W00275

NOAA FORM 76-35A

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

DESCRIPTIVE REPORT

Type of Survey **Hydrographic Multibeam Survey**
Project No. **OSD-UNH-07**
Registry No. **W00275**

LOCALITY

State **Maine and New Hampshire**

General Locality **Portsmouth Harbor**

Sub-locality **Vicinity of Fort Point**

2007

UNH Summer Hydrographic Field Course 2007

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University of New Hampshire
Center for Coastal and Ocean Mapping
Joint Hydrographic Center

DESCRIPTIVE REPORT

Fort Point, Portsmouth Harbor, NH

2007 Summer Hydrographic Field Course

R/V Coastal Surveyor

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Submitted 22 June 2007

The purpose of this survey is to provide contemporary surveys to update National Ocean Service (NOS) nautical charts. All separates are filed with the hydrographic data. Any revisions to the Descriptive Report (DR) generated during office processing are shown in bold red italic text. The processing branch maintains the DR as a field unit product, therefore, all information and recommendations within the body of the DR are considered preliminary unless otherwise noted. The final disposition of surveyed features is represented in the OCS nautical chart update products. All pertinent records for this survey, including the DR, are archived at the National Geophysical Data Center (NGDC) and can be retrieved via http://www.ngdc.noaa.gov/.

A. AREA SURVEYED

A1. Introduction

This Descriptive Report documents a hydrographic survey conducted in the Fort Point vicinity of Portsmouth Harbor, New Castle, NH. The data were acquired to fulfill the requirements of the University of New Hampshire Center for Coastal and Ocean Mapping – Joint Hydrographic Center 2007 Summer Hydrographic Field Course. The hydrographic data were acquired with a Kongsberg EM3002D dual-head multibeam echo-sounding (MBES) system bow-mounted on the R/V COASTAL SURVEYOR.

A2. Project Description

The major objective was to repeat a hydrographic survey of a large sand shoal in Portsmouth Harbor, NH multiple times over the two-week survey period. Five high-resolution multibeam echosounder (MBES) datasets were acquired over a spring-neap cycle to identify changes in bedform morphology in the survey area for the purposes of better understanding tidal controls on coarse-grained sediment transport in the lower Great Bay Estuary (GBE). A second objective of the hydrographic survey was to obtain a 100% coverage surface of the survey area for the purposes of updating the existing National Oceanic and Atmospheric Administration (NOAA) nautical chart 13283 (Cape Neddick Harbor to Isles of Shoals).

Requirements for the survey exceed IHO Special Order specifications for depth and position accuracy. Successful completion of the project entails resolving and locating, with decimeter-level accuracy, sand waves with minimum amplitude of at least 0.2 m and minimum wavelength of at least 4 m.

A3. Survey Area

The survey area was located in Portsmouth Harbor immediately south of Fort Point, New Castle, NH (Figure 1). The survey area was bounded to the west by New Castle, NH, and to the east by Gerrish Island, ME. A previous survey of this area conducted by NOAA Ship WHITING in November, 2000 indicates that the area is dominated by a large (0.14 km^2) shoal bounded by flat bottom to the west and rocky bottom to the east.

The MBES data were acquired on June 8 and 14-15, 2007 (Day Numbers 159 and 165-166). Each of the five hydrographic surveys included, on average, 4.8 linear nm of multibeam sounding lines at 19 m line spacing and 0.35 linear nm of crosslines. The entire survey area encompassed 0.17 km^2. A total of 23.94 linear nm of sounding lines from the survey area was acquired for the project.

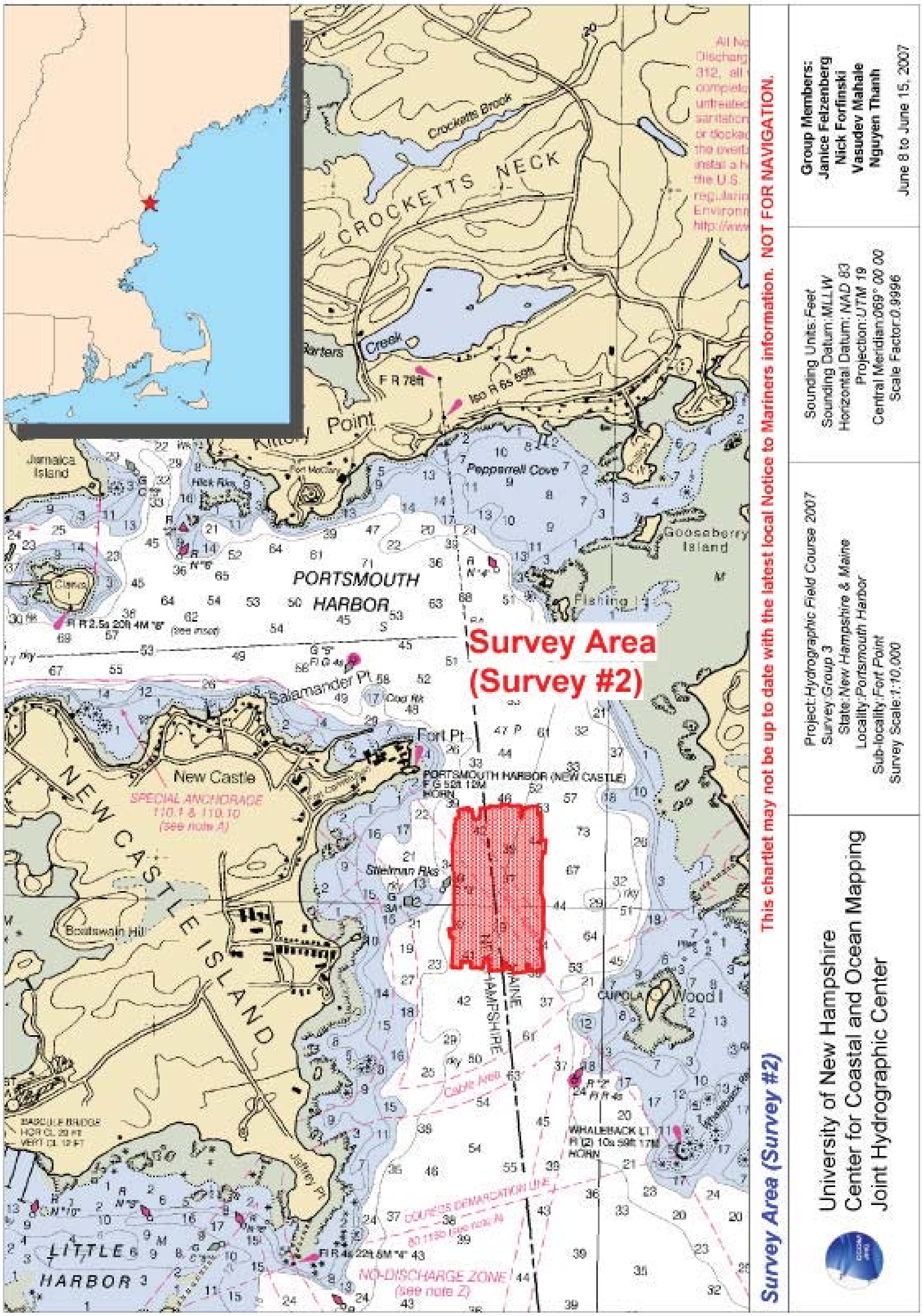


Figure 1 Chartlet of survey area with approximate extent of survey coverage (taken from Survey #2).

B. DATA ACQUISITION AND PROCESSING

B1. Equipment

1.0 Survey Vessel

1.1 Vessel Specifications

R/V COASTAL SURVEYOR is a 12.2-meter subchapter "C" research vessel built specifically for coastal hydrography (Figure 2). Propelled by a single-screw diesel engine and roll-stabilized with Niad active fins, R/V COASTAL SURVEYOR is capable of survey speeds ranging from 2.5 to 10 knots, although a minimum speed of 5 knots is required for full effective roll stabilization. The vessel is equipped with a motor-driven bow ram, the base of which is used to mount a variety of sonar systems.

Figure 2 Acquisition Platform. Data were acquired with systems aboard R/V COASTAL SURVEYOR (source: http://ccom.unh.edu).

2.0 Hardware

2.1 Hardware Systems Inventory

Table 1 summarizes the major hardware components used during the survey. A generalized schematic of the survey system is shown in Figure 3, and the major communication ports are detailed in Table 2.

Table 1 Hardware systems inventory.

Equipment	Manufacturer	Model	Serial Number
Vertical Control			
Water Level Gauge	Aanderaa	3791	47
Optical Level	Keuffel & Esser Co.	-	JHC00165
Horizontal Control			
RTK Base Station Receiver	Trimble	5700 CORS	2203582930
RTK Base Station Radio Modem	Trimble	Trimmark3	456152537
RTK Rover Radio Modem	Trimble	Trimmark3	4526152531
WAAS DGPS Rx	C&C Technologies	C-Nav	787004
VHF DGPS Rx	Trimble	DSM212H	0220261281
Laptop	Dell	-	29360279953
Sound Speed			
Surface Velocimeter	Odom	Digibar Pro 9800	98139
Sound Speed Profiler	Applied Microsystems	SV Plus	3319
Positioning, Heading, & Attitude System			
PCS	Applanix	-	2171
IMU	Applanix	-	179
Primary Rx	Trimble	BD950	4452A44285
Secondary Rx	Trimble	BD950	4447A44091
Echo Sounding			
Port/Starboard Transducers	Kongsberg	EM 3002D	322/481
SIS Computer	Kongsberg	EA400	230
Processing Unit (PU)	Kongsberg	EM 3002	1014

