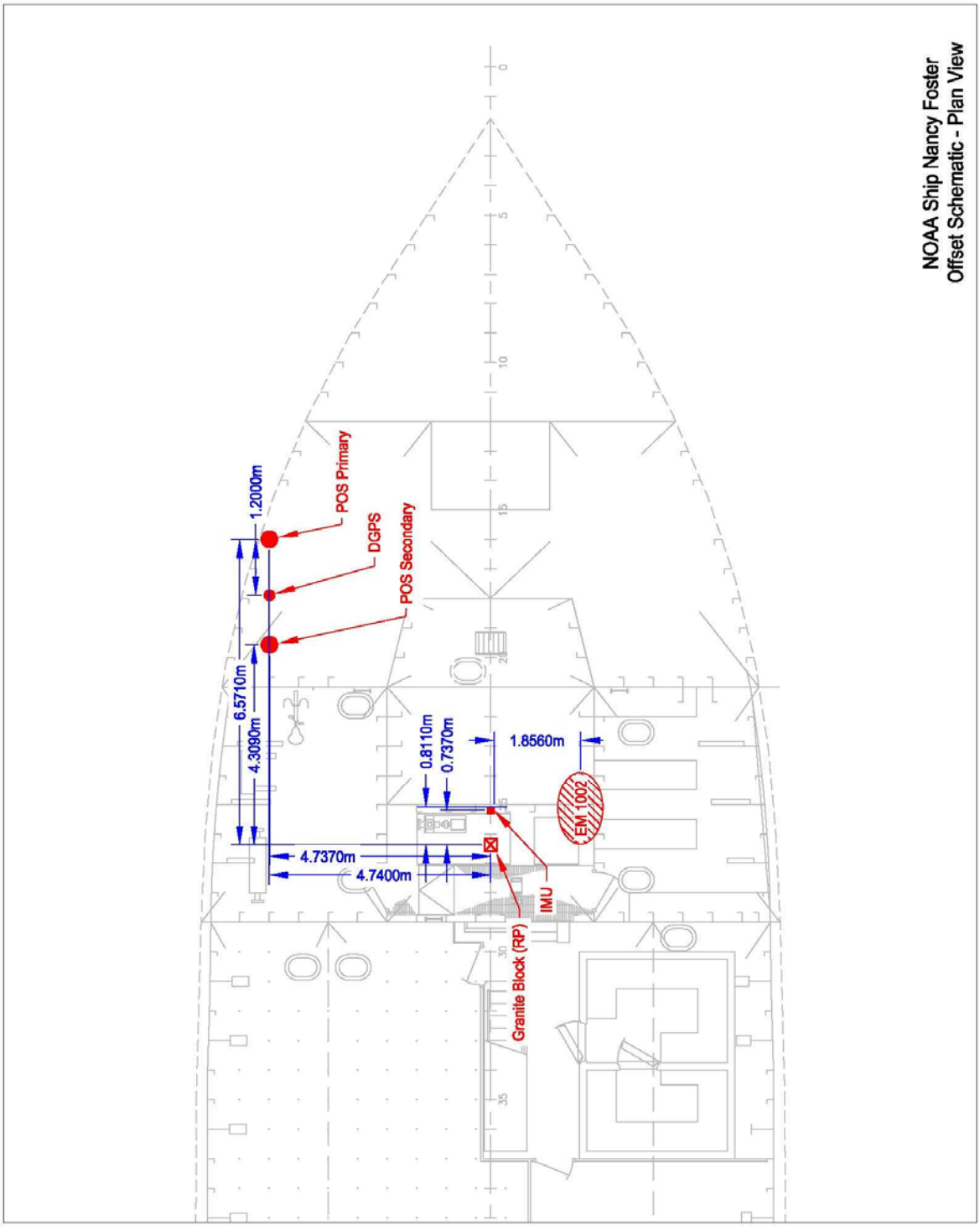
Figure 3-53. Sign Polarity Convention



APPENDIX H:

NOAA Ship NANCY FOSTER Offset Diagram


NOAA Ship Nancy Foster
Offset Schematic - Profile View
POS Primary
POS Secondary
IMU
Granite Block (RP)
6.5710m
4.3024m
16.2820m
16.3080m
0.1250m
0.8110m
EM 1002
0.7370m
1.6760m
NOAA
R 352


NOAA Ship Nancy Foster
Offset Schematic - Plan View
POS Primary
DGPS
POS Secondary
1.2000m
6.5710m
4.3090m
0.8110m
0.7370m
1.8560m
EM 1002
4.7370m
4.7400m
IMU
Granite Block (RP)

APPENDIX I:

Multibeam Calibration Procedures & Patch Test Report

Calibration Date: March 21, 2006

Ship	NOAA Ship Nancy Foster
Vessel	
Echosounder System	Simrad EM1002
Positioning System	POS/MV Model 320 M4
Attitude System	POS/MV Model 320 M4

Calibration type:

Annual		Full	X
Installation	X	Limited/Verification	
System change			
Periodic/QC			
Other:			

The following calibration report documents procedures used to measure and adjust sensor biases and offsets for multibeam echosounder systems. Calibration must be conducted A) prior to CY survey data acquisition B) after installation of echosounder, position and vessel attitude equipment C) after changes to equipment installation or acquisition systems D) whenever the Hydrographer suspects incorrect calibration results. The Hydrographer shall periodically demonstrate that calibration correctors are valid for appropriate vessels and that data quality meets survey requirements. In the event the Hydrographer determines these correctors are no longer valid, or any part of the echosounder system configuration is changed or damaged, the Hydrographer must conduct new system calibrations.

Multibeam echosounder calibrations must be designed carefully and individually in consideration of systems, vessel, location, environmental conditions and survey requirements. The calibration procedure should determine or verify system offsets and calibration correctors (residual system biases) for draft (static and dynamic), horizontal position control (DGPS), navigation timing error, heading, roll, and pitch. Standard calibration patch test procedures are described in *Field Procedures for the Calibration of Multibeam Echo-sounding Systems*, by André Godin (Documented in Chapter 17 of the Caris HIPS/SIPS 5.3 User Manual, 2003). Additional information is provided in *POS/MV Model 320 Ver 3 System Manual* (10/2003), Appendix F, Patch Test, and the NOAA Field Procedures Manual (FPM, 2003). **The patch test method only corrects very basic alignment biases**. These procedures are used to measure static navigation timing error, transducer pitch offset, transducer roll offset, and transducer azimuth offset (yaw). Dynamic and reference frame biases can be investigated using a reference surface.

Pre-calibration Survey Information

Reference Frame Survey

(IMU, sensor, GPS antenna offsets and rotation with respect to vessel reference frame)

Vessel reference frame defined with respect to:

[ ] IMU [X] Reference Position

Reference to IMU Lever Arm

X(m)	Y(m)	Z(m)
0.737	0.001	-0.125

IMU frame w.r.t vessel reference frame

X(deg)	Y(deg)	Z(deg)
-0.009	-0.006	-0.057

Reference to Sensor Lever Arm

X(m)	Y(m)	Z(m)
0.0	0.0	0.0

[X] **Measurements verified for this calibration.**
Reference Centerline Survey report
[X] **Drawing and table attached.**

[X] **Drawing and table included with project report/DAPR:** NF-06-03 DAPR

Position/Motion Sensor Calibration (for POS/MV model 320 M4)

Calibration date: February 7,2006

Reference to primary GPS Lever Arm

X(m)	Y(m)	Z(m)
6.571	-4.740	-16.308

Heave Settings: Bandwidth 18.00 Damping Period .707

Reference to Center of Rotation Lever Arm

X(m)	Y(m)	Z(m)
-12.295	0.000	-1.965

Firmware version 3.22 was used for the entire survey.

Static Draft Survey
(Vessel waterline with respect to RP)

Survey date: March, 21 2006

Prior to conducting the patch test and survey, initial confidence checks were performed to ensure an accurate measurement of water depths. While the Nancy Foster was tied up to the pier at Frederiksted, St. Croix, the survey team initially observed the static draft of the starboard PROJ draft marks at +/-3.69m(12.1ft.). The EM1002 transducer offset from the RP (0,0,0) is a fixed distance of 1.676m, which is entered into the installation parameters in the EM1002 controller software, Merlin V.5.2v2. The waterline to the RP is the elevation required to compensate for draft.

RP to EM1002 offset - WL = Elevation from WL to RP

1.68m - 3.69m = -2.01

To verify the draft and the EM1002 depths, five leadlines were performed from the 02 starboard deck, above and slightly starboard of the EM1002 while tied up alongside the pier. The leadline comprised of an eight-pound lead attached to a 100ft fiberglass tape. While the leadline's were being performed the EM1002 was acquiring multibeam data with the Merlin software. The average leadline value of 18.73m was subtracted from the 02-deck elevation of 7.32m above the WL to equal a final depth of 11.41m. The average elevation of the starboard multibeam data was 11.4m, confirming the draft setting of –2.01m in the Merlin software.

Line	Avg. Raw Z(m)	Leadline Z (m)
00001_20060321_155045	*11.3 – 11.5	11.41
* -2.01 draft, 0.00 tide, 0.00 squat Observed value averaged with starboard beams		

For the duration of the survey from March 21 to April 2, 2006, the static draft change due to fuel consumption and water discharge totaled .213m, or .015m per day. The changes observed were corrected for in the waterline table of the hydrographic vessel file R352_MB.hvf

Static Draft Correction -2.01 **(meters)**

Dynamic Draft Survey

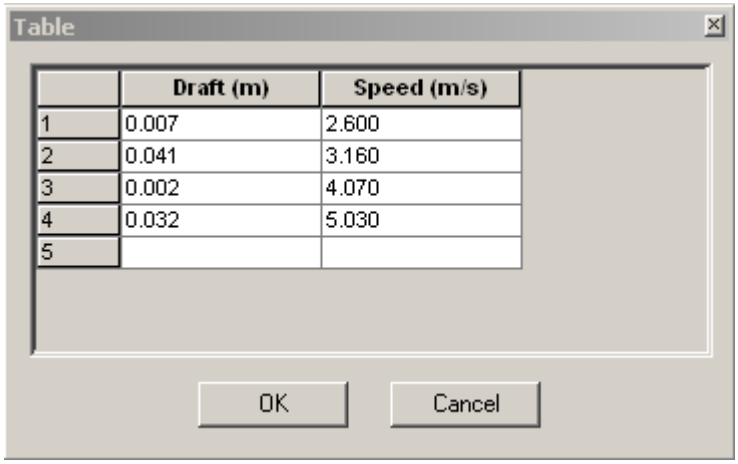
(Vessel waterline with respect to vessel reference frame and vessel speed)

The dynamic draft survey was performed during the Sea Acceptance Test (SAT) offshore of Charleston, South Carolina in March of 2006. Representatives from the NOAA Aviation and Marine Operations (NMAO) performed the survey and evaluated the results. The dynamic draft was determined using the reference surface method as per the NOS Field Procedures Manual. Results of the dynamic draft survey were entered into the CARIS vessel configuration file, R352_MB.hvf

Tabular Summery of Dynamic Draft Results

RPM	Area A		Area B		Area C		Average Speed		Average Δ Draft	
	Speed	*Δ Draft*	*Speed*	*Δ Draft*	*Speed*	*Δ Draft*	*Ave.*	*σ*	*Ave.*	*σ*
0	1.832	0.000	1.327	0.000	0.912	0.000	**1.357**	0.461	**0.000**	0.000
790	6.598	0.026	4.260	-0.026	4.346	0.022	**5.068**	1.326	**0.007**	0.029
1000	6.104	0.088	6.089	-0.078	6.261	0.115	**6.151**	0.095	**0.041**	0.105
1300	7.866	-0.015	7.896	-0.012	8.010	0.034	**7.924**	0.076	**0.002**	0.027
1600	9.816	0.031	9.696	0.063	9.855	0.004	**9.789**	0.083	**0.032**	0.030