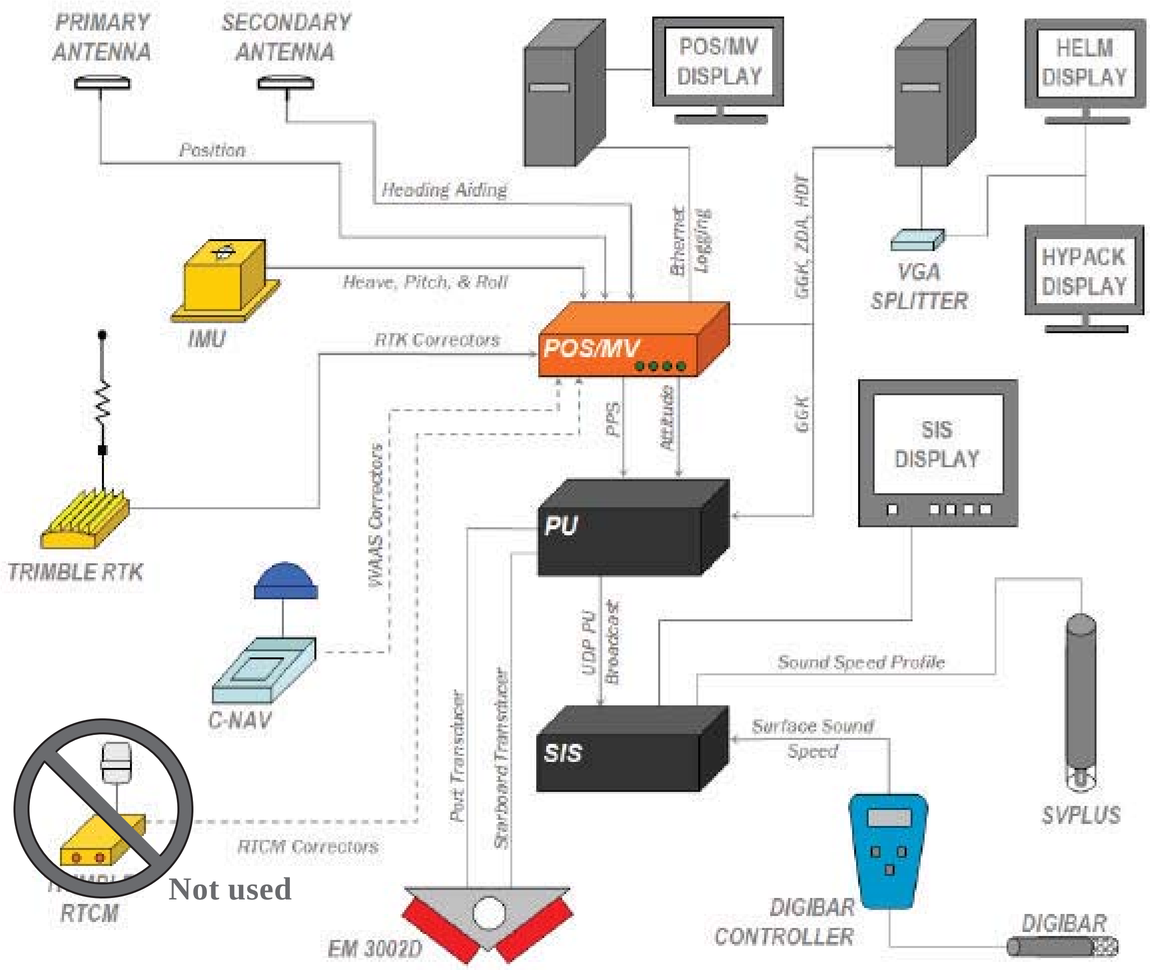


Figure 3 Survey system schematic.

Table 2 Port Configuration.

Port	*Description*	*Port Settings*
POS/MV PCS		
IMU	Receives angular & translational accelerations from IMU	n/a
Antenna 1	Receives position from primary antenna	n/a
Antenna 2	Receives heading aiding from secondary antenna	n/a
GPS 1	Receives RTK correctors (CMR or CMR+) from Trimmark3	19200,n,8,1
GPS 2	Receives WAAS Correctors (RTCM 1 or 9) from C-Nav	19200,n,8,1
LAN	Allows configuration of PCS and Ethernet logging	192.168.0.56/255.255.255.0
COM 1	Outputs NMEA GGK, ZDA, & HDT to PU and Hypack	9600,n,8,1
COM 2	Outputs attitude (Simrad 3000 binary format) to PU	19200,n,8,1
PPS	Allows time synchronization with PU	n/a
EM 3002D PU & SIS		
PU COM1	Receives NMEA GGK from POS/MV	9600,n,8,1
PU COM2	Receives motion & heading (rotation = POSMV/MRU) from POS/MV	19200,n,8,1
SIS COM1	Receives AML SV (C) message from Digibar	9600,n,8,1
SIS COM2	Receives SVP profiles from SVPLUS	9600,n,8,1
LAN	Used by SIS to receive PU datagrams for logging and display	UDP ports 16116 & 16117
HYPACK PC		
COM 1	Receives NMEA GGK & HDT (nmea.dll) messages from POS/MV COM1	9600,n,8,1

2.2 Vertical Control Equipment

Vertical control equipment used during the survey is discussed in detail in Section C1 (Vertical Control) and in the Tide and Water Levels report included in Appendix IV.

2.3 Horizontal Control Equipment

Horizontal control equipment used during the survey is discussed in detail in Section C2 (Horizontal Control).

2.4 Sound Velocity Equipment

Two sound-speed devices were used during the survey: an Odom Digibar Pro velocimeter and an Applied Microsystems SV Plus sound velocity profiler

2.4.1 Odom Digibar Pro 9800

Mounted on the top of the port side of the multibeam sonar transducer mount, the Odom Digibar Pro was used to measure the speed of sound required for beam steering at the face of the two multibeam transducers.

2.4.2 Applied Microsystems SV Plus Sound Velocity Profiler

Water-column sound "velocity" (i.e., speed) data were acquired with an Applied Microsystems SV Plus sound velocity profiler. The program SmartTalk was used to configure the SV Plus prior to each cast and to download the data after each cast.

2.5 Positioning, Heading and Attitude Equipment

Position, heading, and attitude data were acquired with an Applanix POS/MV, version 4, operating in RTK GPS mode. Discussed further in Section C2 (Horizontal Control), the RTK correctors were received by a Trimble Trimmark3 radio modem. A C&C Technologies C-Nav WAAS receiver was configured to serve as a secondary source of differential correctors in the event of RTK outages. The vessel was also equipped with a Trimble DSM212H receiver to receive differential correctors in the event of C-Nav outages; however, the DSM212H was never used.

2.6 Echo Sounding Equipment

MBES data were acquired with a Kongsberg EM 3002D, a 300-kHz dual-head system with the port and starboard transducers mounted at 40° and -40° angles, respectively (in a right-handed coordinate system). Each transducer forms 160 beams, with up to 255 sounding solutions per ping. The along- and across-track beamwidth of each broadside beam is 1.5°.

2.7 Manual Sounding Equipment

No manual sounding equipment was used during the survey.

3.0 Software

3.1 Software Systems Inventory

Software used during the survey is summarized in Table 3.

Table 3 Software systems inventory.

Software	Version	Purpose
Acquisition		
SIS	3.4.1	MBES data display & logging
Smart Talk	2.25	SV Plus configuration/downloading
Hypack	4.3a	Navigation/line steering
POS/MV Controller	3.1.0.1 (build 23)	POS/MV configuration & data logging
Processing		
CARIS HIPS & SIPS	6.1 HF13	MBES data processing
CARIS BASE Editor	2.0	Surface differencing
Pydro	7.3 (r2110)	Feature management & cross line analysis

3.2 Data Acquisition Software

Kongsberg's Seafloor Information System (SIS) was used for the display and logging of the EM 3002D data. The sonar was operated in manual equiangular mode, with the port/starboard coverage of the port and starboard transducers defined to be 50°/15° and 15°/50°, respectively. Whereas the primary antenna-to-IMU lever arm was accounted for in the POS/MV controller, the IMU-to-transducer lever arm was entered into the installation parameters of SIS. A comprehensive report of the SIS installation and runtime parameters is included in Appendix V.

Smart Talk was used to configure the SV Plus prior to a cast and to download SVP data after a cast. A Kongsberg script, csv2asvp.bat, was used to convert the comma-delimited file produced by Smart Talk into the *.asvp format required by SIS for real-time sound speed correction.

Hypack was used only to provide line-steering navigation. No Hypack data were acquired.

The POS/MV controller software (MV-POSView) was used to configure the POS/MV communication ports and to control Ethernet data logging. Sixteen data groups were enabled in Ethernet logging (Table 4). The only lever arm entered in the POS/MV configuration was the primary antenna-to-IMU lever arm. The reference point is the IMU, which is assumed to be located at the center of gravity.

Table 4 Ethernet logging groups.

Group	Description
1	Navigation solution
2	Performance metrics
4	IMU data
5	Event 1
9	GAMS solution
10	General status and fault detection
99	Version and statistics
110	MV general status
111	Heave data
112	NMEA strings
113	Heave data quality control
10001	Primary GPS data stream
10006	Raw DMI data stream
10009	Secondary GPS data stream
10011	Raw differential corrections 1
10012	Raw differential corrections 2

3.3 Data Processing Software

CARIS HIPS 6.1 was used to process the EM 3002D MBES data. Because the depth datagram that is read into CARIS is already corrected for sound speed, attitude, water level, and the transducer lever arm, the only correctors applied in post processing are the patch test correctors and the dynamic draft correctors. The option exists in CARIS to re-apply a sound speed cast to EM data, but this option was not used because (1) the data do not show any significant sound speed or refraction artifacts, and (2) the exact nature of the algorithm used by CARIS was not well-understood by the post-processing personnel. A report detailing the configuration of the HIPS vessel configuration file (HVF) is included in Appendix V.

4.0 Personnel Inventory

An inventory of all survey personnel is summarized in Table 5.

Table 5 Survey personnel inventory.

Captain	
	Ben Smith
Mate/Deck Hand	
	Bridget Kelley
Instructor	
	Capt. Andrew Armstrong
Survey Personnel	
	Janice Felzenberg
	Nicholas Forfinski
	Vasudev Mahale
	Nguyen Thanh

B2. Quality Control

1.0 Procedures

1.1 Survey Planning

Survey planning consisted of determining a uniform line spacing, survey speed, and swath coverage that would ensure the realization of the requirements outlined in Section A2 (Project Description). A simplified EM3002D beam footprint model (included in Appendix V) was developed in Excel to aid in survey planning. The model calculates the across- and along-track dimension of each beam, assuming a flat bottom and equiangular mode and given a water depth and a swath width defined by angles to either side of nadir.

A major constraint in planning the survey was the duration of the maximum-current window within which each survey was to be executed. Although the ideal goal was to have a small line spacing dictated by the resolving capabilities of the smallest footprint in the deepest part of the survey area, the need to survey the area in 1.5 hours while going as slow as possible while maintaining steering capabilities necessitated increasing the line spacing. The combination of a line spacing of 19 meters and a survey speed of 5 kts was determined to be an operationally feasible compromise between maintaining resolving-capability across the entire swath and minimizing the time needed to complete the survey. Nineteen-meter line spacing was also based on ensuring that what was deemed the useable portion of each swath would overlap the usable portion of the adjacent swaths. The usable portion of each swath was deemed to be the portion of the swath containing footprints whose across- and along-track dimension did not exceed 0.8 meters.

1.2 Multibeam Echo Sounder Acquisition and Monitoring

A pre-survey workflow, developed for the purposes of quality control, was implemented at the start of each survey day. The workflow is included in Figure 4.

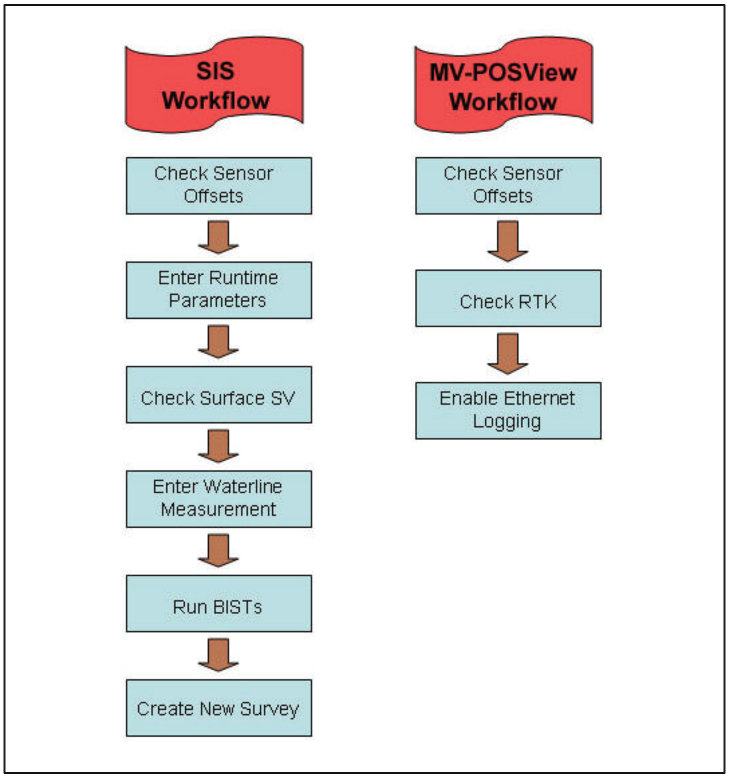


Figure 4 Pre-survey workflow.

Pre-survey protocol involved measuring and entering into SIS the waterline value, checking the surface sound speed output from the Digibar, ensuring that RTK corrections were being received by the POS/MV, enabling Ethernet logging, and running the EM 3002D built-in self-test in the SIS software. Other pre-survey checks included verifying the IMU-to-transducer offsets in the SIS installation, the MBES angular sector and operation mode in the SIS runtime parameters, and the IMU-to-port antenna offsets applied in the POS/MV controller software. Also, a new SV Plus sound velocity cast was loaded into SIS prior to each individual survey.

A standard logbook for MBES acquisition and monitoring was filled out by survey personnel at the time of acquisition. The logbook contained fields for survey date and vessel, local weather conditions, personnel inventory, draft tube readings, sound velocity casts, and MBES line remarks.

Additional checks were made to ensure accuracy during data acquisition and monitoring. When surface sound speed from the Digibar deviated significantly (more than 2-3 m/s) from the surface sound speed from the SV Plus cast, a new sound speed cast was acquired and applied in the SIS software. The numerical display in SIS was also closely monitored for any irregular behavior. Additionally, starting on the final day of acquisition, after the POS/MV was observed periodically receiving RTCM rather than CMR correctors, the GPS mode was displayed in Hypack and monitored for RTK outages.

1.3 Survey Crosslines

A total of 23.94 linear nm of main scheme lines and 1.753 linear nm of survey crosslines (7.32% as compared to main scheme) were acquired for the project. The crossline comparisons were performed by comparing for each survey a crossline BASE surface and a mainscheme BASE surface using the Pydro checkpoint functionality. Within each survey, there is excellent agreement between the mainscheme surface and the crossline surface. Table 6 summarizes the crossline comparisons performed for each survey. The Pydro-generated crossline comparison reports are included in Separate IV.

Table 6 Crossline comparisons.

Survey	# of Comparisons (depth range)		Mean Difference		% Special Order	% Order 1
	[10,15)	[15,20)	[10,15)	[15,20)		
1	56213	27045	-0.04	0	100	-
2	80257	36166	0.02	0.05	100	-
3	76308	08660	0	0.02	99.9	0.1
4	63539	25423	-0.03	-0.01	100	-
5	87074	31023	0.01	0.03	100	-

1.4 Gridded Surface Uncertainty

Table 7 summarizes the uncertainty and standard deviation of the five gridded surfaces. Every uncertainty value (i.e., an *a priori* estimation of error given the assumed error model) and the averages of the standard deviations (i.e., an *a posteriori* estimation of uncertainty) of every gridded surface are within the acceptable IHO error for Special Order surveys; however, the expected uncertainty values are approximately an order magnitude greater than the average of the observed standard deviations. Such a condition may suggest that the errors of the survey system were overestimated. Given the very close proximity of the water level gauge, the relatively calm sea conditions during the times of survey, the centimeter-accuracies associated with RTK positioning, and the relatively shallow depths in the survey area, actual errors close to the observed standard deviations may not be unlikely.

Table 7 Gridded surface uncertainty and standard deviation.

Survey	Uncertainty			Standard Deviation		
	min	*max*	*mean*	*min*	*max*	*mean*
1	0.208	0.225	0.219	0	0.529	0.034
2	0.212	0.234	0.220	0	0.700	0.037
3	0.211	0.239	0.220	0	0.507	0.037
4	0.209	0.242	0.219	0	0.566	0.035
5	0.213	0.239	0.220	0	0.533	0.038

1.5 Gridded Surface Difference

Surface differences of the final BASE surfaces were calculated using CARIS BASE Editor. A difference surface calculated by subtracting Survey 5 (collected DN 165, 13:25 – 14:42 UTC) from Survey 2 (collected DN 165, 19:34 – 20:49 UTC). The difference surface is included in Figure 5. The differences (alternating vertical offsets -0.439 m to 0.797 m in magnitude) visible in the difference surface indicate systematic errors in the data. These systematic errors are presently not well understood, but may be the result of improperly applied vessel static draft, variations from the experimentally determined dynamic draft, and/or a heave frequency below the lower cutoff of the high pass heave filter in the POS/MV controller software.

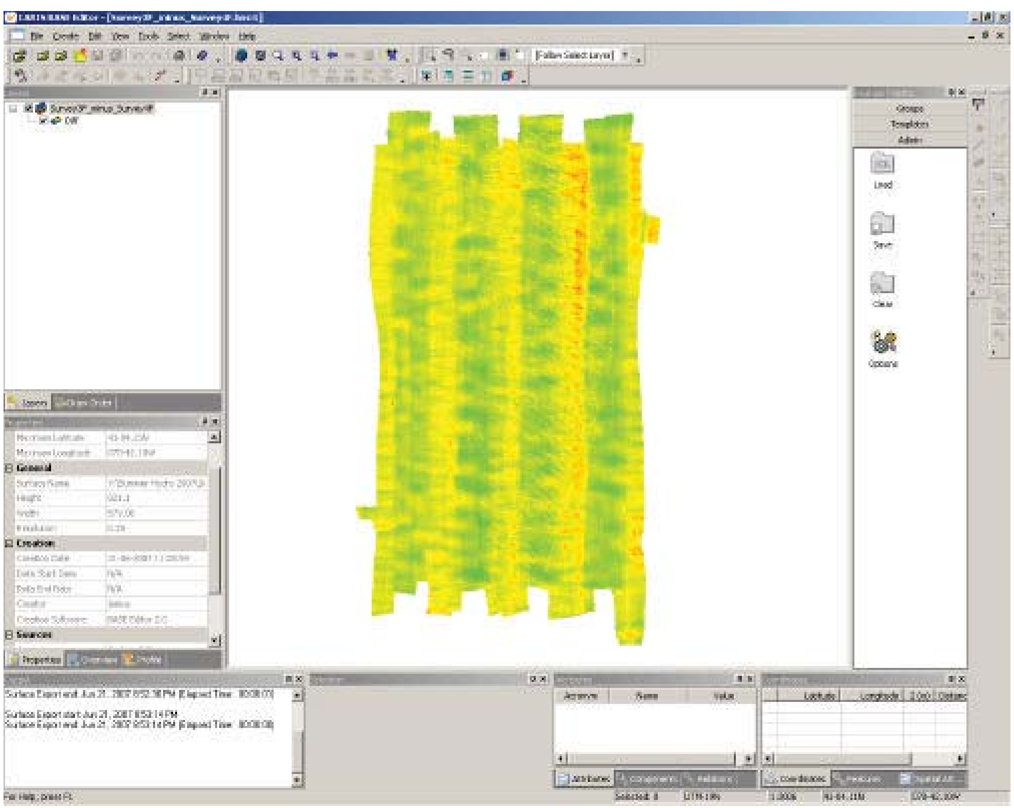


Figure 5 Surface difference calculated from subtraction of Survey 5 (DN 165, 13:25 – 14:42 UTC) from Survey 2 (DN 165, 19:34 – 20:49 UTC). Minimum and maximum differences are -0.439 m and 0.797.

B3. Corrections to Echo Soundings

1.0 Vessel HVFs

The CARIS HIPS Vessel File (HVF) was used to define the survey vessel offsets and equipment uncertainty. The HVF was used for converting and processing data collected by the survey platform. An HVF report produced in the CARIS Vessel Editor is included in Appendix V.

2.0 Vessel Configuration Parameters

Sensor offsets aboard R/V COASTAL SURVEYOR were measured on June 1-2, 2007 at the Jackson Estuarine Laboratory pier, Adams Point, Durham, NH. Sensor offsets were measured with respect to the vessel's reference mark (RP) at the top center of the POS/MV inertial measurement unit (IMU). Offsets from the IMU to the primary (port) GPS antenna and from the IMU to the port and starboard transducers were measured using tape measures, rulers and a t-square. The measurement uncertainties of the X, Y and Z sensor offsets (0.002 m, 0.003 m, and 0.003 m, respectively) are the calculated RMS values of the standard deviations of redundant X, Y and Z offsets and were entered into the TPE section of the CARIS HVF.

Offset values were applied in the MV-POSView and SIS software prior to data acquisition. The IMU-to-port antenna separation was entered into the MV-POSView lever arm tab. The separation between IMU and the port and starboard transducers and the mounting angles of the transducers were input into the sensor location fields in the SIS software.

Transducer and primary GPS antenna offset measurement reports for R/V COASTAL SURVEYOR are included in Appendix V.

3.0 Static Draft and Loading

Static draft was measured prior to surveying each day by measuring the distance from the water level in the in-board draft tube relative to a marked point +0.300 m from the vessel RP. The measured draft value was entered as the waterline in the SIS software prior to surveying. At the end of each survey day a subsequent draft value was measured as a check to verify that there were no significant changes in the vessel's draft.

The waterline values for DN 159, 165 and 166 were 0.510 m, 0.521 m, and 0.529 m. Of the waterline values, only those for DN 166 were correctly entered into SIS during data acquisition. On DN 159 the waterline measurement entered into SIS (0.533 m) was measured from a closed draft tube, resulting in a difference of -0.023 m from the waterline measured at the end of the survey day. On DN 165 the value for the previous day (0.510 m) was applied in SIS for a difference of +0.011 m relative to the measured value.

The waterline measurement uncertainty was estimated to be 0.01m and was entered into the TPE section of the CARIS HVF.

4.0 Settlement and Squat

Dynamic draft correctors for R/V COASTAL SURVEYOR were taken from the 2006 Summer Hydrographic Field Course modeled values, which were based on RTK GPS measurements. The 2006 results were applied in the CARIS HVF during post-processing. The dynamic draft measurement uncertainty calculated by the 2006 field course personnel (0.12 m) was entered into the TPE section of the CARIS HVF.

Table 8 contains the results of the 2006 dynamic draft experiment. A full description of the 2006 dynamic draft experiment is available in the 2006 R/V COASTAL SURVEYOR Hydrographic Field Course Descriptive Report (Registry Number W00178).

Table 8 Dynamic draft measurement table (CARIS coordinate system).