Dynamic Draft Table, R352_MB.hvf



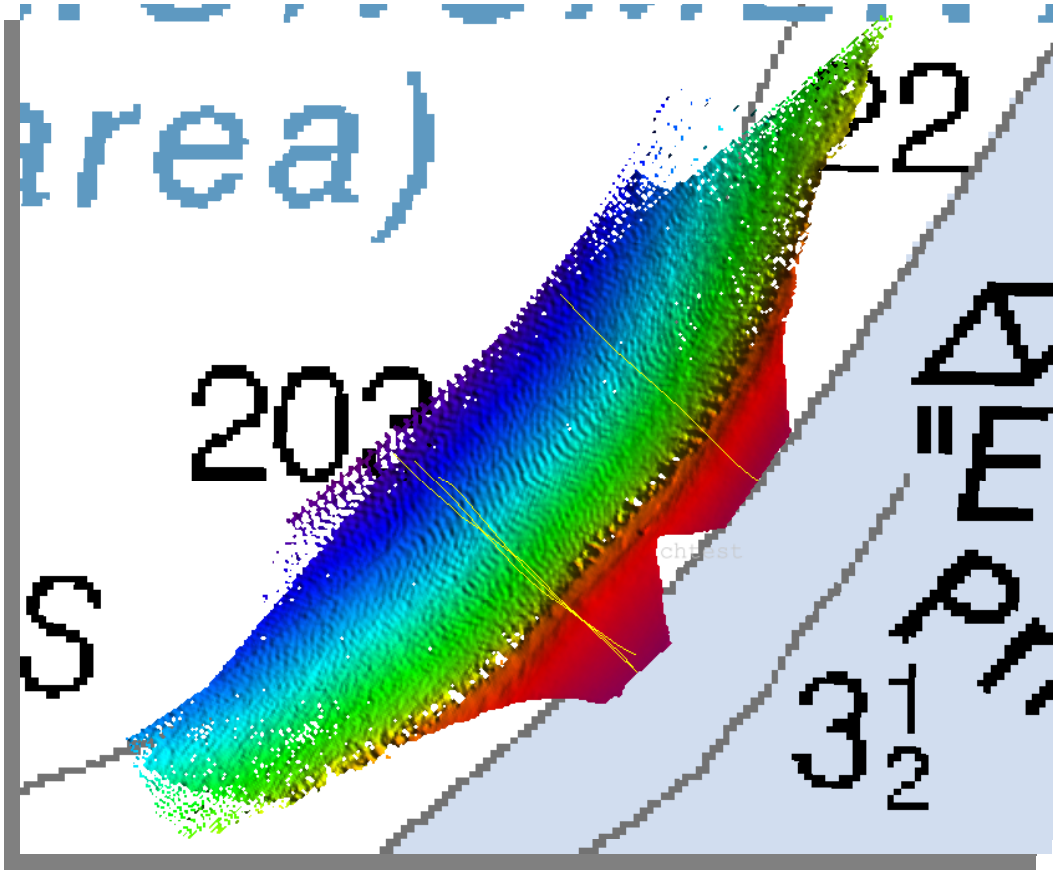
Calibration Survey Information

A patch test was performed before the surveying operations commenced. Biases were estimated by running a series of calibration lines, as described in the NOS Hydrographic Specifications and Deliverables, March 2003 Edition (HSSD). The patch test calibration quantified residual biases between the POS/MV V4's Inertial Measurement Unit and the EM1002 multibeam transducer alignments. The patch test also identified time latency within the positioning and acquisition system. All values in Merlin and in the CARIS vessel configuration file were changed to zero before the patch test was collected.

Calibration Area

Site Description for Latency, Pitch and Yaw Procedures

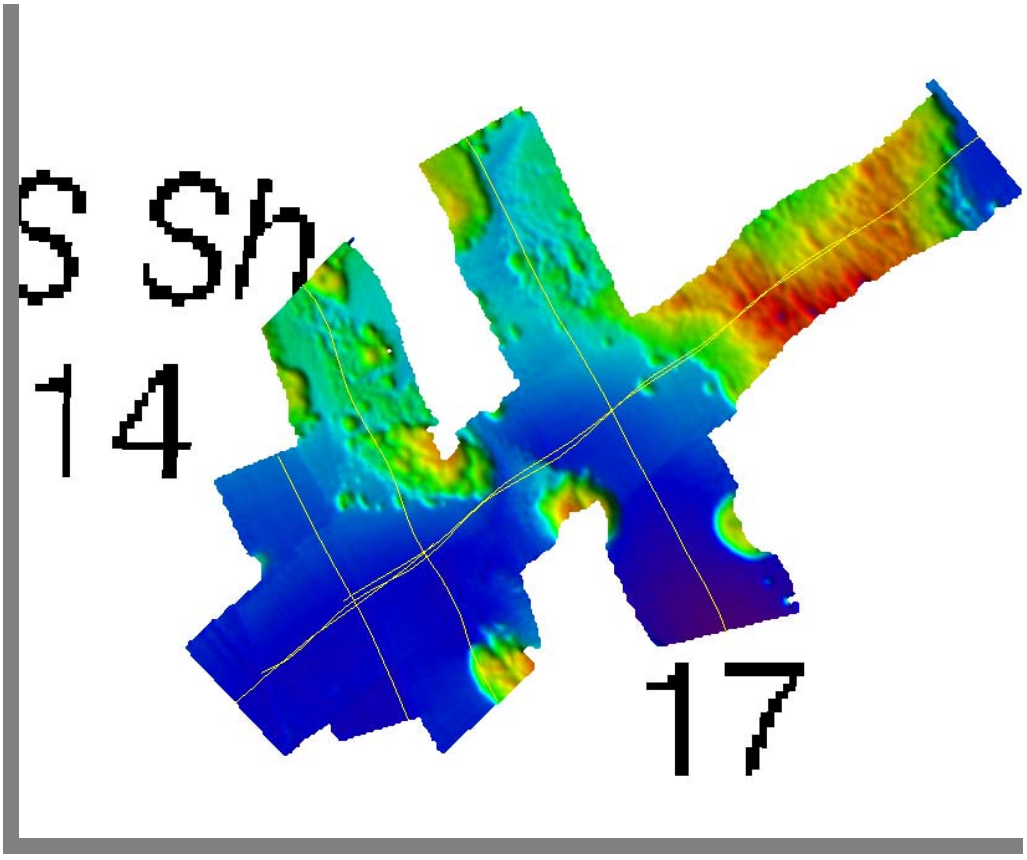
An area 1.5 nautical miles west of Buck Island was identified to provide the steep and smooth slope with little change in across track depth to accurately assess the latency, pitch and yaw biases for the Nancy Foster's EM1002 multibeam system. Two planned survey lines were oriented perpendicular to slope, parallel and spaced apart to ensure overlap of outer beams for the yaw calibration. A sound velocity cast was performed prior to conducting the patch test in the immediate vicinity. A total of four lines were surveyed. Vessel speeds were consistent for the latency, pitch and yaw transects at approximately 4 knots. Vessel speeds were increased to approximately 7 knots for the second latency line of the patch test.



Site Description for Roll and Outer Beam Angle Offset Procedures

The roll and outer beam angle offset calibration procedures require a flat seafloor. An area 5.1 nautical miles to the east of Buck Island, near Lang Bank, proved to be sufficient enough for calibrations. A deeper site would have been preferred but the bathymetry of the area deemed it necessary to make due with the 15-fathom plateau east of Buck Island. A sound velocity cast was performed before the calibration lines were surveyed.

The outer beam angle offset calibration procedure is unique to the EM1002 and is required for electronic beam steering for all beam angles larger than 50°. The EM1002 transducer coating has a sound speed that is significantly different from the sound speed of water and varies with temperature. The outer beam angle offset coefficient is found by estimating the beam pointing angle error in degrees by comparing the depths measured in the outer beams to those of the nadir beams. Comparing two perpendicular surveyed lines with CARIS's roll calibration tool, entering the estimated offset value into Merlin, and re-surveying the lines for verification was necessary before the surveying operations commenced.

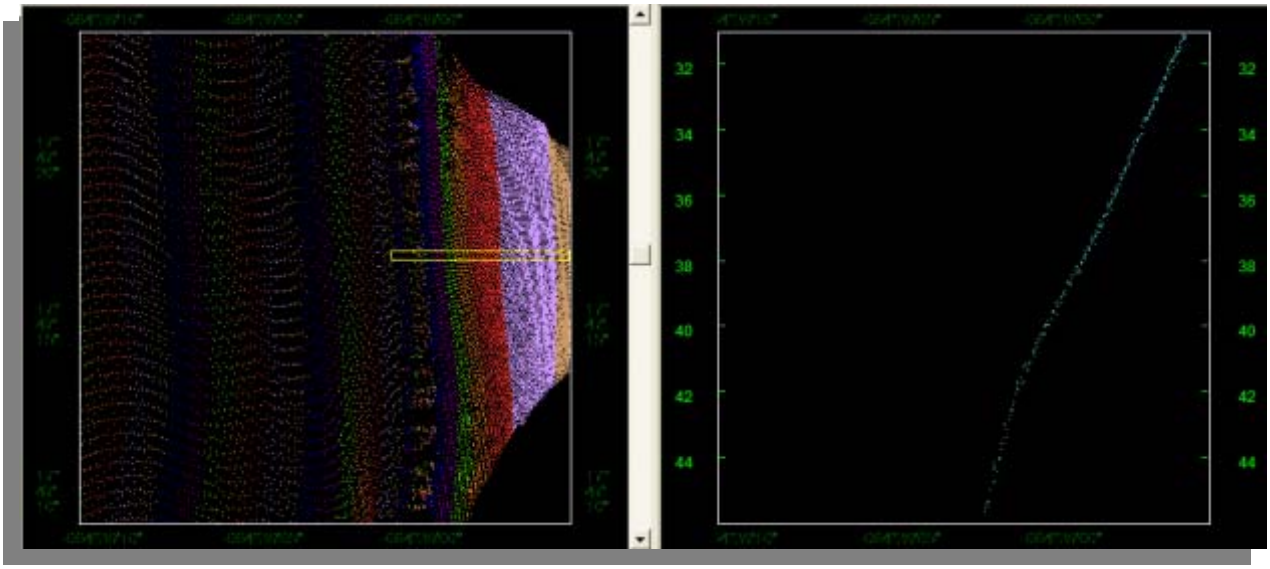


Calibration Survey Information

The hydrographer performed the biases calculations in the order described in the HSSD using CARIS HIPS's calibration tool.

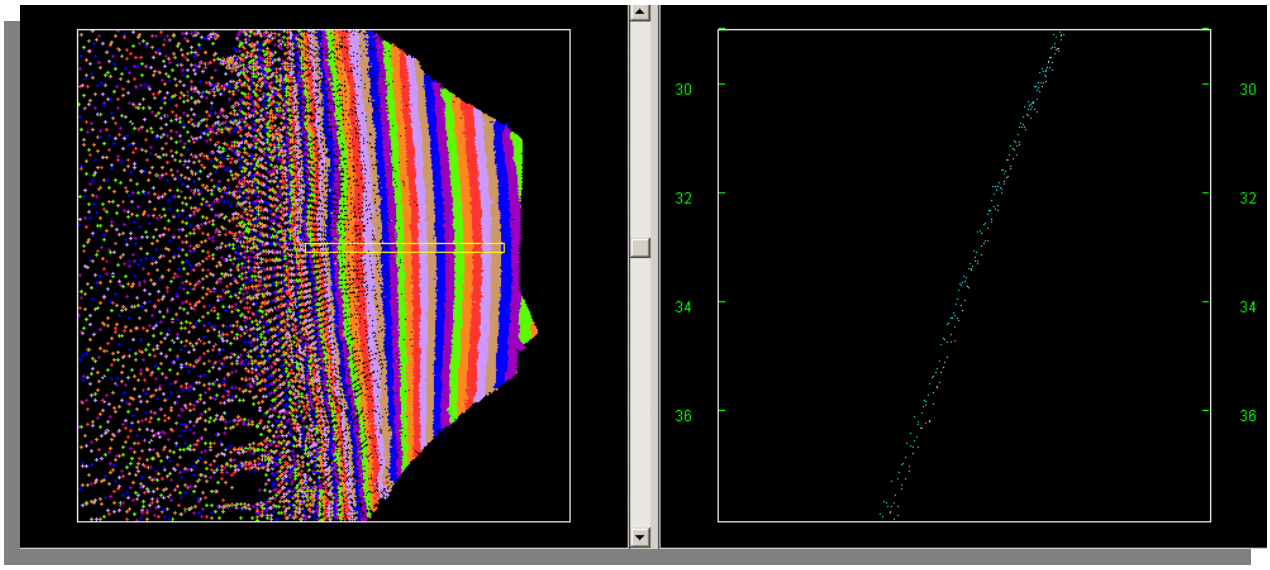
- Latency was calculated first, observing two surveyed lines in the same direction up a slope, at different speeds. Nadir beams were observed with an estimated 0.0 seconds of latency, which is typical of the POS/MV systems.