Speed (kt)	Errors (kt)	Height (m)	Errors (m)
0.000	+/- 0.790	0.000	+/- 0.0448
1.000	+/- 0.790	-0.025	+/- 0.0448
2.000	+/- 0.790	-0.040	+/- 0.0448
3.000	+/- 0.790	-0.043	+/- 0.0448
4.000	+/- 0.790	-0.035	+/- 0.0448
5.000	+/- 0.790	-0.017	+/- 0.0448
6.000	+/- 0.790	0.012	+/- 0.0448
7.000	+/- 0.790	0.053	+/- 0.0448
8.000	+/- 0.790	0.104	+/- 0.0448
9.000	+/- 0.790	0.166	+/- 0.0448
10.000	+/- 0.790	0.239	+/- 0.0448

5.0 Patch Test

A patch test for the EM3002D dual-head multibeam system on the R/V COASTAL SURVEYOR was conducted on June 8, 2007 (DN 157). The patch test was processed independently for the port and starboard transducers using the CARIS HIPS calibration utility. The pitch, roll, and heading biases obtained for the port and starboard transducers were entered into the Swath1 and Swath2 sensors, respectively, and the average of the port and starboard timing biases was entered into the navigation sensor (Table 9).

The survey area for the patch test was under 1 nm southeast of Odiornes Point, NH, and was selected on the basis of bathymetry acquired in 1994 by NOAA Ship RUDE. Biases were determined by surveying a series of planned survey lines at different speeds and headings over a pre-selected patch of seafloor. A chartlet of the patch test survey area is included in Figure 6. The patch test report is included in Appendix V.

Table 9 Patch test offsets.

	Port Transducer	Starboard Transducer
Timing	0.110	0.110
Pitch	1.810	1.290
Roll	-0.990	-1.600
Yaw	-0.580	0.010

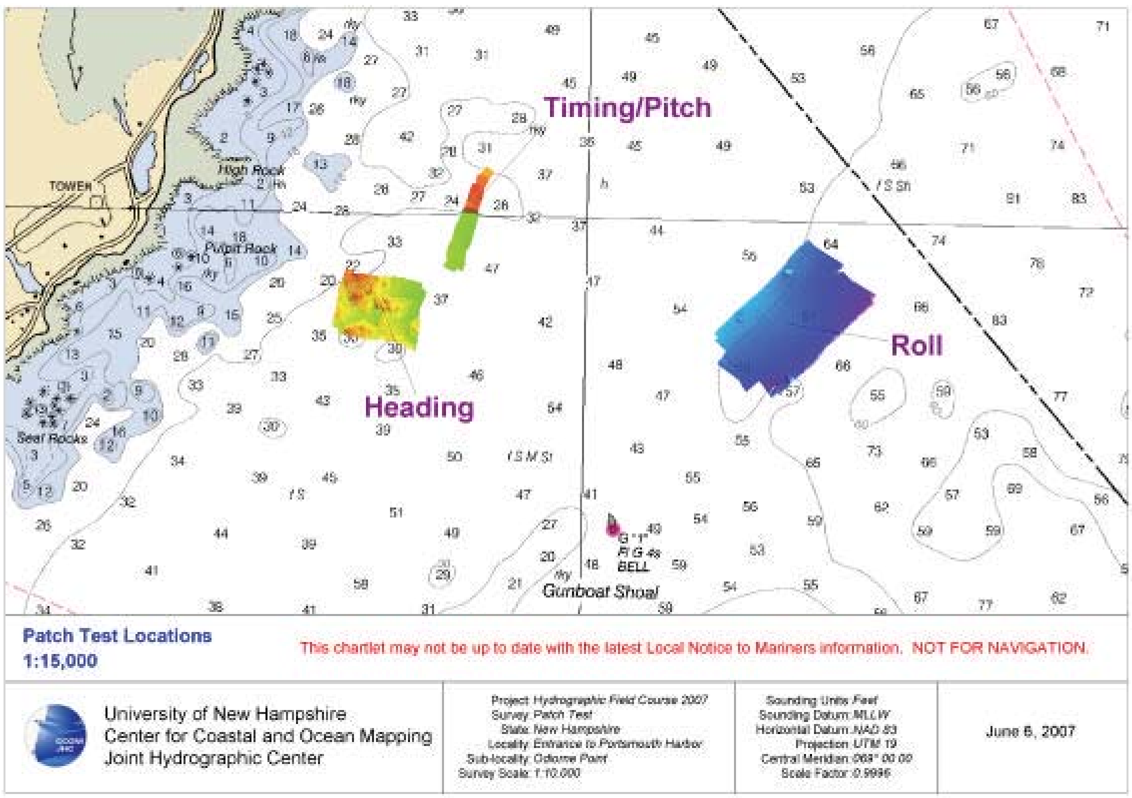


Figure 6 Patch test location over NOAA Chart 13283 with surfaces created from lines collected for timing, pitch, roll, and heading calibration.

6.0 POS/MV Correctors

6.1 POS/MV GAMS Calibration

A GAMS calibration was performed on June 6, 2007 (DN 157). A report detailing the GAMS calibration is included in Appendix V.

6.2 Attitude Computation

The instantaneous pitch, roll and heading values computed by the POS/MV were applied as correctors to the MBES data in real time during data acquisition. Specifications for the POS/MV obtained from the manufacturer indicate a roll/pitch measurement accuracy of 0.010° for RTK solutions, and a heading measurement accuracy of 0.020° for a 2m antenna baseline and RTK/DGPS solution.

6.3 Heave Computation

The instantaneous heave values computed by the POS/MV were applied as correctors to the MBES data in real time during data acquisition. Specifications for the POS/MV obtained from the manufacturer indicate a heave measurement accuracy of the greater of 0.050 m or 5% of the heave amplitude.

TrueHeave data were acquired with respect to the IMU in MV-POSView during data acquisition. Though logged, the TrueHeave data were not applied to the sounding data in post-processing because the sounding solutions present in the *.all file converted into CARIS had offsets applied during data acquisition, and were therefore referenced to the transducers.

7.0 Sound Speed Correctors

Sound speed measured at the transducer head was applied as a corrector to the data in the SIS software in real time to facilitate beam steering by the EM3002D. Additionally, sound speed casts from the SV Plus were processed and applied to the data in the SIS software as correctors to the echosounder data.

A description of all sound speed casts applied to the data is included in Separate 2.

8.0 Water Level Correctors

Preliminary water levels from the NOAA gauge at Fort Point, New Castle, NH (ID: 8423898) were used to reduce sounding data to the MLLW chart datum. A detailed description of the water level corrections applied to the data is available in Section C1 (Vertical Control).

B4. Data Processing

1.0 Multibeam Echo Sounder Data Processing

The acquired multibeam data collected on June 8 and 14-15, 2007 (DN 159 and 165-166) were processed using CARIS HIPS 6.1 software. At the end of each survey day, the acquired data were checked for any holidays and artifacts as well as blunders or other errors. The final processing was carried out from June 18-21, 2007. The steps involved in processing were logged using a check sheet to avoid processing-ambiguity and establish quality control. Processing logs are included in Separate 1.

1.1 Processing Workflows

A workflow depicting the steps involved in CARIS HIPS/SIPS data processing is included in Figure 7.

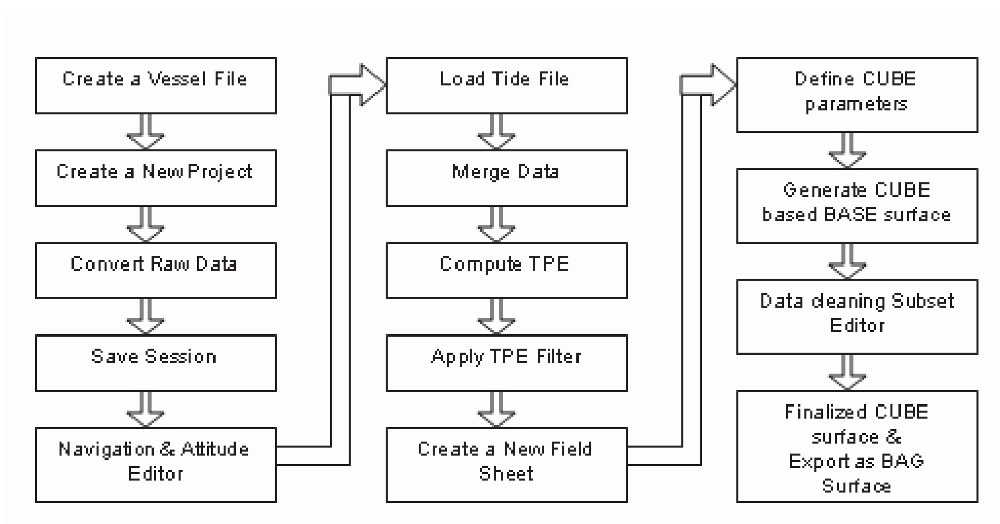


Figure 7 CARIS HIPS 6.1 data processing workflow.

1.2 Data Cleaning and Filtering Procedures

The first step taken in multibeam data processing was the creation of a HIPS vessel configuration file (HVF). This file normally contains the sensor offsets; however, since these offsets had already been applied in the SIS and MV-POSView software, offsets in the CARIS HVF were set to zero. The HVF contained the dual-head transducer pitch, roll and yaw values and timing offset determined from the patch test. The dynamic draft table was applied in the draft table of the HVF. Information regarding the model and manufacturer of the sensors was also included in the HVF. An HVF Report produced in the CARIS Vessel Editor is included in Appendix V.

Along with vessel configuration information, the HVF also contains information used for calculating Total Propagated Error (TPE) values for the multibeam data. The TPE section of the HVF contains all sensor offset values, as well as the transducer head roll angles. Standard deviation values for gyro, heave, roll, pitch, position, and timing are taken from the CARIS HIPS and SIPS TPE Computation Resource (http://www.caris.com/tpe/), which is based on manufacturer specifications. X,Y, and Z offset standard deviation values are based on the RMS values of redundant measurements for each offset. Other standard deviation values are based on empirical estimates of field work.

The next step in the CARIS data processing routine was to create a project file. The project file contains the vessel file, survey area boundaries, and projection. The project file is used to manage the raw multibeam data and all information about the data that was flagged during the editing process.

The multibeam data were imported into CARIS HIPS as raw Simrad *.all files and were subsequently converted into CARIS proprietary data file format. Next, a tide file was loaded for the imported lines to apply the tidal correction. The tide file was created from preliminary water level data from the NOAA tide gauge installed at Fort Point (ID: 8423898) that were downloaded from the NOAA CO-OPS website. Subsequent to loading the tide file, lines were merged to apply the tidal correction and HVF file.

Once the TPE values were computed, depth soundings were filtered to reject all data with a horizontal positioning accuracy of greater than 0.5 m. This filter is depicted in Figure 8.

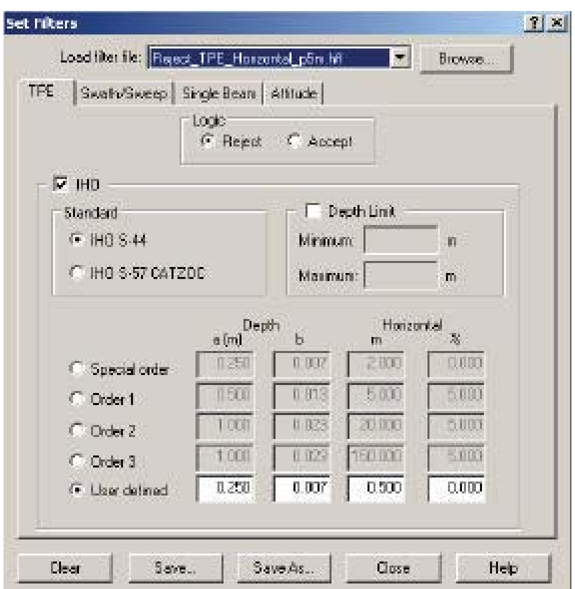


Figure 8 TPE filter settings.