1) Latency

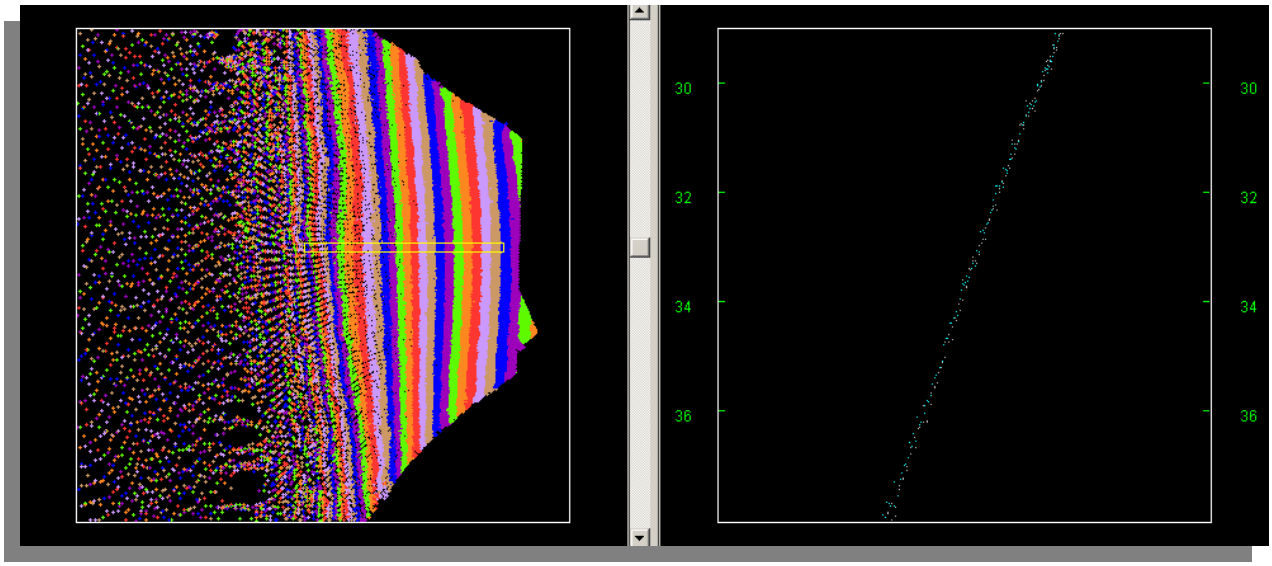


- The pitch offset was calculated next, observing nadir data with two-surveyed lines in opposing directions over a slope.

2) Pre-Pitch Alignment



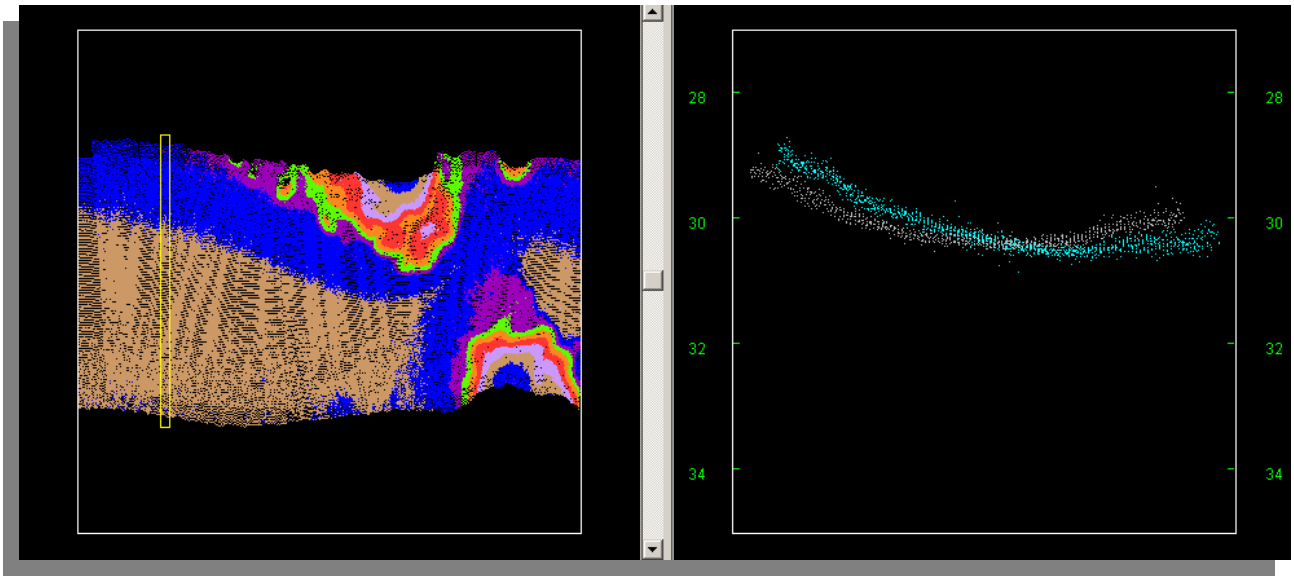
2a) Post-Pitch Alignment



- A Pitch offset of -0.9° was identified and entered into the R352_MB.hvf.

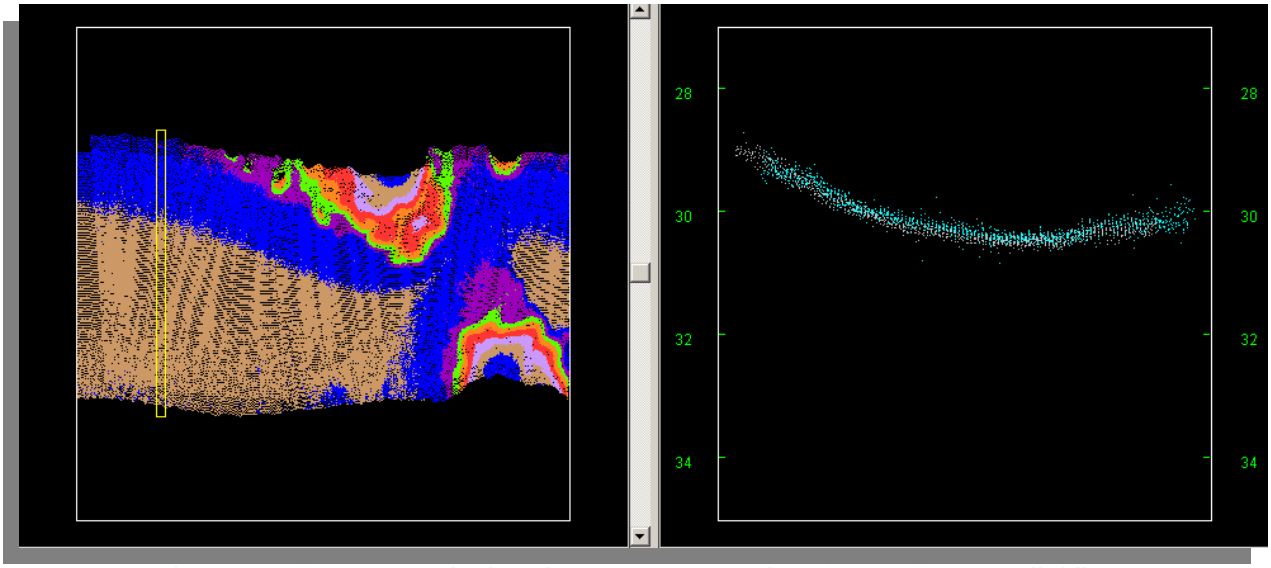
3) Pre-Roll Alignment

- The Roll offset was calculated next, observing the full swath of two-surveyed lines in opposing directions over a flat area.



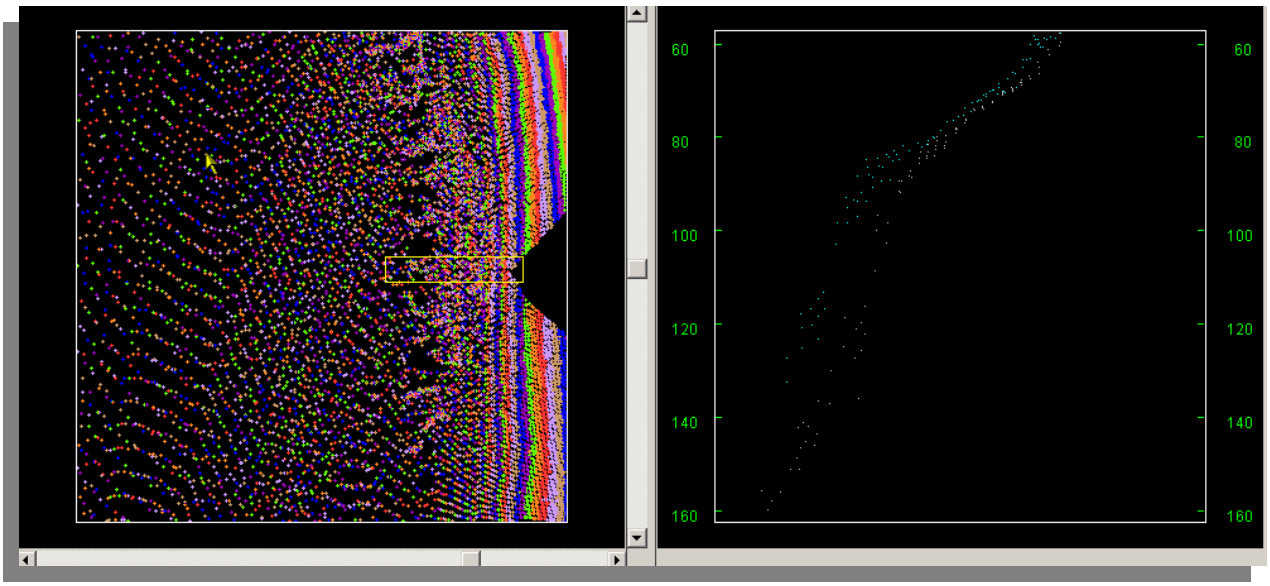
- A roll offset alignment of -0.11° was identified and entered into the R352_MB.hvf.

3a) Post-Roll Alignment



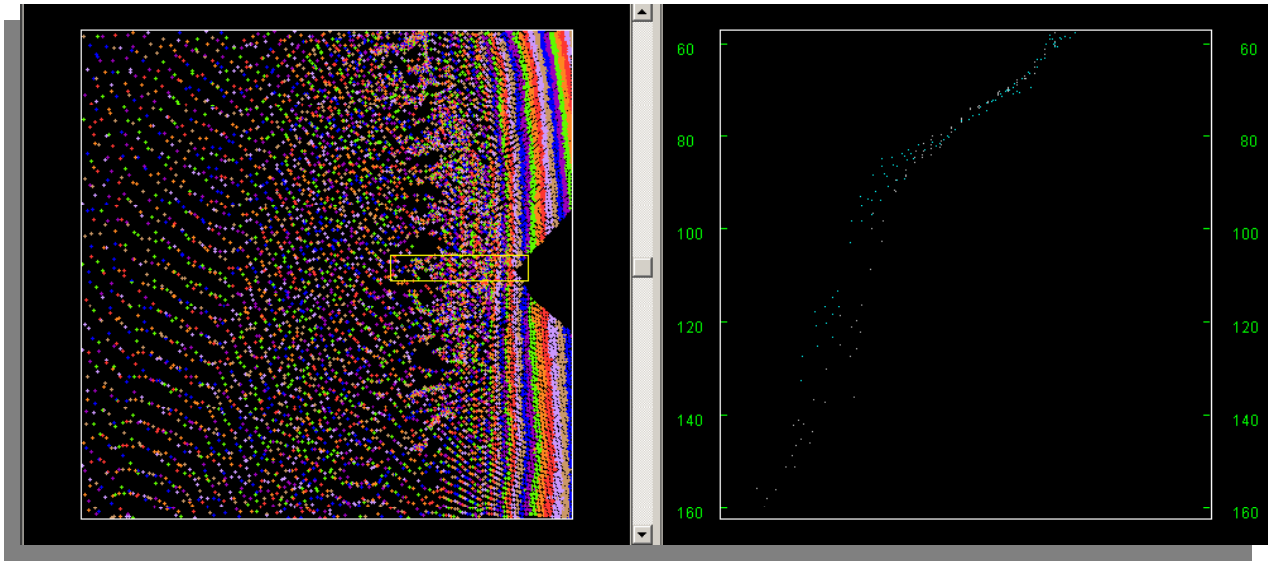
- The Yaw offset was calculated next, outer swaths of two offset parallel lines surveyed in the same direction over a slope.