A swath filter was applied to selected survey lines, whereby the swath angle was limited to 45 degrees on either side. This filter was applied because small artifacts were observed in the outer beams of some survey lines, and rejecting the outer beams tended to remove the artifacts. The processing logs, included in Separate I, indicate all lines to which the swath filter was applied.

The navigation editor was used to check and correct navigational error. A query was made to detect abrupt jumps in vessel speed, but no such incidents were detected in the data. Similarly, a check for anomalous changes in attitude sensor data revealed no significant issues.

After cleaning and filtering, the survey lines were re-merged to compute final depth values taking into consideration all the defined parameters, offsets and dynamic correctors.

1.3 BASE Surfaces

A BASE surface was created for each survey using the CUBE algorithm. Each surface was created with a resolution of 0.25 m, the IHO S-44 Order specified as Special Order, and the disambiguation method set to Density and Locale. The parameter menus are shown in Figure 9. After creation of the CUBE surface, the subset editor was used to investigate areas where the CUBE algorithm assigned more than one hypothesis for depth measurement. With very few, minor exceptions, the primary CUBE hypotheses were deemed correct and no manual assignments were made. After subset editing, the CUBE surface was re-computed and finalized. Final uncertainty for the finalized BASE surface was taken from the greater of the uncertainty and the standard deviation (scaled to the 95% confidence interval).

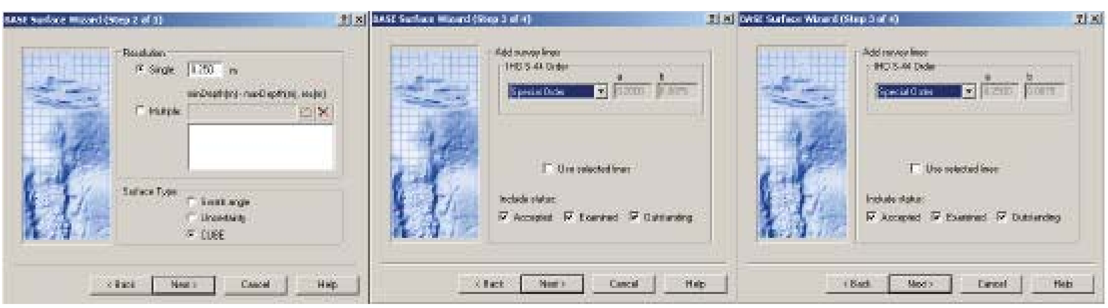


Figure 9 CUBE Parameter Setup.

1.4 Final Product

The final products include the CARIS HIPS Bathymetry Associated with Statistical Error (BASE) surface computed at 0.25 m resolution, as well as the Bathymetric Attributed Grid (BAG) or Open Navigation Surface (ONS). A final BASE surface of Survey 2 (DN 159) is presented in Figure 10. The Navigation Surface is a gridded product that allows the optimal level of detail to be preserved and contains information regarding uncertainty, designated soundings, elevation and metadata. Software and more information regarding the BAG can be found at http://www.opennavsurf.org/. A BAG and BASE surface was created for each survey in accordance with Section 8.5.3 (Shallow-Water Multibeam and Lidar Data) of the NOAA NOS Hydrographic Surveys Specifications and Deliverables (April 2007).

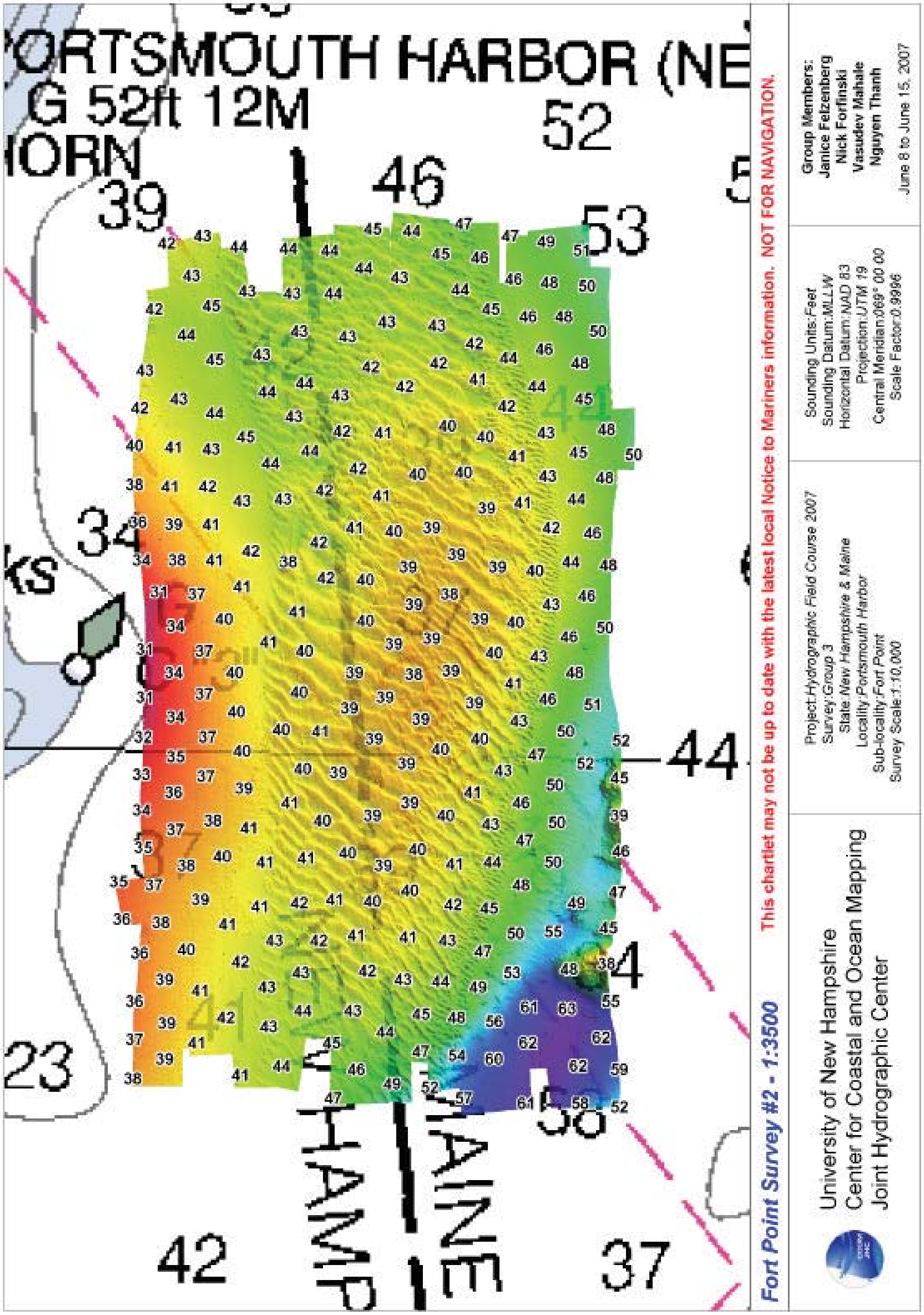


Figure 10 Final 0.25 m BASE surface of Survey 2 (DN 159) with soundings.

C. VERTICAL AND HORIZONTAL CONTROL

C1. Vertical Control

The NOAA tide gauge station at Fort Point, New Castle, NH (ID: 8423898; location 43° 3.4' N, 70° 42.7' W) was used to reduce sounding data to chart datum (MLLW), which was used as the vertical datum for the survey. Discrete tidal zoning for the tidal data from this station was provided by NOAA Center for Operational Oceanographic Products and Services (CO-OPS); however, the data need not be corrected as the zoning scheme indicates a zoning time corrector of 1 minutes and range corrector of 1.00 from the Fort Point tide station.

On June 6, 2007, the NOAA tide gauge station was leveled with respect to six tidal benchmarks located within a 0.2 m radius of the station. The benchmark stamping numbers are NO 2 1919 (primary), NO 1 1919, NO 6 1994, CONSTITUTION 147 NO 1 1841, BM 4 TIDAL US, and PORTSMOUTH USCG 1994.

Tidal data were also logged by a secondary tide gauge established in the vicinity of the NOAA gauge by 2007 Summer Hydrographic Field Course personnel. The second gauge was established due to observed data dropouts in the NOAA gauge. However, no data dropouts were observed in the NOAA preliminary tides during the times of survey, and measurement error on the NOAA gauge was resolved prior to the start of survey (the controller to the Aquatrak acoustic sensor was replaced by CO-OPS personnel on June 7, 2007). A report of vertical control activities is included in Appendix IV.

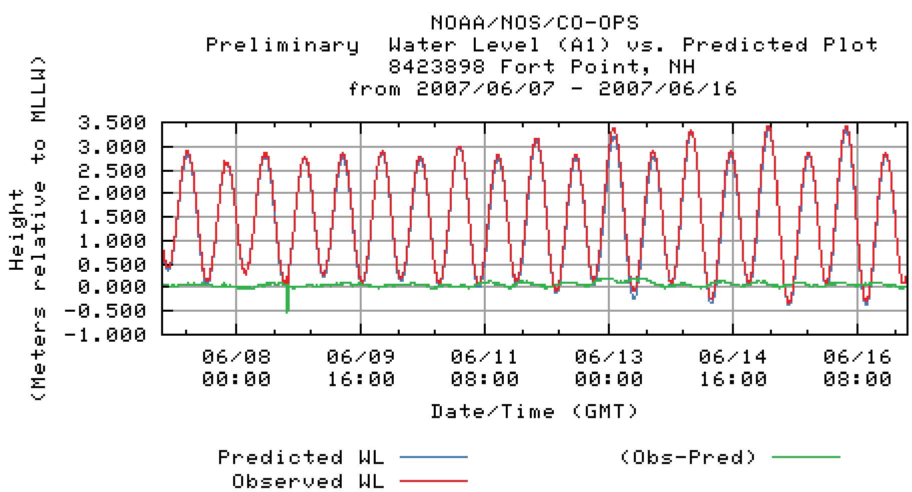


Figure 11 Plot of difference between predicted and preliminary observed water levels from NOAA tide station (ID: 8423898) at Fort Point, New Castle, NH.

C2. Horizontal Control

Horizontal control for the survey was established with Real Time Kinematic (RTK) GPS correctors integrated into the POS/MV system. RTK correctors were provided by a Trimble RTK network established within line-of-sight of the survey area. Horizontal control was established relative to the NAD 83 reference ellipsoid.

1.0 Real Time Kinematic (RTK) GPS Network

An RTK base station was set up at the Seacoast Science Center, Odiornes Point, Rye, NH. This site was chosen because it had a clear line-of-sight to each survey location. The base station consisted of a Trimble 5700 receiver (S/N: 2203582930) and Zephyr antenna (S/N: 60073787) connected to a Trimmark3 modem (S/N: 456152537). Differential corrections were broadcast on Channel 5 at a frequency of 462.3750 MHz. The transmit power was set to 10 W encompassing a line-of-sight radius of over 5 to 6 miles. The Compact Measurement Record (CMR) format was chosen to broadcast the RTK corrector to the rover unit. The transmission was set for a baud rate of 19200 bits per second (bps). The broadcasting radio antenna was mounted approximately 10 m high, and was connected via a low loss RG233 coaxial cable. The base station was configured using a NOAA laptop (S/N: 29360279953) running GPS Configurator (v. 3.2.0.0) software, connected to the Trimble 5700 receiver via serial cable.