4) Pre-Yaw Alignment



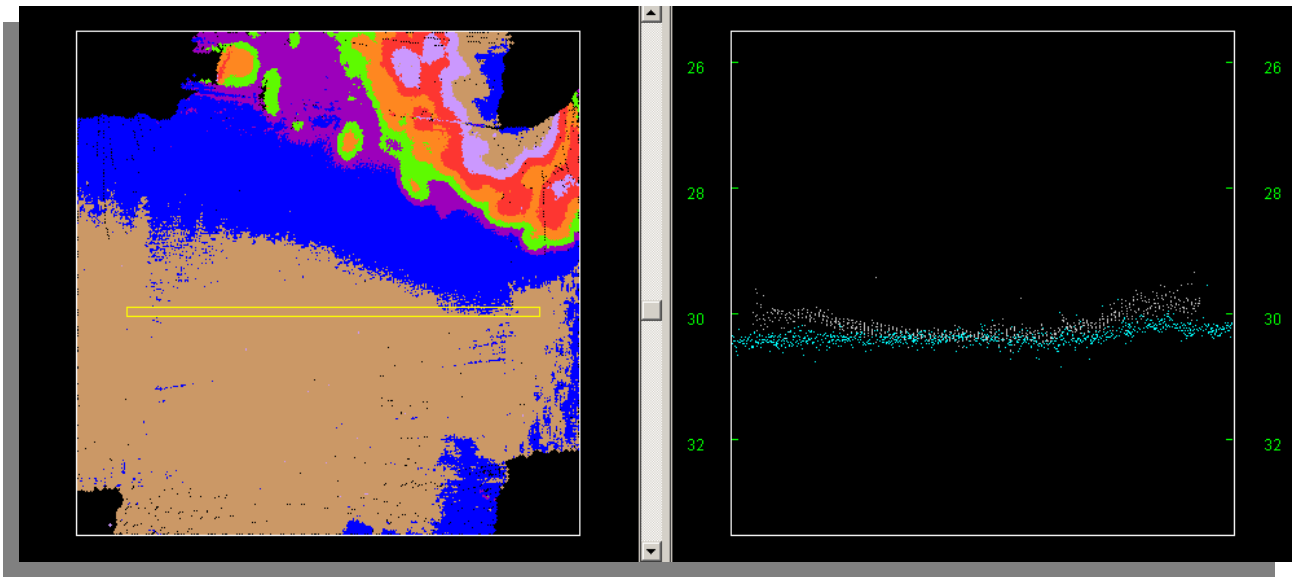
- A Yaw offset alignment of -0.2° was identified and entered into the R352_MB.hvf

4a) Post-Yaw Alignment



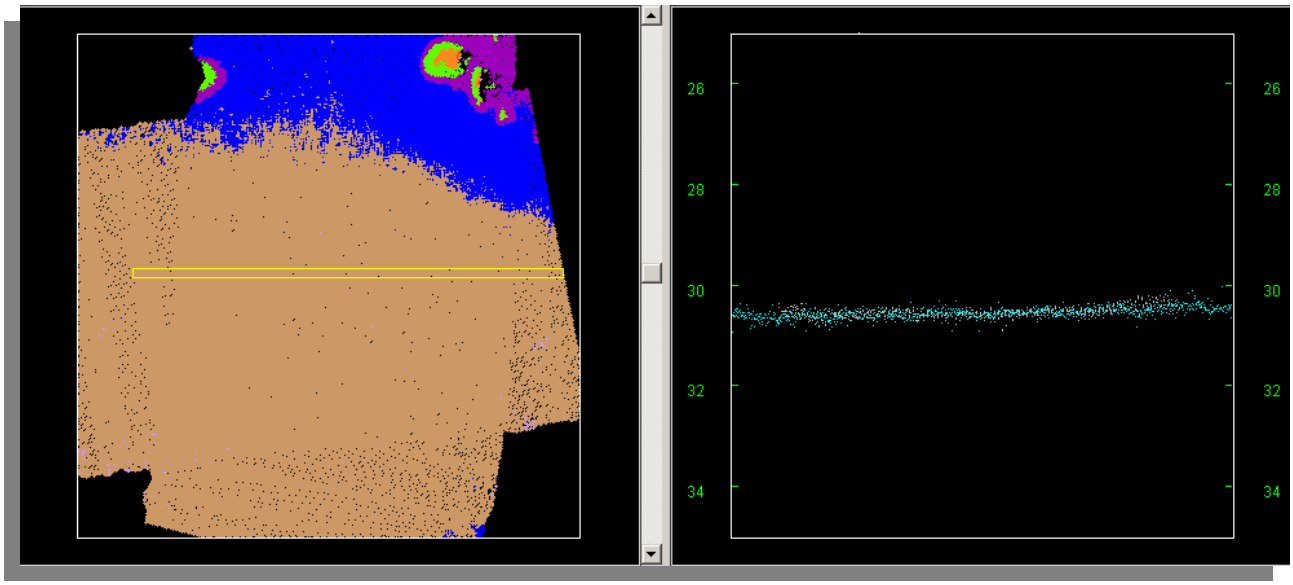
- The outer beam angle offset was the final calculation, observing the nadir beams versus the full swath, of two perpendicular lines over a flat area.

4) Pre-Outer beam angle offset



- An outer beam angle offset of -0.36 was identified and entered into the Merlin acquisition system.

4a) Post-Outer beam angle offset



The patch test results were proven with seafloor alignment from opposing swaths throughout the data set. The CARIS vessel configuration file R352_MB.hvf was updated with the values obtained from the patch test and used for the duration of the S-1911-NF-06 cruise and the post-processing of multibeam data.

Calibration Lines

Line	Direction	Speed	Bias Measured
0001_20060321_204909	NE	5	R1
0003_20060321_212834	NW	5	OBC 1
0003_20060321_212834	SE	5	OBC 2
0005_20060322_000559	SE	4	L1,P1
0006_20060322_002023	NW	4	Y1
0007_20060322_002922	SE	7.5	L2
0008_20060322_003522	NW	4	P2,Y2
0009_20060322_0042103	SW	5	OBC Check
0010_20060322_043013	NW	5	OBC Check

Sound Velocity Correction

Measure water sound velocity (SV) prior to survey operations in the immediate vicinity of the calibration site. Conduct SV observations as often as necessary to monitor changing conditions and acquire a SV observation at the conclusion of calibration proceedings. If SV measurements are measured at the transducer face, monitor surface SV for changes and record surface SV with profile measurements.

Sound Velocity Measurements

Cast	Time	Depth(m)	Northing	Easting
13_060800152.359	2030	36	1966085	337946
14_06080230.4608	2325	450	1967715	324843

Tide Correction

Predicted tides applied.

Gauge ID

Approximate distance of gauge from calibration site: (n. N/A **mi.)**

Approximate water level range at calibration site: .050 **(meters)**

Water level corrections applied:

- [X] Predicted
- [ ] Preliminary
- [X] Zoned
- [ ] Verified

Data Acquisition and Processing Guidelines

Initially, calibration measurement offsets were set to zero in the vessel configuration files. Static and dynamic draft offsets, inertial measurement unit (IMU) lever arm offsets, and vessel reference frame offsets were entered in appropriate software applications prior to bias analysis. Performed minimal cleaning to eliminate gross flyers from sounding data.

Navigation Timing Error (NTE)

Measure NTE correction through examination of a profile of the center beams from lines run in the same direction at maximum and minimum vessel speeds. NTE is best observed in shallow water.

Transducer Pitch Offset (TPO)

Apply NTE correction. Measure TPO correction through examination of a profile of the center beams from lines run up and down a bounded slope or across a conspicuous feature. Acquire data on lines oriented in opposite directions, at the same vessel speed. TPO is best observed in deep water.

Transducer Roll Offset (TRO)

Apply NTE and TPO corrections. Measure the TRO correction through examination of roll on the outer beams across parallel overlapping lines. TRO is best observed over flat terrain in deep water.

Transducer Azimuth Offset (TAO or yaw)

Apply NTE, TPO and TRO corrections. Measure TAO correction through examination of a conspicuous topographic feature observed on the outer beams of lines run in opposite directions.

Patch Test Results and Correctors

Evaluator	NTE (sec)	TPO (deg)	TAO (deg)	TRO (deg)
Mike Stecher	0.0	0.90	-0.2	-0.11

Corrections calculated in: CARIS HIPS

[X] Caris [ ] ISIS

[ ] Other _____

Caris Vessel Configuration File

Name: R352_MB.hvf

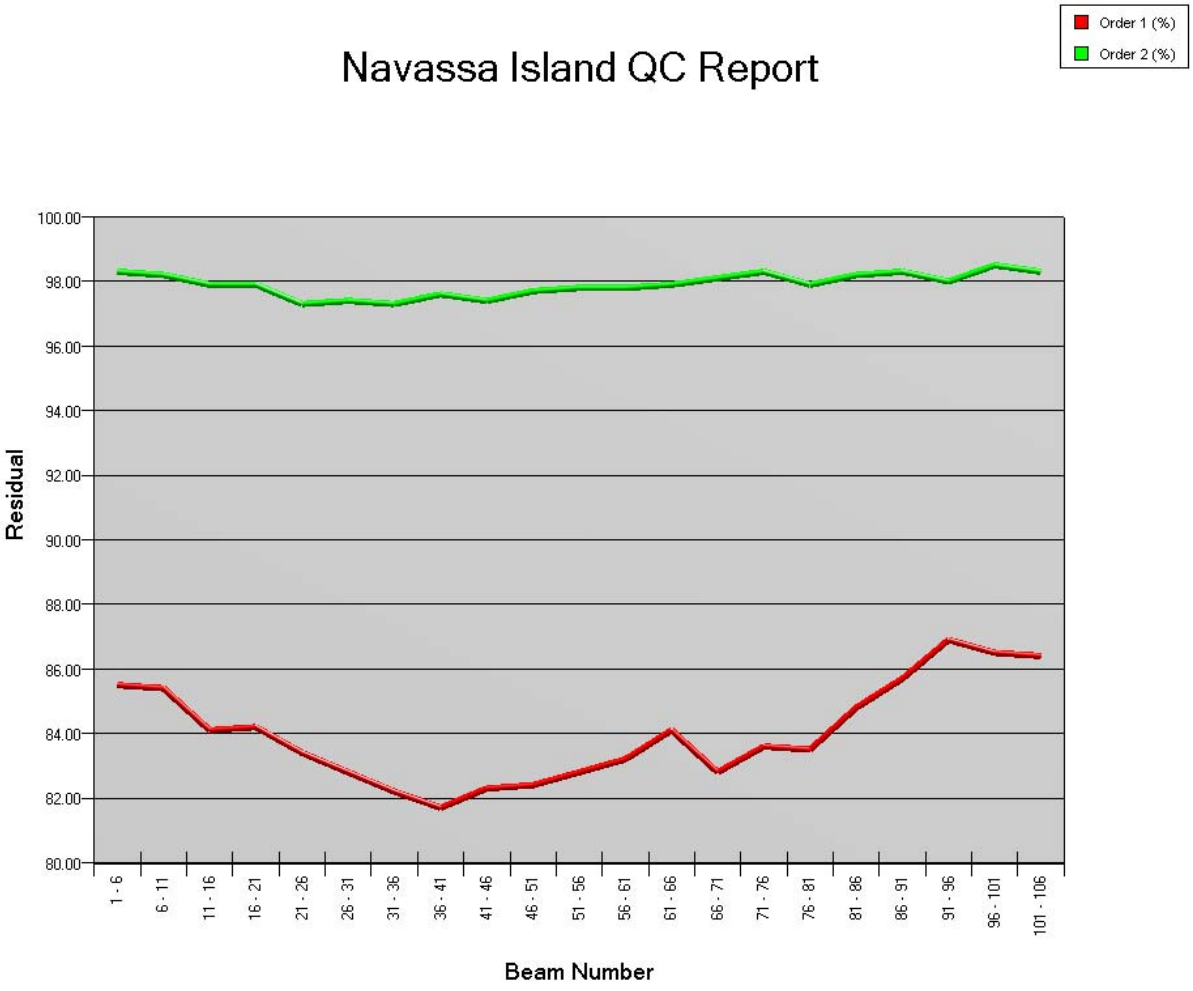
Version: 6.0 SP 1 HF 1-18

New [X] Appended values with time [ ] tag

Evaluator: Mike Stecher, Lead Hydrographer

APPENDIX J

CARIS Quality Control Report


Navassa Island QC Report
Order 1 (%)
Order 2 (%)
Residual
100.00
98.00
96.00
94.00
92.00
90.00
88.00
86.00
84.00
82.00
80.00
1 - 6
6 - 11
11 - 16
16 - 21
21 - 26
26 - 31
31 - 36
36 - 41
41 - 46
46 - 51
51 - 56
56 - 61
61 - 66
66 - 71
71 - 76
76 - 81
81 - 86
86 - 91
91 - 96
96 - 101
101 - 106
Beam Number

APPENDIX K

NF-06-05-NAVAS Cruise Instructions

CRUISE INSTRUCTIONS: NOAA SHIP NANCY FOSTER

Cruise Title: **Characterization of Navassa National Wildlife Refuge**

Cruise Number NF-06-05-NAVAS

Period of Cruise: DEP: 04/20/06 San Juan, Puerto Rico
ARR: 05/03/06 Puerto Plata, Dominican Republic

Area of Operation: Navassa National Wildlife Refuge. Navassa is a small, uninhabited island approximately 35 miles west of Haiti (Figure 1). The area of operations will likely be confined within the following coordinates:

18.42° N, 75.04° W	18.42° N, 74.99° W
18.38° N, 75.04° W	18.38° N, 74.99° W

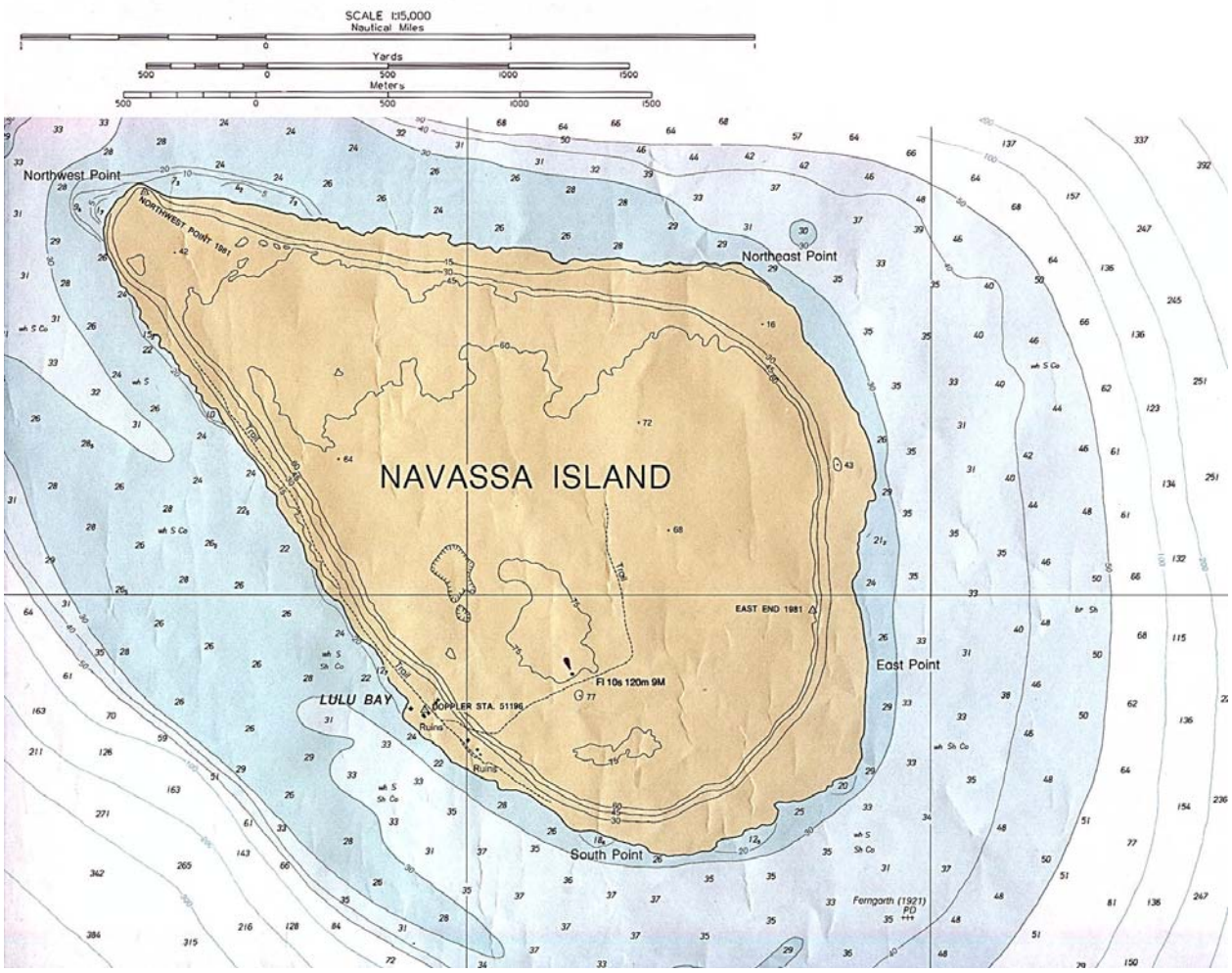


Figure 1. Navassa Island and its surrounding bathymetry.

1.0 Scientific Objectives:

Primary:

A) Generate habitat maps for resource managers using sidescan and/or multibeam sonar, drop cameras and/or ROV, and diver surveys (fish transects, benthic photoquadrats). The primary area of interest is the deep terrace (30-50 m), but operations will also be conducted in shallower water (< 30 m).

B) Drop camera, diver surveys, and interviews with fishermen to determine the abundance of artisanal fishing gear, type of gear used, benthic habitats fished, catch landed, and impact to benthic resources.

C) Stable isotope analyses and herbivory assays, to determine the trophic structure on coral reefs in Navassa and energy transfer between trophic guilds and/or habitat types.

D) Quantification of the physical environment around Navassa (CTD casts, light profiles, installation of long-term temperature loggers, Acoustic Doppler Current Profiler data) to model benthic productivity and to determine potential susceptibility to coral bleaching.

E) Assess population status of species (conch, turtles) newly targeted by artisanal fishers.

Secondary:

F) Provide Fish and Wildlife Service personnel access to Navassa Island for terrestrial sampling and observations.

2.0 Schedule of Operations:

2.1 Daily Schedule:

12 March (Sunday): Science party makes sure that all gear not to be hand-carried (sidescan sonar, dive gear, drop cameras, Hyperlite recompression chamber, oxygen cylinders, etc.) are loaded and stored on the NANCY FOSTER prior to the ship's departure for the Caribbean on 13 March.

19 April (Wednesday): Science party arrives in San Juan, Puerto Rico. Some science party may remain onboard from previous cruise.

20 April (Thursday): Sail for Navassa. Request earliest possible departure.

21 April (Friday) – 22 April (Saturday): Transit to Navassa.

23 April (Sunday): Begin sampling at stations, using up to 2 launches simultaneously at locations to be determined. Daytime dive work entails mapping previously installed fixed transects with video, fish counts, benthic coring, and stable isotope sample collection. Sonar work using sidescan sonar or multibeam system during or in between dives.

24 April (Monday) – 1 May (Monday): Continue as on 23rd. Choice of stations will be based upon sea state and set, often maneuvering to the most sheltered locations and remaining stations to conduct dive operations.

2 May (Tuesday): Conclude sampling ~1800 and depart for Puerto Plata, Dominican Republic.

3 May (Wednesday): Arrive Puerto Plata. Science party disembarks. A majority of the gear will be left on-board, to be off-loaded when the NANCY FOSTER returns to Charleston (expected arrival May 10).

2.2 Watches:
Vessel operations will typically be on a ~ 20 hour workday. A "give and take" operation cycle will be instituted during these workdays via consultation between the Chief Scientist and Commanding Officer in order to balance crew complement with demands of day-night operations. One crew member will be required on deck to work the winch for sidescan sonar, Niskin bottle deployment, and drop cameras.

In the Science Party, the Field Party Chief and the Data Manager are responsible for organization of operations and data, respectively. The Chief Diver is responsible for dive record keeping and developing dive profiles for presentation to the Chief Scientist who will clear them with the Commanding Officer or a designee.

3.0 Site Locations:
Due to the exploratory nature of the trip and the fact that this is the science party's first trip to the area, site locations will be determined ad hoc. Previous cruises by other researchers have established several sites that may be sampled during this cruise, including:

North Shelf 18° 24.810' N, 75° 01.334' W
West Pinnacles 18° 24.331' N, 75° 01.507' W
Deep Patch 18° 24.277' N, 75° 01.613' W
NW Point 18° 24.825' N, 75° 01.786' W
Lulu Bay 18° 23.75' N, 75° 01.19' W
Syringodium bed 18°24.728'N, 75°00.938'W

3.1 Map of Operations:
Specific work sites around Navassa will be identified during the cruise. For a general chart of the area, see Figure 1 at the top of the text.

4.0 Description of Operations:
General Operations: The general scientific tasks are similar to those our group routinely conducts in the Tortugas aboard the NANCY FOSTER, and the majority of the science party has considerable experience from those cruises. They are organized into teams with defined responsibilities. With the exception of one proposed observer diver, all members of the scientific party are either NOAA Divemasters, NOAA Working Divers, NOAA Scientific Divers or divers with NOAA reciprocity (see Section 6.3). There are also numerous skilled NOAA-qualified small boat operators, some with life-long experience in the operation of vessels less than 15m, certified in CPR and First Aid, and available to operate small craft should the Ship desire this assistance. We request use of hand-held radios for communication among the deck, science lab, sea lab, small boats, and Ship Operations.

We will request mounting of a continuous recording light sensor topside as well as at least two DGPS beacons.

Dive Operations (general): The science party has numerous personnel cleared under the new NOAA small boat operations guidelines to operate Class I and II vessels and are thus available to

relieve ship's personnel in these surveys. The NANCY FOSTER will provide a review of their sonic recall system used for diver retrieval prior to dive operations. In addition to all NOAA dive safety equipment, the sonic retrieval system will be aboard the launch operating furthest from the ship for all dives deeper than thirty feet. Under conditions where tracking of bubbles may be difficult, arrangements will be made at the surface prior to diving for one diver to deploy a pop buoy for tracking purposes (each diver carries a pop buoy). If a diver buoy is to be deployed, care must be taken to avoid fouling if a second buoy is released for marking the manta. If upon arrival at a site, the fast buoy is being pulled under by current, the dive will be aborted and the buoy retrieved. For dives at depths greater than or equal to 90', a spare Enriched Air Nitrox tank will be hung at 15' and perhaps at deeper depths (based on discussion with NDC) on the buoy line.

Qualified ship's crew are welcome to participate in dive operations, at the discretion of the Commanding Officer.

Dive Operations (specific):
The Science Party will request the deployment of either one 3-person dive team or two 2-person dive teams to best facilitate sampling at each station. The third diver may be necessary for safety reasons, or to accomplish additional tasks during the dive. There are several cruise objectives that require dive operations, and protocols will vary slightly depending on the task. A detailed dive plan will be submitted to the NOAA Dive Center and to the NANCY FOSTER. The general protocols are as follows:

Habitat Characterization:

1. Launch goes to dive site. In the case of predetermined sampling sites, launch will navigate to site's location using science party Trimble DGPS and/or launch's DGPS. When new sites are to be established, depth must be confirmed. If the launch has no depth finder (one was proposed to be installed on the Sea Ark as part of the winter refit; the RHIB has no depth finder), science party will confirm depth using hand-held unit.
2. Upon arrival at the site, launch drops fast buoy. Divers follow buoy line to bottom.
3. Diver #1 conducts a fish census on the reef first, deploying a meter tape as he/she goes. Although the fish survey runs for 30m, diver #1 will unreel the tape to 30m for the benthic transect.
4. Diver #2 follows behind diver #1 and shoots photoquadrats along the 30m transect, using digital still photography. Diver #1 waits at the end of the meter tape for diver #2 to finish. Upon completion of the photographs, diver #1 reels in the tape while both divers swim back to the start of the transect. Repeat if time is available.
5. Divers will collect and stow all gear and begin ascent up the buoy line.

NOTE: If sufficient technical dive support can be obtained from NURC and/or the NOAA Dive Center, some habitat surveys may be conducted using planned decompression diving. Please see the dive plan for additional details.

Herbivory Assays:

1. Launch goes to dive site. In the case of predetermined sampling sites, launch will navigate to site's location using science party Trimble DGPS and/or launch's DGPS. When new sites are to be established, depth must be confirmed. If the launch has no depth finder (one was proposed to be installed on the Sea Ark as part of the winter refit; the RHIB has no depth finder), science party will confirm depth using hand-held unit.

2. Upon arrival at the site, launch drops fast buoy. Divers follow buoy line to bottom.
3. Dive team deploys herbivory units; each unit consists of a piece of rock rubble with native algae attached using a rubber band. Diver #1 will deploy 6 horizontal units, and diver #2 will deploy 6 vertical units.
4. Divers will collect and stow all gear and begin ascent up the buoy line.

Gear Impact Observations:

1. Launch approaches selected surface buoy for artisanal fishing gear. A DGPS point will be collected using the science party's Trimble DGPS and/or launch's DGPS. Site depth will be confirmed using the launch's depth finder or a small hand-held depth finder.
2. Divers will use the gear buoy for descent. Diver #1 will collect digital still photographs or digital video of the fishing gear. Diver #2 records observations on a slate, including type of gear, depth, type of habitat fished, and type of catch (if visible). Divers will NOT physically interact with the gear in any way.
3. Divers will collect and stow all gear and begin ascent up the buoy line.

Miscellaneous dive tasks:

At the discretion of the chief scientist, dives may be required for specific tasks that may not always be compatible with primary dive operations. Alternatively these tasks may be delegated to a third diver on one of the dive tasks above when appropriate. Dives will generally be conducted as above, with launch transit to selected sites and ascent/descent along a buoy marker. These additional dive tasks may include, but are not limited to:

1. Installation of temperature loggers. Divers will install rebar or stainless steel stakes and subsurface floats, and use cable ties to secure temperature loggers to stake.
2. Collection of samples for stable isotope analysis. Microalgae may be collected using small sediment cores (as in the Tortugas). Macroalgae and certain invertebrates will be collected by hand, while small amounts of coral tissue will be collected with a hammer and chisel. Targeted fish species would be collected using pole spears. Algae and invertebrate samples will be sealed in Ziploc bags underwater, and stored in mesh gear bags for transport to the surface. Fish samples will be placed directly in mesh gear bags.
3. Collect algal bait and rock rubble for use in herbivory experiments. All collection will be done by hand, and samples stowed in mesh bags for transport to the surface.
4. Divers may be necessary to assess the status of conch populations around Navassa. Specific dive tasks could include in situ species identification, measuring shell length, or collecting specimens for genetics/reproductive status.
5. Haitian artisanal fishers in Navassa have been known to create underwater debris middens with discarded catch (Miller et al. 2003). If such middens can be located, divers may be dispatched to measure/collect turtle bones and/or conch shells to determine what size/age classes may be targeted by the fishery.

Multibeam sonar mapping: **Pending acquisition of trained operator as part of the science party.** CCFHR considers the lack of multibeam surveys an important data gap for Navassa National Wildlife Refuge, but currently lacks expertise in using the NANCY FOSTER's multibeam gear. If an appropriate operator can be found, multibeam surveys will be conducted using standardized techniques as described in the NOAA and USACE hydrographic surveying manuals.

The following survey datums shall be used:
Horizontal – WGS 84 or Universal Transverse Mercator Zone 17 (UTM 17N)
Vertical – Referenced to MLLW from modeled or predicted NOAA tides

A. Hydrographic Data: Hydrographic survey coverage for the area depicted on the attached map shall be provided. The contractor shall conduct the multibeam surveys as to ensure 100% coverage to the extent practical of the centerline paths shown on the attached map. Estimated survey time for 30 stations is ~15 days. A priority list will be provided by the CCFHR to The contractor in the event that all stations cannot be mapped within the allotted 10 days; however, the best attempt possible will be made to collect the maximum amount of data in the allotted time.
B. System Calibration and Check: The contractor shall calibrate and check the multibeam system in accordance with the USACE and NOAA hydrographic survey specifications and deliverables. The positioning system shall be checked and calibrated against land-based benchmarks if the opportunity arises. A digital log containing the results of all calibrations and checks will be kept on file by The contractor and final results of these calibrations will be provided to the NOAA CCFHR in the form of FGDC standard metadata files in HTML or XML format.

Sport Scan-based mapping: As the acquisition of a multibeam operator is unlikely, we will rely on sidescan sonar for the majority of our habitat mapping effort. For ship-board operations, we request that the unit (1 m long and ~ 30 lbs) be deployed using the J-frame and smaller hydro winch off the side of the ship. Best configuration can be discussed when scientists arrive. We request that a Tom weight (science party provides) be lowered to proscribed depths (~80% of the water depth) and the Sport Scan would trail ~ 10-20' behind the weight. Further, we request that the ship move ahead at dead slow, ~2 knots while scanning these small areas. Towing coordinates TBA. Where shallow depths do not permit entry, we may request use of a launch. Frequent communication between the deck and bridge with regard to depth is needed to maintain the Tom weight at ~ 80% of the water depth and avoid collision of unit with seafloor.

Video surveys: Benthic habitat surveys may be conducted using drop cameras, towed video platforms (e.g. MiniBat) and/or remotely operated vehicles. Gear will be lowered over the side of the NANCY FOSTER using the J-frame, and may require the use of a Tom weight (provided by science party). We request that the ship drift or maintain (in consultation with the science party) tracks along bathymetric contours using the dynamic positioning system. Tracking of drifts and trawl tracks are requested; this may be supplemented by science party tracking from the Dry Lab. Additional surveys may be carried out using a drop camera deployed from a launch, using the science party's Trimble DGPS to provide drift tracks.

Stable Isotope (SI) sampling: At each site, divers may collect seagrass, macroalgae, benthic microalgae, coral and other invertebrates, and fish for stable isotope analysis. Tissue samples may either be dried and stored in a desiccator or deep frozen; therefore, access to a deep freeze is requested.

Misc. overboard collections:
1) *CTD casts (potentially)* –Water will be filtered for phytoplankton SI, chlorophyll and biomass. No gear is to be deployed without approval of the Officer of the Deck for each deployment.

2) *Light profiles* - At randomly located sites between 1000 and 1400 h we may conduct vertical light profiles using hand-lowered gear. A 2-pi, gimbaled light sensor will be attached to a continually recording datalogger mounted atop an unrestricted location (as approved by the Commanding Officer or designee) for measuring the amount of light reaching the top of the sea surface. No gear is to be deployed without approval of Officer of the Deck for each deployment.

3) *Stable isotope sampling* – potential use of hook-and-line gear to collect fish samples. As above, access to a deep freezer is requested.

Ancillary data: Continuous navigation and meteorological data are also requested.

Miscellaneous launch activities: Occasional launch transport for Fish and Wildlife Service personnel to land on Navassa for terrestrial surveys. May be accompanied by members of scientific party or ship's crew, as appropriate.

SPECIAL CONSIDERATIONS:

1. Support for dive operations is requested on an as needed basis. Dive ops during this cruise will be extensive. Science Party requests the use of two, 2-person or one, 3-person dive teams to best facilitate sampling
2. Request that continuous recording of ship's SCS data provided in digital format at end of cruise.
3. Use of NANCY FOSTER's small launches requested.
4. Request continuous support of the ship's Enriched Air Nitrox system.
5. Request aperiodic boxed lunches for science party daytime surveys (specific requests must be made to the steward the night before).
6. Request installation of HYPACK communication between science lab (dry) and bridge to convey trackline and station locations from the science party to the FOSTER.
7. Request *conditional availability of survey launch* for multibeam, sidescan, and/or drop camera surveys. Necessity of launch to be determined by CO, XO, and Chief Scientist prior to the FOSTER's departure from Charleston on March 13.
8. Request vegetarian diet for C. Addison, A. Poray, and S. Viehman. *Additional vegetarian meals may be requested prior to departure, pending confirmation of dietary preferences of other members of the science party.*
9. Science party will request deployment of a Hyperlite emergency hyperbaric stretcher and two trained operators from NURC or the NOAA Dive Center. Science party will also provide ~20 cylinders of medical-grade oxygen for use in dive operations and emergencies.
10. Request permission to load a majority of the scientific equipment onto the vessel before the NANCY FOSTER departs Charleston for its Caribbean leg. A large portion of the gear we need will also be used by Jud Kenworthy's Puerto Rico trip. Our gear may be stowed below and should not impact the USVI cruise, but we will check with the PI for that trip.

5.0 Requirements and Equipment:

5.1 Vessel Provided:

1. Rigid vessels (i.e. Inflatable/RHIBs and SeaArk) for dive, survey, and equipment deployment operations - access to 12V battery of launch for powering small inverter.
2. Divers to assist in dive operations (optional).
3. Dry and wet Laboratory space for equipment storage, equipment / sample prep, sample workup, and "office" use by science party.
4. Air compressor and Enriched Air Nitrox system for SCUBA tank and bank filling.
5. Emergency oxygen for dive operations with sufficient capacity for 3 h breathing for two divers.
6. J-frame for deploying ship's CTD.
7. J-frame and meter block for deploying drop camera/ROV w/ 0.250" dia. wire rope.
8. J-frame and meter block for deploying Sport Scan sonar unit w/ 0.250" dia. wire rope.
9. SCUBA air tanks and (6) 100 cubic foot NITROX-ready tanks.
10. DGPS positioning as digital SCS output at end of cruise.
11. Ultra-cold freezer (-15C) space for biological samples.
12. Diver recall system.
13. Hand held radios for communication between deck, Sea Lab, launches, etc.
14. Bolts for fastening bollard to deck (determined by thread size of bolting points on ship's deck).

5.2 Program Provided:

1. Drift camera sled (MiniBat) and associated tow apparatus (possibly launch deployed).
2. Two Sport Scan sidescan units and associated mounting devices and cables (possibly launch deployed).
3. Laptop computers for Science Party use (~ 5).
4. SeaView underwater video cameras (~ 4)
5. Digital video cameras and associated equipment (~ 3).
6. Digital still cameras and associated equipment (~4).
7. Trimble DGPS units (~ 3).
8. ~ 20 Enriched Air Nitrox SCUBA tanks with racks (brought by science party).
9. Misc. benthic sampling equipment (core tubes, Ziploc bags, glass vials, etc.).
10. Small generator or inverter (12V operated) for sonar and video mapping when using small launches.
11. Permits for conducting otherwise prohibited activities in Navassa waters.
11. Cell phones.
12. Equipment for stable isotope collection (hammer, chisel, pole spears, etc.)
13. Extra emergency oxygen kits (2).
14. Beam trawls (2).
15. Spill response kit.
16. Large Tom weight for use in deployment of Sport Scan units (~ 70#).
17. LiCOR light meter and associated cabling.
18. Bollard for coiling cables during overboard deployment of drift cameras and the Sport Scan.
19. Secondary diver recall system.
20. Hyperlite recompression chamber/stretcher (from NURC or NOAA Dive Center)
21. Oxygen cylinders (125 cubic feet) for dive operations/emergencies (~20)

6.0 Scientific Personnel:

6.1 Chief Scientist Authority:
The Chief Scientist has the authority to revise or alter the technical portions of the instructions provided that, after consultation with the Commanding Officer, it is ascertained that the proposed changes will not: 1) jeopardize the safety of the personnel on the ship, 2) exceed the time allotted for the project, 3) result in undue additional expense, or 4) alter the general intent of the Project Instruction.

6.2 Chief Scientist:
Dr. Greg Piniak, CCFHR, NOS/NCCOS (252) 728-8732 work / (252) 646-5625 cell
greg.piniak@noaa.gov

6.3 Scientific Personnel List (TENTATIVE):

Male:	diver	VEGETARIAN
Piniak	x	
Fonseca	x	
Wiener		observer?
Schwagerl	x	
TBD		
TBD		
TBD		

Female:	diver	VEGETARIAN
Viehman x		x
Addison	x	x
Whitfield x		
Uhrin	x	
Nero	x	
Kelty	x	
Poray	x	x
TBD		

Primary responsibilities (tentative):
Chief scientist: Piniak
Field party chief: Viehman
Data guru: Addison
FWS representative: Schwagerl
Translator: Wiener
Chief diver: Whitfield
Chamber operator/DMT: TBD (2 male berths allocated; personnel from NURC or NOAA Dive Center)

TASK TEAMS ***Person in*** *bold* ***is field party chief – responsible for prepping rest of team***

DIVE TEAM A
Fish Addison
Photo **Fonseca**
Misc TBD

DIVE TEAM B
Fish Whitfield
Photo **Poray**
Misc Viehman

DIVE TEAM C
Fish Nero
Photo **Uhrin**
Misc TBD

DIVE TEAM D
Fish **Kelty**
Photo Piniak
Misc TBD

TEAM E (non-tasked but available divers/non-diving duty)
Wiener
Schwagerl
TBD (chamber operator)

TECH DIVING TEAM (IF APPLICABLE)
Research divers: Whitfield, Addison
Safety diver: Poray/TBD
Standby diver: TBD

EXAMPLE ROTATIONS

DAY 1
0830 Team a / boat 1 Team d / deck ops
0900 Team b / boat 2
1100 Team c / boat 1 Team a / deck ops 1500
1530 Team d / boat 1
1600 Team a / boat 2 Team b / deck ops until dark
Team c night shift

DAY 2
0830 Team b / boat 1 Team a / deck ops
0900 Team c / boat 2

1100 Team d/ boat 1 Team b / deck ops until 1500
1530 Team a / boat 1
1600 Team b / boat 2 Team c / deck ops until dark
Team d night work

DAY 3
0830 Team c / boat 1 Team b / deck ops
0900 Team d / boat 2
1100 Team a / boat 1 Team c / deck ops until 1500
1530 Team b / boat 1
1600 Team c / boat 2 Team d / deck ops until dark
Team a night work

DAY 4
0830 Team d / boat 1 Team c / deck ops
0900 Team a / boat 2
1100 Team b / boat 1 Team d / deck ops until 1500
1530 Team c / boat 1
1600 Team d / boat 2 Team a / deck ops until dark
Team b night work

REPEAT CYCLE

Identification: All scientific personnel planning to board the ship should have in their possession at the time of boarding, a proper photo identification card (agency ID, drivers license, etc.).

Up to date NOAA or AAUS dive and Enriched Air Nitrox certifications will be cleared through the NOAA Dive Office before arrival aboard NANCY FOSTER. All dive personnel should have in their possession at the time of boarding, a copy of their NOAA certified dive physical (water proof paper preferred). Observer divers must be approved by the NOAA Dive Center and the NANCY FOSTER prior to departure.