The RTK rover station on R/V COASTAL SURVEYOR consisted of a Trimmark3 modem (S/N: 456152531) and antenna mounted next to the mast of the vessel for direct reception of the RTK corrector from the base station. The Trimmark3 output was channeled to the POS/MV, which provided navigation information to the sonar system.

2.0 GPS Data Processing

For positional refinement, raw GPS observations were logged at the base station for over two hours and submitted to National Geodetic Survey (NGS) Online Positioning User Service (OPUS). OPUS then processed the GPS observations using NGS computers and software to determine the accurate position, which was subsequently entered into the base station during configuration. The refined position of the base station calculated by OPUS was (f = 43º 02’ 43.372” N, ? = 070º 42’ 49.699” W, height= -13.912 m) relative to the NAD 83 reference ellipsoid. The accuracy of the base station determined by OPUS is such that the horizontal root mean square value of the measurements is 0.021 m and 0.025 m along the vertical dimension.

The base station was configured for NAD 83 based on post-processed coordinates provided by OPUS relative to the NAD 83 reference ellipsoid. The RTK rover station, however, was configured for WGS 84 and thus received a “pre-RTK-corrected” position fix relative to the WGS 84 reference ellipsoid. However, the CMR corrections received by the rover station (broadcast in NAD 83 from the base station) effectively changed the rover’s reference datum from WGS 84 to NAD 83. The difference between CMR corrections relative to WGS 84 and NAD 83 are millimeter-scale, thus the effect on the positioning data is considered negligible.

3.0 Data Quality Factors

On the last survey day (DN 166) sporadic outages of CMR corrections were noticed by survey personnel. During those few moments (~15 s maximum) of CMR outages, the POS/MV system switched over to the RTCM differential signal received by the integrated WAAS antenna. However, no jumps in the navigation or attitude data were noticed. This is attributed to the high quality inertial navigation system built into the POS/MV, which can maintain accurate positioning for several minutes after loss of CMR correctors. The positional accuracies reported by the POS/MV were less than 0.03 m throughout the survey, except during times of CMR outage, during which it jumped to 0.5 m.

At the end of the project, survey personnel discovered that the raw GPS data was not logged during the survey period. Hence, GPS raw data were acquired from a Continuous Operating Reference Station (CORS) (ID: NHUN) GPS base station installed in 2005 at the University of New Hampshire. Further information regarding this CORS station is available at http://fac-gis.unh.edu/.

D. RESULTS AND RECOMMENDATIONS

D1. Chart Comparison

1.0 Chart Comparison Methods

The final BASE surfaces were compared with NOAA Raster Navigational Chart (RNC) 13283, scale 1:20 000, 19th edition, corrected through June 9, 2007. The most recent Weekly (25-2007; June 23, 2007) and Local Notices to Mariners (24-07; June 11, 2007) published at the time of the chart comparison were found to contain no further corrections to the NOAA RNC.

Chart comparison was accomplished using CARIS HIPS/SIPS 6.1. A visual comparison was performed between the RNC, the final BASE surface, and a soundings layer derived from the BASE surface. Soundings were generated by CARIS Field Sheet Editor using shoal-biased radius selection criteria, whereby the least depth within 3.00 mm of each grid node at the 1:10 000 survey scale was selected for display. All soundings were rounded to the nearest survey foot using NOAA Sounding Rounding rules.

Comparison was made between the BASE surfaces, NOAA charted soundings, and charted shoals and potentially dangerous features. Additionally, general agreement and trends between the BASE surface and RNC were evaluated.

2.0 Comparison with Charted Soundings

Overall agreement between the charted depths of NOAA chart 13283 and the present survey soundings is very good, considering the differences in age, sounding methods, and horizontal and vertical control between the present survey and the survey(s) used to compile the chart. However, it is noted that the comparison was limited to the seven total charted soundings present within the survey area at the largest chart scale available (1: 20 000).

The BASE surface indicates neither a shoaling nor deepening trend within the survey area as compared with the chart. Rather, the minor differences from charted values in this survey area (~2 feet or less) may be explained by discrepancies in horizontal control between the two products. The survey area encompasses part of the Portsmouth Harbor main channel, and it appears that there are no major discrepancies between the survey and the reported depth of the main channel.

3.0 Comparison with Shoals and Potentially Dangerous Features

No shoals or potentially dangerous features are presently charted within the survey area, nor does the current survey indicate any significant changes to NOAA chart 13283. Because there are no identified dangers to navigation within the survey area, no Danger to Navigation Reports have been submitted for this survey.

Additional targets located by the survey include a 15-m long object at 43.06765°N, 70.70656°W that may be a partially buried outcrop or wreck, and a 3x3-m rectangular object at 43.06784°N, 70.70552°W. Heavy scouring observed around the rectangular object is indicative of strong currents in this area. Neither object is expected to pose a danger to navigation. The least depth on the partially buried object is 31 ft, while the least depth on the rectangular feature is 39 ft. These features have been documented in the Survey Feature Report included in Appendix II.

4.0 Recommendations

No significant differences between the charted depths and the character of the seafloor as captured by the final surfaces were noted. As such, no recommendations are made to the existing NOAA chart 13283. However, NOAA may want to investigate the two uncharted features listed in the attached Survey Feature Report (Appendix II) as time and resources permit.

D2. Additional Results

1.0 Shoreline Verification

No shoreline is included within the survey limits.

2.0 Prior Survey Comparisons

No prior survey comparisons were conducted.

3.0 Aids to Navigation

All aids to navigation encountered within the survey vicinity were observed to serve their intended purpose. Aids to navigation within the survey vicinity include green day marker no. 3A and green buoy no. 3.

4.0 Bridges, Overhead Cables and Overhead Pipelines

No bridges, overhead cables, or overhead pipelines are located within the survey limits.

5.0 Ferry Routes

No ferry routes or ferry terminals are active within the survey limits.

6.0 Submarine Cables and Pipelines

NOAA chart 13283 identifies a submarine cable crossing within the survey area, although there is no indication of any submerged cables in the 0.25 m grid resolution BASE surfaces generated from the MBES data. No crossing signs were observed on the shoreline.

7.0 Scientific Results

The major objective of this project was to survey a large sand shoal south of Fort Point multiple times, with sub-meter horizontal positioning uncertainty, to detect bedform migrations during the planned survey period. A difference surface generated from 0.25-m grid resolution BASE surfaces of Surveys 2 and 5 (DN 159 and 166) using CARIS Base Editor indicates a maximum -0.4 m shift on the lee (N) edge of sandwaves along the eastern perimeter of the shoal. This difference would appear to indicate flood-oriented migration in this area during the survey period. However, the *a priori* horizontal positioning uncertainties of the final BASE surfaces are all within the 0.20 – 0.25 m range (the standard deviations of the final BASE surfaces, on the other hand, are less than 0.1 m), which makes any interpretation difficult at this time. Furthermore, centimeter- to decimeter-level vertical shifts between survey datasets, visible in the difference surfaces (Section B2, 1.5, Gridded Surface Difference), will need to be resolved before bedform migration can be interpreted from the data.

APPENDIX I

TIDE NOTE AND GRAPHICS

NOAA FORM 76-77
(10-71)

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

(SPACE FOR ARCHIVES STAMP)

LEVELING RECORD—TIDE STATION

LOCALITY

Fort Point Tide Gauge

Newcastle, NH

INSTRUMENT

Level: Keuffel + Esser Co. (SN: JHC00165)

Rod: Marine Technical Source

Date: 6 June, ~~19~~ JF 2007

J. Felzenberg, **Chief of Party.**

T. Nguyen, **Observer.**

N. Forfinski, **Rodman.**

CONTENTS

INSTRUCTIONS

This form is intended for use in lines of spirit levels between tide staff and bench marks.

The closing error in the levels between the forward and backward measure should not exceed $0.035\sqrt{K}$, in which K is the distance in statute miles leveled between adjacent bench marks. For convenience of use the following table is given:

Distance between B. Ms. feet	Maximum error allowed feet
500 or less	0.011
1,000	0.015
2,000	0.021
3,000	0.027
4,000	0.030
5,000	0.034

EXPLANATION

Elev. indicates elevation, which should usually be referred to the zero of the tide staff. B. S.+ is the back sight, which is added to the elevation to obtain the height of instrument (H. I.). F. S.− is the fore sight, which is subtracted from the height of instrument to obtain the elevation of bench mark or turning point.

When several fore sights are taken from one position of the instrument, they should be entered successively in the F. S. lines, leaving the intermediate B. S. lines vacant. In this case the height of instrument must be repeated in the H. I. lines.

In the column of "Remarks" the object on which the rod is held should be indicated.

On pages 30 and 31 a method of computing the results is given, which should always be filled out by the Chief of Party before the leveling record is forwarded to the office.

Attention is invited to Special Publication No. 196, Manual of Tide Observations.

DESCRIPTION OF TIDE STAFF

Date of installation ....

Portable or fixed .... Glass tube? ....

Hinged? .... Vitrified scale? ....

Length of graduated staff ....

Position of stop on portable staff ....

Staff graduation used for rod stop ....

Top of staff support .... feet below wharf floor.

Zero of tide staff .... feet below wharf floor.

Depth of water .... feet below staff zero.

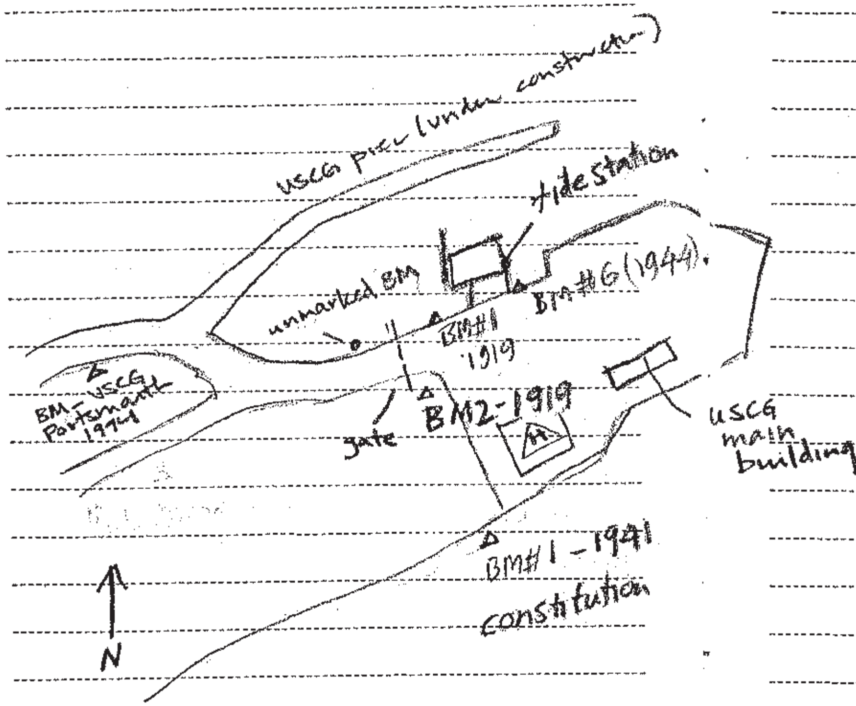
Top of float well .... feet below wharf floor.