6.4 Medical History Reports: should be sent directly to MOC for clearance by Medical Office. Command can no longer medically clear participants for sailing. MOC Medical is at 439 West York St, Norfolk, VA, 23510 or forms can be faxed to 757.441.3760

7.0 Miscellaneous Activities:
None known at this time - however, the highly exploratory nature of the Navassa sampling will likely spawn some kind of rapid-reaction sampling.

7.1 Bridge Activities:

It is requested that a copy of the ship's *Deck Log - Weather Observation Sheet NOAA 77-13d* for and digital SCS data for the entire cruise be provided to the Chief Scientist upon departure of the science party or transmitted within 2 weeks thereafter.

8.0 Modification of Cruise Instructions:

Additional operations and ancillary projects, not covered under the main project, may be performed on a "not to interfere" basis. The Chief Scientist is responsible for determining the priority of the additional work, provided that any changes are discussed with the Commanding Officer and do not constitute a risk to the safety of the ship or personnel and do not significantly change the schedule for this cruise. If the requirements for the additional work place significantly different requirements on the ship, amendments to the Cruise Instructions must be prepared and approved.

9.0 Ancillary Tasks:
Ship's personnel conduct ancillary tasks. Instructions for ancillary tasks routinely assigned to Marine Operations Center ships are contained in *Marine Operations Center Directive 1803.00, Ancillary Tasks for NOAA Vessels*.

10.0 Hazardous Materials:
An inventory list and a *Material Safety Data Sheet* for each hazardous material will accompany hazardous material brought on board NOAA Ship NANCY FOSTER by scientific parties. This information should be provided to the Commanding Officer. On departure from the ship, scientific parties will provide an inventory of hazardous material to the Commanding Officer showing that all hazardous material brought on board have been properly used up or removed in suitable waste containers. Anticipated hazardous materials (due to their flammable nature) include:

1) emergency oxygen (2 portable kit with 2 bottles each, plus up to 20 additional cylinders for dive emergencies)
2) three, 2.5-Oz. Butane refill canisters for cable repair, kept in toolbox.
3) No sample preservatives (ethanol, formalin, etc.) are anticipated at this time. This is subject to change but will be cleared with the NANCY FOSTER before departure.

The *Material Safety Data Sheet* is normally available from the manufacturer of the hazardous product. Procedures followed for use of chemicals will be those outlined in the *Chemical Hygiene Plan for Chemical Labs* aboard NOAA ships. The Science Party will provide a small spill containment kit appropriate for these chemicals.

11.0 Navigation:
Navigation for sampling surveys and dive station location will often be by Differential GPS. Science Lab will use independent DGPS that is compatible with program software - communication on navigation will be maintained. Small boat ops will be directed both by NANCY FOSTER and program DGPS. Station operations will be recorded in DGPS. For the rest of the cruise, navigation will be by the best method available.

12.0 Communications:
A progress report on operations prepared by the Chief Scientist may be relayed to the program office. Sometimes it is necessary for the Chief Scientist to communicate with another vessel, aircraft, or shore facility. Through various modes of communication, the ship is able to maintain contact with the Marine Operations Center on an as needed basis. These methods will be made available to the Chief Scientist upon request, in order to conduct official business. Due to a new directive from Marine Operations Center, the ship must charge the science party for all calls made on the cell or sky-cell telephone. INMARSAT, Sky Cell and cellular communication costs shall be reimbursed to the ship for telephone calls made by all scientific personnel. Currently, Sky Cell

and cellular telephone services are about $0.89 per minute and INMARSAT Mini-M is around $1.68 per minute for voice. These charges will be assessed against the program after NOAA Ship NANCY FOSTER receives the bill. There is generally a three-month delay receiving the bill for review. The Chief Scientist will be required to keep a log of all calls made by the science party. The program will also provide a cell phone to be kept on the bridge.

13.0 Disposition of Data:
The Chief Scientist is responsible for the disposition of data.

14.0 Reports:
The requirement for a formal cruise report by the Chief Scientist is left to the discretion of the CCFHR Center Director. A Ship Operations Evaluation Form is to be completed by the Chief Scientist(s) and forwarded to:

Office of Marine and Aviation Operations
Program Services and Outsourcing Division
SSMC3, Room 12872
1315 East-West Highway
Silver Spring, MD 20910-3282

15.0 Cruise Instruction Approvals:

The Marine Operations Center and NOAA Ship NANCY FOSTER will acknowledge receipt of these instructions.

Submitted by:

Dr. David Johnson Center Director, Center for Coastal Fisheries and Habitat Research	Dr. Greg Piniak Chief Scientist, Center for Coastal Fisheries and Habitat Research
Date_____	Date_____

Approved by:

Rear Admiral Nicholas Prahl Director, Marine Operations Center	James Verlaque Commanding Officer NOAA ship NANCY FOSTER
Date_____	Date_____

This Document is for Office Process use only and is intended to supplement, not supersede or replace, information/recommendations in the Descriptive or Evaluation Reports

AHB COMPILATION LOG

General Survey Information	
REGISTRY No.	W00201
PROJECT No.	NF-06-05-NAVAS
FIELD UNIT	NOAA SHIP *NANCY FOSTER*
DATE OF SURVEY	4/18-5/1/2006
LARGEST SCALE CHART	***26194, edition 5, 20040701, 1:15000***
ADDITIONAL CHARTS	***N/A***
SOUNDING UNITS	**METERS**
COMPILER	LCDR Chris van Westendorp

Source Grids	**File Name** H:\Compilation\HXXXXX_XXXX _XXXX\AHB_HXXXXX\
	E-SAR Final Products\GRIDS\W00201_2m_Final.hns
	E-SAR Final Products\GRIDS\W00201_4m_Final.hns
	E-SAR Final Products\GRIDS\W00201_8m_Final.hns
	E-SAR Final Products\GRIDS\W00201_16m_Final.hns
Surfaces	**File Name** H:\Compilation\HXXXXX_XXXX-XXXX\AHB_HXXXXX\COMPILE\Working
Combined	**W00201_16m_Combined_Final.hns**
Interpolated TIN	\Interpolated TIN**W00201_16m_InterpTIN.hns**
Shifted Interpolated TIN	\Shifted Surface**W00201_16m_InterpTIN_Shifted.hns**
Product Surface	\Product Surface**W00201_15k_100mrad_16mres.hns**
Final HOBs	**File Name** H:\Compilation\HXXXXX_XXXX-XXXX\AHB_HXXXXX\COMPILE\Final_Hobs\
Survey Scale Soundings	**W00201_SS_Soundings.hob**
Chart Scale Soundings	**W00201_CS_Soundings.hob**
Contour Layer	**W00201_Contours_RRV.hob**
Feature Layer	**W00201_Features.hob**
Meta-Objects Layer	**W00201_MetaObjects.hob**
Blue Notes	**W00201_BlueNotes.hob**
ENC Retain Soundings	**N/A**

Meta-Objects Attribution	
Acronym	**Value**
M_COVR	
CATCOV	Coverage available
SORDAT	20060501
SORIND	US,US,survy,W00201
M_QUAL	
CATZOC	6 – zone of confidence U (data not assessed)
INFORM	NF-06-05-NAVAS, Nancy Foster
POSACC	10
SORDAT	20060501
SORIND	US,US,survy,W00201
SUREND	20060418
SURSTA	20060501

DEPARE	
DRVAL 1	10.770 m
DRVAL2	1000.770 m
SORDAT	20060501
SORIND	US,US,nsurf,W00201

SPECIFICATIONS:

I. COMBINED SURFACE:
   a. Number of ESAR Final Grids: 4
   b. Resolution of Combined (m): 16

II. SURVEY SCALE SOUNDINGS (SS):
   a. Radius
   b. Shoal biased
   c. Use Single-Defined Radius (mm at Map Scale): 15000; Radius Value = 1
   d. Queried Depth of All Soundings
      i. Minimum: 11 m
      ii. Maximum: 1000 m

III. INTERPOLATED TIN SURFACE:
   a. Resolution (m): 16m
   b. Linear
   c. Shifted value: -0.75 m

IV. CONTOURS:
   a. Use a Depth List: W00201_NOAA_depth_curves_list.txt
   b. Line Object: DEPCNT
   c. Value Attribute: VALDCO

V. FEATURES:
   a. Total Number of Features: 1
   b. Number of Insignificant Features: 0

VI. CHART SURVEY SOUNDINGS (CS):
   a. Number of ENC CS Soundings: 985
   b. Radius
   c. Shoal biased
   d. Use Single-Defined Radius: m on the ground
      i. Radius Value (m): N/A
      ii. Or use a Sounding Space Range Table (if applicable): W00201_SSR.txt
   e. Filter: Interpolated != 1
   f. Number Survey CS Soundings: 1260

VII. Notes:

ATLANTIC HYDROGRAPHIC BRANCH
EVALUATION REPORT to ACCOMPANY
SURVEY W00201 (2006)

This Evaluation Report has been written to supplement and/or clarify the original Descriptive Report. Sections in this report refer to the corresponding sections of the Descriptive Report.

A. AREA SURVEYED

Navassa Island, National Wildlife Refuge, 35 mi W. of Haiti

II. Area

The boundaries of the survey run from 18°27'10.8"N 075°04'45.5"W to 18°21'08.9"N 074°57'00.9"W.

B. DATA ACQUISITION AND PROCESSING

B.1 DATA PROCESSING

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

CARIS HIPS/SIPS version 6.1 (SP2, HF 1-8)
CARIS Bathy DataBASE version 2.1 (SP1, HF 1-10)
CARIS S-57 Composer version 2.0 (HF 1-3)

B.2 (IV in DR). QUALITY CONTROL

The office processor edited survey bathymetry data in CARIS HIPS for flyers using Swath and Subset editors. New surfaces were computed to conform to 2009 HSSD requirements and appropriate IHO orders. The following details the final depth-thresholded CUBE grids to be used for compilation:
W00201_2m_Final (2m grid using 2m parameters; depth range 10-52 m)
W00201_4m_Final (4m grid using 4m parameters; depth range 46-120 m)
W00201_8m_Final (8m grid using 8m parameters; depth range 103-350 m)
W00201_16m_Final (16m grid using 16m parameters; depth range 325-1000 m)

B.2.1. H-Cell

The AHB source depth grid for the survey's nautical chart update product entailed the grids detailed above [B.2 (IV in DR)], combined at 16 meter resolution, and then using them to create a product surface grid with a resolution of 16m. The survey scale selected soundings were extracted from the 16m product surface using a spacing table text file (W00201_SS_SoundingSpacing.txt). The selected sounding set is approximately 10 to 20 times the number of charted depths. The chart scale selected soundings (CS Soundings) are a subset of the survey scale selected soundings and were also generated using a spacing table text file (W00201_SSR.txt). Generation of the CS Sounding spacing file entailed a visual trial-and-error method of CS Sounding layer generation and comparison with charted sounding spacing. An overall increase of CS Soundings was also desired, particularly in deeper

portions of the chart, and the submitted CS_Sounding layer contains over 25% more soundings than are currently charted. The surface model was referenced when selecting the chart scale soundings, to ensure that the selected soundings portrayed the bathymetry within the common area.

Depth curves were created from a 16m product surface grid. The 16m grid resolution product surface model was generated at a scale of 1:15,000, generalization radius of 100m with no defocusing. The depth curves are forwarded to MCD for reference only. The curves were utilized during chart scale sounding selection and quality assurances efforts at AHB. The depth curves are incorporated into the SS H-Cell product as per 2009 H-Cell Specifications.

The pre-compilation products or components (Stand Alone HOB files (SAHOB)) are detailed in the Pre-Compile Process Log attached at the end of this document. The SAHOB files included depth areas (DEPARE), depth contours (DEPCNT), sounding selections (SOUNDG), features (SBDARE, WRECKS), US5PR50M_ENC Features (SBDARE, WRECKS), US4MA14M_ENC Features (SBDARE, WRECKS), Meta objects (M_COVR, M_QUAL), and cartographic Blue Notes ($CSYMB).

All of the components with the exception of the sounding selection and depth contours were inserted into one feature layer (including the Bluenotes, as dictated by Hydrographic Technical Directive 2008-8), and this layer was exported into S-57 format in order to create the H-Cell deliverable. No conversion of metric units to fathoms/feet was necessary since the chart (26194) displays metric units. The final products are two S-57 files, in Lat/Lon NAD-83, one that contains the chart soundings, all the features, Meta objects, and Bluenotes (W00201_CS_meters.000), and one that contains the sounding selection and depth contours (W00201_SS_meters.000). Finally, quality assurance checks were made utilizing CARIS S-57 Composer (version 2.0) validation checks and DKART INSPECTOR (version 5.1) tests.