Intake to well .... feet below wharf floor.

Harbor bottom .... feet below wharf floor.

Remarks ....

SKETCH SHOWING LOCATIONS OF TIDE STATION AND BENCH MARKS



REMARKS

1. B. M. No. Portsmouth USCG
2. Established by National Geodetic Survey
   Date 1994
3. Recovered by J. Felzenberg
   Date 6/6/2007
4. Type of mark Bronze Disc
5. How stamped Horizontal control Mark NGS
6. Location and detailed description
   Benchmark is located on top of rock outcrop on hill to the south of the Fort Point coast guard pier (under construction)

   Benchmark condition good.

1. B. M. No. unknown (marked 'US')
2. Established by unknown
   Date unknown
3. Recovered by J. Felzenberg
   Date 6/6/2007
4. Type of mark metal rod in large granite block
5. How stamped 'US'
6. Location and detailed description
   Benchmark consists of metal rod in large granite rock on the beach of the southern end of the small embayment to the east of the coast guard pier. Benchmark is unmarked except for letters 'US' carved into granite block.

1. B. M. No. 2
2. Established by U.S. Coast and Geodetic Survey
   Date 1919
3. Recovered by J. Felzenberg
   Date 6 June 2007
4. Type of mark Bronze Disc
5. How stamped U.S. Coast + Geodetic Survey Benchmark 2
6. Location and detailed description
   Benchmark located in outcrop on small hill to SE of entrance gate to US Coast Guard station.
   Benchmark condition good.

1. B. M. No. 'constitution No 1.'
2. Established by U.S. Coast and Geodetic Survey,
   Date 1941
3. Recovered by J. Felzenberg
   Date 6 June 2007
4. Type of mark Bronze Disc
5. How stamped U.S. Coast + Geodetic Survey Reference Mark, constitution No 1, 1941, 147
6. Location and detailed description
   Benchmark is located in outcrop along shoreline to SE of coast guard station parking lot. Location is marked with large white arrow on outcrop.
   Benchmark condition good.

1. B. M. No. 1
2. Established by U.S. coast and Geodetic Survey
   Date 1919
3. Recovered by J. Felzenberg
   Date 6 June 2007
4. Type of mark Bronze DISC
5. How stamped U.S. coast + Geodetic Survey
   Benchmark No. 1 1941
6. Location and detailed description
   Benchmark is located in granite bulkhead directly behind large, 2-story, tan coast Guard workshop.
   Benchmark recovered in Good condition.

1. B. M. No. 6
2. Established by US Coast and Geodetic Survey
   Date 1944
3. Recovered by J. Felzenberg
   Date 6 June 2007
4. Type of mark Bronze DISC
5. How stamped US coast + Geodetic Survey
   Benchmark No. 6 1944
6. Location and detailed description
   Benchmark is located in concrete bulkhead 1 1/2 m to east of gangway to floating dock to the E of the coast guard boat shed.
   Benchmark recovered in good condition.

1. B. M. No. ....
2. Established by ....
   Date ....
3. Recovered by ....
   Date ....
4. Type of mark ....
5. How stamped ....
6. Location and detailed description ....

1. B. M. No. ....
2. Established by ....
   Date ....
3. Recovered by ....
   Date ....
4. Type of mark ....
5. How stamped ....
6. Location and detailed description ....

Station Fort Point, Newcastle, NH

Year 2007 Month June Day 06

	Meters ~~Feet~~	Dec's	Remarks
Elev.	20	0	Top of staff
B. S.+	2	596	staff to BM6
H. I.	22	596	
F. S.−	1	428	" "
Elev.	21	168	BM6
B. S.+	1	434	BM6 to BM1
H. I.	22	602	
F. S.−	1	488	" "
Elev.	21	114	BM1
B. S.+	2	358	BM1 to TP1
H. I.	23	472	(TP1 in N corner of
F. S.−	0	409	Helipad)
Elev.	23	063	TP1
B. S.+	1	496	TP1 to 'constitution No 1'
H. I.	24	559	
F. S.−	1	876	
Elev.	22	683	constitution no. 1
B. S.+	2	071	'constitution No 1' to BM2
H. I.	24	754	
F. S.−	1	390	
Elev.	23	364	BM2

Staff to 'Portsmouth USCG' benchmark

Observer Nguyen Thanh Rodman Nick Forfinski

	Feet	Dec's	Remarks
Elev.	23	364	BM2
B. S.+	0	155	BM2 to TP2
H. I.	23	519	(outside front gate)
F. S.−	2	050	
Elev.	21	469	TP2
B. S.+	1	006	TP2 to unmarked BM
H. I.	22	475	
F. S.−	2	848	
Elev.	19	627	unmarked BM
B. S.+	3	076	unmarked BM to TP3
H. I.	22	703	(to E of coast guard
F. S.−	0	179	Pier entrance)
Elev.	22	524	TP3
B. S.+	2	938	TP3 to TP4
H. I.	25	462	TP4 → on pavement to W of
F. S.−	0	623	
Elev.	24	839	TP4 'Portsmouth USCG'
B. S.+	1	945	TP4 to 'Portsmouth USCG'
H. I.	26	784	benchmark
F. S.−	1	196	
Elev.	25	588	Portsmouth USCG Benchmark

Station Fort Point Newcastle, NH

Year 2007 Month June Day 6

	FEET	DEC'S	REMARKS
Elev.	25	588	Portsmouth USCG BM
B. S.+	~~0~~	~~615~~	~~'Portsmouth USCG'~~
H. I.			~~to TP5~~ (JF)
F. S.−	~~2~~	~~974~~	~~(TP5 to W of coast~~
Elev.			~~guard pier entrance~~)
B. S.+	~~0~~	~~274~~	~~TP5 to unmarked BM~~
H. I.	Instrument was not level –		
F. S.−	measurements void - starting		
Elev.	over from 'Portsmouth USCG' BM		
B. S.+	0	650	'Portsmouth USCG' to TP5
H. I.	26	238	(TP5 located to W of coast
F. S.−	3	015	guard pier entrance)
Elev.	23	223	TP5
B. S.+	~~3~~ 0 (JF)	~~015~~ 233	TP5 to unmarked BM
H. I.	23	456	
F. S.−	3	833	
Elev.	19	623	Unmarked BM
B. S.+	3	342	unmarked BM to TP6
H. I.	22	965	(TP6 is approx. 7 m SW
F. S.−	0	665	from fire hydrant
Elev.	22	300	near BM

↑ TP6 — Marginside road).

'Portsmouth USGC' benchmark to staff

Observer Vasudev Mahale Rodman Nguyen Thanh

	FEET	DEC'S	TP6 REMARKS
Elev.	22	300	~~TP6 to BM2~~ JF
B. S.+	1	768	TP6 to BM2
H. I.	24	068	
F. S.−	0	666	
Elev.	23	402	BM2 constitution
B. S.+	1	462	BM2 to Benchmark No1
H. I.	24	864	
F. S.−	2	092	~~Benchm~~ (JF)
Elev.	22	772	CONSTITUTION BM NO1 ~~constitution~~
B. S.+	1	707	Benchmark No1 to TP7
H. I.	24	479	(TP7 located approx.
F. S.−	2	323	5 m east of Diesel
TP7 Elev.	22	156	fuel tank in parking lot, behind paint locker)
B. S.+	0	~~6~~72 (JF)	TP7 to BM1
H. I.	22	828	
F. S.−	1	626	
Elev.	21	202	BM1
B. S.+	1	626	BM1 to BM6
H. I.	22	828	
F. S.−	1	574	
Elev.	21	254	BM6

Station Reiteration of "off" measurements from Runs 1+2

Year 2007 Month June Day 06

	FEET m	DEC'S	REMARKS
Elev.			BM (costitution) - BM2
B. S.+	2	014	
H. I.			
F. S.−	1	333	
Elev.			BM2 → Unmarked BM
B. S.+	0	055	
H. I.			
F. S.−	3	830	
Elev.			Unmarked BM - BM2
B. S.+	3	934	
H. I.			
F. S.−	0	158	
Elev.			BM2 - BM1 (1941 - costitution)
B. S.+	1	421	
H. I.			
F. S.−	2	101	
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			

Observer Nick Rodman Janice

	FEET	DEC'S	REMARKS
Elev.			Unmarked BM → TP8
B. S.+	3	783	
H. I.			
F. S.−	0	.270	
Elev.			TP8 - Portsmouth USGS
B. S.+	3	055	
H. I.			
F. S.−	0	605	
Elev.			Portsmouth USGS - TP9
B. S.+	0	555	
H. I.			
F. S.−	3	006	
Elev.			TP9 - Un Marked BM
B. S.+	0	075	
H. I.			
F. S.−	3	585	
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			

Station ____________________

Year ______ Month ____________ Day ____________

	FEET	DEC'S	REMARKS
Elev.			
B. S.+			
H. I.			
F. S.–			
Elev.			
B. S.+			
H. I.			
F. S.–			
Elev.			
B. S.+			
H. I.			
F. S.–			
Elev.			
B. S.+			
H. I.			
F. S.–			
Elev.			
B. S.+			
H. I.			
F. S.–			
Elev.			

Observer ____________ Rodman ____________

	FEET	DEC'S	REMARKS
Elev.			
B. S.+			
H. I.			
F. S.–			
Elev.			
B. S.+			
H. I.			
F. S.–			
Elev.			
B. S.+			
H. I.			
F. S.–			
Elev.			
B. S.+			
H. I.			
F. S.–			
Elev.			
B. S.+			
H. I.			
F. S.–			
Elev.			

Station ____________________

Year ______ Month ____________ Day ____________

	FEET	DEC'S	REMARKS
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			

Observer ____________ Rodman ____________

	FEET	DEC'S	REMARKS
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			

Station ______

Year ______ Month ______ Day ______

	Feet	Dec's	REMARKS
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			

Observer ______ Rodman ______

	Feet	Dec's	REMARKS
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			

Station ____________

Year ______ Month ______ Day ______

	FEET	DEC'S	REMARKS
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			

Observer ____________ Rodman ____________

	FEET	DEC'S	REMARKS
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			

Station

Year Month Day

ABSTRACT OF LEVELING

The symbol B. M. (a) is used here to designate the staff stop on the support used with the portable tide staff, or the graduation of the scale corresponding to the point at which the level rod was held.

For convenience, copy the direct elevations for each bench mark, as given by the forward and backward runnings of levels into the form below. List the bench marks in the order of their connection to the staff on the forward run.