Chart compilation was performed by Atlantic Hydrographic Branch personnel in Norfolk, Virginia. Compilation data will be forwarded to Marine Chart Division, Silver Spring, Maryland.

W00201 CARIS H-Cell final deliverables include the following products:

W00201_CS_meters.000	1:15,000 Scale	W00201 H-Cell with Chart Scale Selected Soundings
W00201_SS_meters.000	1:15,000 Scale	W00201 Selected Soundings (Survey Scale)

B.2.2. Junctions

No contemporary surveys junction with W00201.

(V. in DR) CORRECTIONS TO ECHO SOUNDINGS

System Alignment and Calibrations

The HIPS Vessel File used during office processing for all survey data was R352_MB_2006.hvf, which conformed to all offsets and other settings described as being in R352_MB.hvf.

C. VERTICAL AND HORIZONTAL CONTROL

No vertical correction processing was completed (aside from applying zerotide.tid) by either field unit or office personnel due to lack of tide correction data (remote survey area).

Horizontal control used for this survey is based on North American Datum of 1983 (NAD83), UTM projection Zone 18N. No further office horizontal processing was required.

D. RESULTS AND RECOMMENDATIONS

(VI. in DR) STATEMENT OF ACCURACY AND SUITABILITY FOR CHARTING

Due to: (1) the relatively deep nature of bathymetry collected for this survey, (2) the lack of any visible tide artifacts in the bathymetric subset data or final grids, and (3) the lack of navigationally significant features, the office processor recommends using this survey to update the nautical chart.

Assessment of Object Detection (Bottom Coverage and Line Spacing)

Some holidays in the final surfaces exceed HSSD specifications, however overall bottom coverage for the vast majority of the survey area meets complete coverage requirements.

D.1 CHARTS used for H-Cell Production

RNC 26194 (5th Edition, 20040701)
Scale 1:15,000

ENC US5PR50M
Edition 2
Application Date: 20060516
Issue Date: 20060516
Chart 26194

D.1.1 Hydrography

The charted hydrography originates with prior surveys and requires no further consideration.

a) Examination of Chart 26194 reveals that charted contours and depths were possibly based on relatively sparse survey coverage, particularly in the deeper portions of the chart (beyond the 50 meter depth contour). While shapes of the depth curves between charted and current survey soundings are generally the same, the majority of contours have shifted between 10-250

meters from charted positions. Charted depths generally match survey soundings within 3-5 meters inside the 50 meter contour and within 10-20 meters in areas deeper than 50 meters.

b) A wreck was found during office processing that matches the description of AWOIS #3 (FERNGARTH – See Figures 1 and 2 below). Length and width of the wreck is approximately 110m and 15m, respectively. The reported length and width of FERNGARTH (according to The Statue of Liberty – Ellis Island Foundation) was 115m (380 feet) and 16m (52 feet), respectively. The wreck correlates with and is located 350m SW of charted PD Wk "Ferngarth (1921)". Location of the least depth (39.073m) of the wreck is 18/23/12.03N 075/00/11.46W. Office personnel recommend removing the charted Wk symbol along with text "Ferngarth (1921) PD" and adding a non-dangerous Wk symbol at the surveyed position.

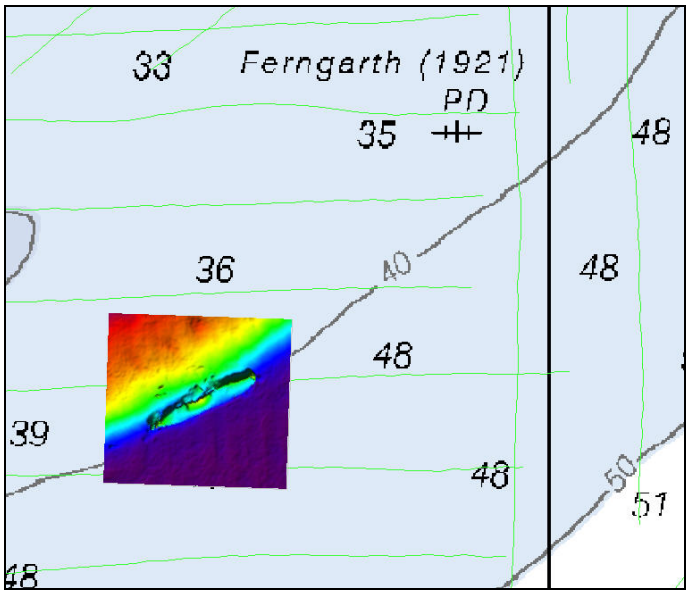


Figure 1. Location of Wk approximately 350m SW of charted PD Wk Ferngarth.

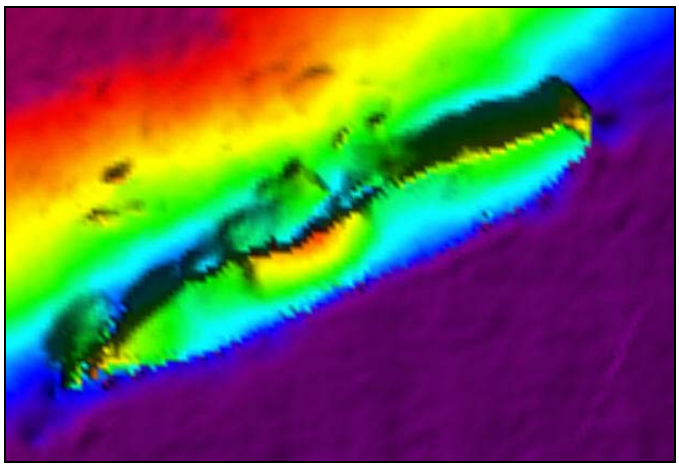


Figure 2. Close-in view of Wk DTM.

c) The field unit did not obtain bottom samples, therefore all charted sea bed characteristic objects (SBDARE) within the survey boundary were exported from the corresponding ENC (US5PR50M) and imported into the

W00201_Features layer. These seabed characteristic objects should be retained as charted, except where newly drawn coral seabed areas (from analysis of the 2 meter final bathymetric grid) overlap the previously charted objects.

d) In some cases where surveyed soundings were located in close proximity to and overlapped with charted shoreline, a deeper sounding further from the shoreline was selected in the CS_Soundings layer over a shoaler sounding. Example is detailed below in Figures 3 and 4:

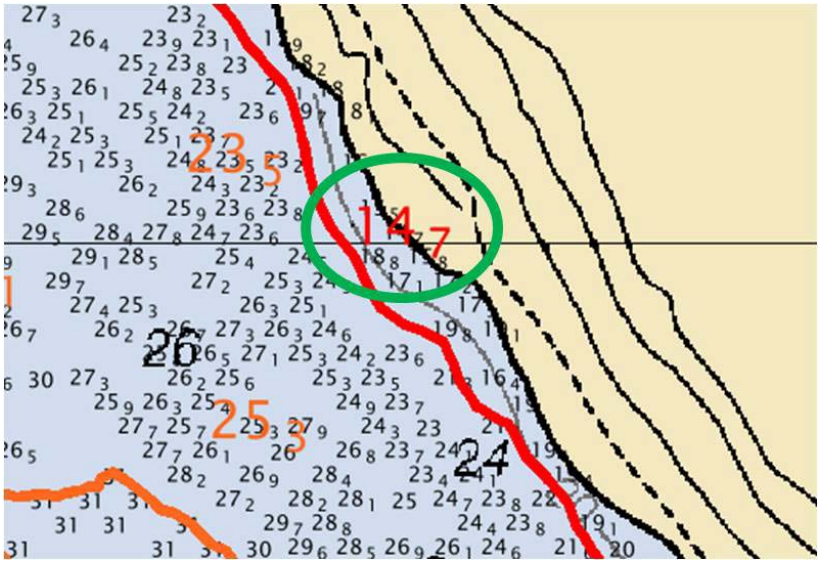


Figure 3. (CS soundings are in red and orange; SS soundings are in smaller black font) The initial CS_Sounding layer contained a 14.7m sounding that overlapped with the charted shoreline (circled in green).

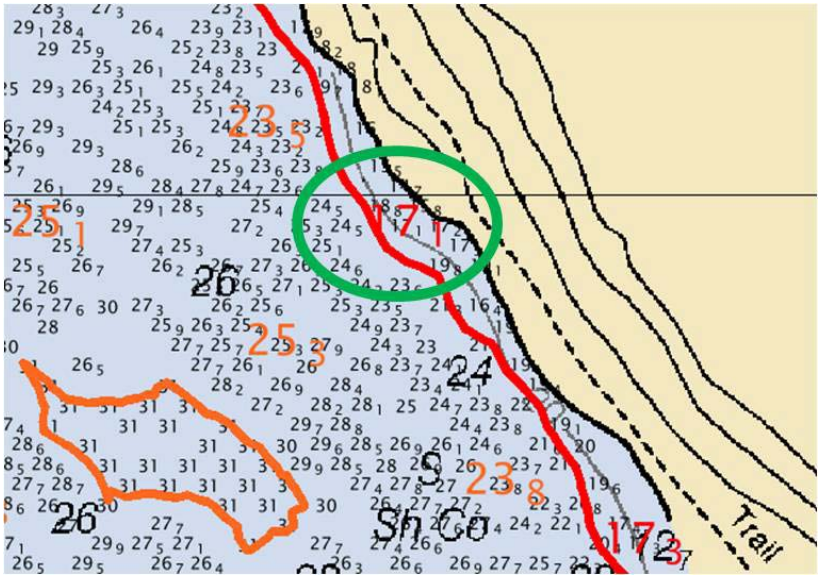


Figure 4. To prevent overlap with charted shoreline while maintaining cartographic integrity, the 14.7m sounding was removed from the CS_Sounding layer and a nearby 17.1m sounding was imported in its place.

D.2. ADDITIONAL RESULTS

There are no additional results to report.

D.2.1. Aids to Navigation

No Aids to Navigation were positioned during survey W00201.

D.3. MISCELLANEOUS

Chart compilation was done by Atlantic Hydrographic Branch personnel, in Norfolk, Virginia. Compilation data will be forwarded to Marine Chart Division, Silver Spring, Maryland. See Section D.1. of this report for a list of the Raster Charts and Electronic Navigation Charts (ENC) used for compiling the present survey.

D.3.1. Data Management

When this survey was acquired in 2006, no formal data management path had been established for *Nancy Foster* hydrographic survey data to update the nautical chart. Copies of the survey data existed both on the ship as well as with the scientific party(ies) ashore. As a result, the Atlantic Hydrographic Branch received this survey in multiple submissions from multiple sources, including *Nancy Foster* (Charleston, SC), NCCOS Center for Coastal Fisheries and Habitat Research (Beaufort, NC), and NCCOS Biogeography Branch (Silver Spring, MD). Due to the varied levels of data management and deliverables from these three sources, the ending submission of this survey and its products to NGDC and HSD/MCD result from fusing the submissions into a single final deliverable package.

D.4. ADEQUACY OF SURVEY

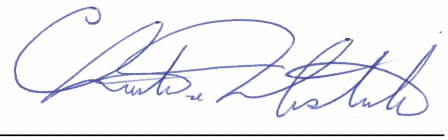
The present survey is adequate to supersede the charted bathymetry within the common area. If any charted features exist that were not specifically addressed in the H-Cell BASE Cell File then they should be retained as charted. Refer to the Data Acquisition & Processing Report (also the Descriptive Report) for further recommendations by the hydrographer.

APPROVAL SHEET
W00201

Initial Approvals:

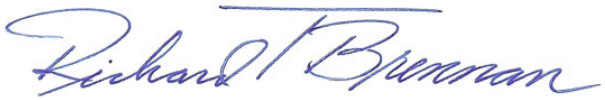
The completed survey has been inspected with regard to survey coverage, delineation of depth curves, representation of critical depths, cartographic symbolization, and verification or disproval of charted data. All revisions and additions made to the H-Cell files during survey processing have been entered in the digital data for this survey. The survey records and digital data comply with National Ocean Service and Office of Coast Survey requirements except where noted in the Descriptive Report and the Evaluation Report.

All final products have undergone a comprehensive reviews per the Hydrographic surveys Division Office Processing Manual and are verified to be accurate and complete except where noted.



Christiaan van Westendorp
Lieutenant Commander, NOAA
Staff, Atlantic Hydrographic Branch

I have reviewed the H-Cell files, accompanying data, and reports. This survey and accompanying Marine Chart Division deliverables meet National Ocean Service requirements and standards for products in support of nautical charting except where noted.



Richard T. Brennan
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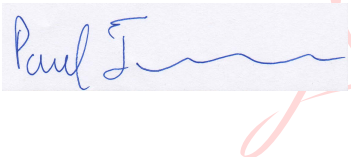
Approved: _____

Richard T. Brennan
Lieutenant Commander, NOAA
Chief, Atlantic Hydrographic Branch



Paul Turner
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