ELEVATION

B. M. Nos.	Forward Run	Backward Run
	Feet	*Feet*
(a) Staff	20.000	20.001
BM6	21.168	21.169
BM1	21.114	21.117
constitution No1	22.683	22.687
BM2	23.364	23.367
unmarked BM	19.589	19.591
Portsmouth USCG	25.552	25.552

DIFFERENCE OF ELEVATION

Designation of Section	Forward Run	Backward Run	Mean
	Feet	*Feet*	*Feet*
Elevation of (a) above zero of tide staff=			4.000
Staff-BM6	1.168	1.168	1.168
BM6-BM1	-0.054	-0.052	-0.053
BM1-constitution No1	1.569	1.570	1.570
constitution No1-BM2	0.681	0.680	0.681
BM2-unmarked BM	-3.775	-3.776	-3.776
unmarked BM-Portsmouth USCG	5.963	5.961	5.962

Indicate sections as "Staff to 1," etc., with the sign of the forward run for the mean.

The algebraic sum of the successive mean differences gives the elevations above zero of tide staff.

ELEVATIONS ABOVE ZERO OF TIDE STAFF

B. M. 6 = 5.168 feet.	B. M. unmarked = 3.590 feet.
B. M. 1 = 5.115 feet.	B. M. Portsmouth USCG = 9.552 feet.
B. M. constitution No.1 = 6.685 feet.	B. M. ______ feet.
B. M. 2 = 7.365 feet.	B. M. ______ feet.

Station Fort Point, Newcastle, NH

Year 2007 Month June Day 6

	Feet	Dec's	Remarks
Elev.	21	254	BM6
B. S.+	1	505	BM6 to top of tide staff
H. I.	22	759	
F. S.−	2	673	
Elev.	20	086	Top of Tide staff
B. S.+			
H. I.			
F. S.−			
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			

Observer Vasudev Mahale Rodman Nguyen Thanh

	Feet	Dec's	Remarks
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			
B. S.+			
H. I.			
F. S.−			
Elev.			

Table of Contents Page

IV.A.1 - TIDE AND WATER LEVELS

IV.A.1.i - Station Description

A back up water level sensor was installed on June 4, 2007 at the US Coast guard base Portsmouth Station in New Castle, New Hampshire in support of the Field Hydrographic Course at the University of New Hampshire. The reason for the installation was because the permanent tide gauge installed and operated by NOAA was showing data gaps in both the transmission and on the internal data logger. Data from the newly installed back up water level sensor would be used to fill any gaps in the data from the primary NOAA gauge if necessary.

On June 7, 2007 Carl Kammerer of the Joint Hydrographic Center (JHC) replaced the Aquatrak Controller in the NOAA gauge. After the replacement of the controller there were three data gaps each of which were only 6 min long. The gaps were on June 6, 2007 at 12:12 (UTC), June 9, 2007 at 21:00 (UTC) and June 13, 2007 at 19:24 (UTC). Surveying for this project was scheduled to be done between June 11th and 13th. However, due to rough seas, 3-5 ft, no data was collected on June 13th. Thus the previously mentioned gaps in the primary gauge data did not effect the survey.

In order to prepare for the back up gauge installation a team of students from the Center of Coastal and Ocean Mapping (CCOM) made a reconnaissance trip to the site and determined the most appropriate location to install the backup gauge was along was along the eastside of the covered Coast Guard pier. This location was chosen because of its vicinity to the survey area and the primary NOAA gauge, the USCG pier provided an excellent structure for mounting the gauge and a floating dock provided a working platform for banding the sensor's cable to the piling.

The backup sensor was mounted inside a 4-in diameter white PVC pipe using a 5" stainless steel section of althread. This section of althread penetrated through both the pipe and mounting hole on the end of the sensor (see IV.A.2). Stainless steel nuts and washers were used to fasten the sensor in an upright position to prevent pivoting of sensor around the mounting rod. The offsets for the sensor int eh PVC pipe are shown in appendix IV.A.3. The 10-ft PVC pipe was attached to the piling with steel banding. The cable connecting the sensor to the datalogger was routed up the same piling the PVC pipe was mounted to, under the wood flooring of the pier and inside the covered building where the entire logging unit; which includes the logger, battery, compensating unit and external battery; rested in place against a metal support beam. Mounting the logger inside the building both protected the unit from weather, which was important because the unit itself was not fully weather resistant and water leaked through the seam around the door, and provided a dry place for the tide observer to download data or perform maintenance on the logger.

The primary NOAA water level sensor is an Aquatrak acoustic sensor with a SUTRON data logger. The sensor has an accuracy of ±0.025% of the range and a resolution of

0.001 m, these specifications can be found on the Aquatrak website http://www.aquatrak.com/. The backup water level sensor is an Aanderaa strain gauge with an accuracy of ±0.2% of the range and a resolution of 0.1% of the range.

IV.A.1.ii - Logging Parameters

The CCOM backup gauge was programmed to log battery voltage, water level, and water temperature every 30 seconds. It takes 15 seconds to log all four measurements, 5 seconds for battery voltage, 5 sec for water level and 5 sec for water temp. Each measurement is a 30 sec average time stamped with the time at the beginning of the first measurement. The raw measurements from the Aanderaa sensor are converted to depth in meters using eq. 1.1 provided in the Aanderaa Instruments datasheet for water level/temperature series 3791-3798.

$$WaterLevel(m) = \frac{A + B*N + C*N^2 + D*N^3}{d*g} \quad (1.1)$$

where A, B, C and D are coefficients given in the sensor's calibration sheet, N is the raw data value measured by the logger, d is the density of water (g/cm^3), and g is gravity. The coefficient values for the backup sensor are shown in the table below. Note that the table shows a value of 0.00 for water density and based on the sensor data sheet *g* is 9,80665 (the international standard). Uncertainty is introduced by the fact that these values are not site specific.

CH	Parameter	Unit	A	B	C	D
00	Battery Voltage	Volt	+0.000E+00	+1.000E-02	+0.000E+00	+0.000E+00
02	Water Level	m	-8.645E-02	+5.138E-03	+6.808E-08	+0.000E+00
03	Water Temp	Deg. C	-7.823E+00	+4.321E-02	+5.084E-06	+0.000E+00

Table 1 – Coefficients in the Aanderaa datalogger used to convert from raw measurements to volts, m, and Deg. C.

The converted data (volts, m, Deg. C) were logged to a 128 Mb compact flash card in an Persistor Instruments Inc. external data logger. The NOAA gauge takes a 181 sec average every 6 min on the hour (i.e. 00:06, 00:12, 00:18, …) and time stamp of the reading is centered in the averaging period

Drift of the Aanderaa Datalogger 3634 was monitored during maintenance trips. The clock in the data logger was synced with GPS time, which was retrieved from a handheld Garmin GPS receiver, on the day of installation (June 4, 2007 UTC). By June 13, 2007 the datalogger was reading 7 sec slower than GPS time on the handheld receiver.

IV.A.1.iii - Sensor movement

The water level readings were tied into the local tidal datum though spirit leveling. Installation levels were conducted on June 6 and 7 of 2007 and check levels were conducted on June 15, 2007 (see IV.A.3 and IV.A.4). There was a maximum difference in elevation of 0.002 m between the 2007 installation levels and the NOAA published benchmark elevations, which can be found at the http://tidesandcurrents.noaa.gov,).

A total of 7.03 hrs of gauge to staff comparisons were observed during 5 different periods of time between June 4th and June 6th (see IV.A.5). A benchmark elevation drawing is shown in appendix IV.A.6. For each period of observations the average difference for the CCOM gauge to staff, NOAA gauge to staff, and NOAA gauge to CCOM gauge comparisons were computed**.** The average of those five averages was then used as the final staff constant for each of the three comparisons. Because of the 7 second clock drift in the Aanderaa datalogger (see IV.A.6) the measured water levels values from the Aanderaa sensor were interpolated to the 6 min interval using the MATLAB function 'interp1()' in order to compute the gauge to gauge comparisons. Residuals from the final staff constant for each of the three comparisons show the NOAA sensor to be the most stable with a standard deviation of 0.007 m (see IV.A.7). The fluctuation in comparisons of the CCOM gauge to the staff and the NOAA gauge suggested movement of the CCOM sensor. Check levels run on June 15, 2007 showed an elevation difference of -0.001m which meant there was little to no movement in the sensor and the fluctuation in staff to gauge comparisons was due to either phase lag in the water level introduced by the stilling well or observer error. Based on the gauge to gauge comparisons there was a measurement shift in one of the sensors that corresponds with the time Carl Kammerer replaced the Aquatrak controller in the NOAA gauge. Prior to the replacement of the controller there signal of the difference had an increasing trend of 0.006 m/day and a peak-to-trough amplitude of approximately 6cm. After the controller was replaced the trend reduces to -0.0001 m/day and the amplitude reduces to approximately 2cm (Fig. IV.A.1.iii.a). The frequency of the signal appears to match that of the tidal signal with a positive difference during periods of low tide and a negative difference between periods of high tide. This means that at high tide the Aanderaa sensor was reading higher than the Aquatrak whereas at low tide the Aanderaa sensor was reading lower than the Aquatrak. Also the amplitude of the signal in the differences appears to scale with the amplitude of the tide, as the amplitude of the tide increased the amplitude differences increased and as the amplitude in the tide decreased so did the amplitude of the differences. Although the Aanderaa sensor installed for the CCOM gauge was last calibrated by the manufacture in June of 2000, which leaves suspicion as to the accuracy of the gauge, the record of differences between the two gauges over the 7 day period of time suggests the uncertainty of the data from the NOAA gauge was improved from 6 cm to 2 cm when the new Aquatrak controller was installed on June 7, 2007 at 20:18 (UTC).

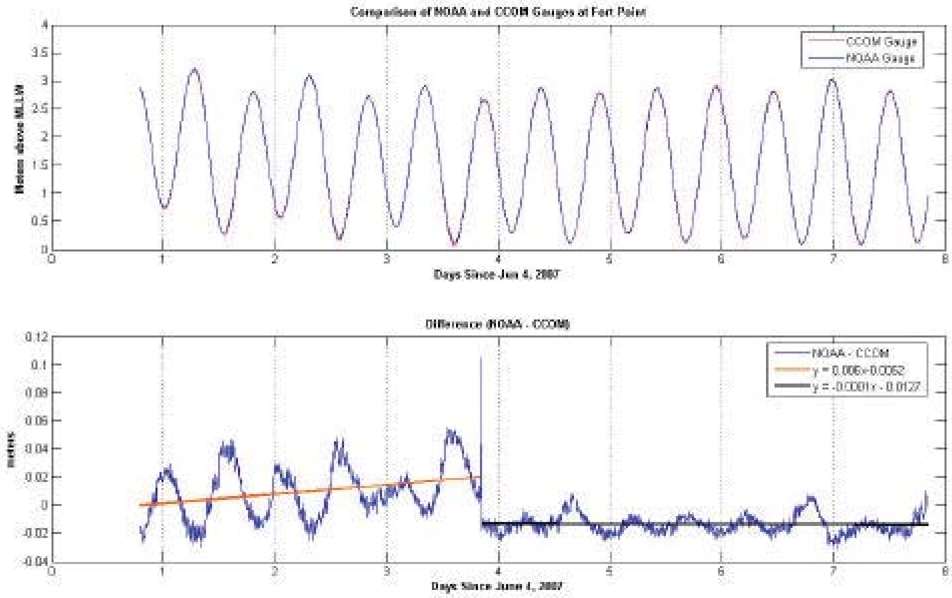
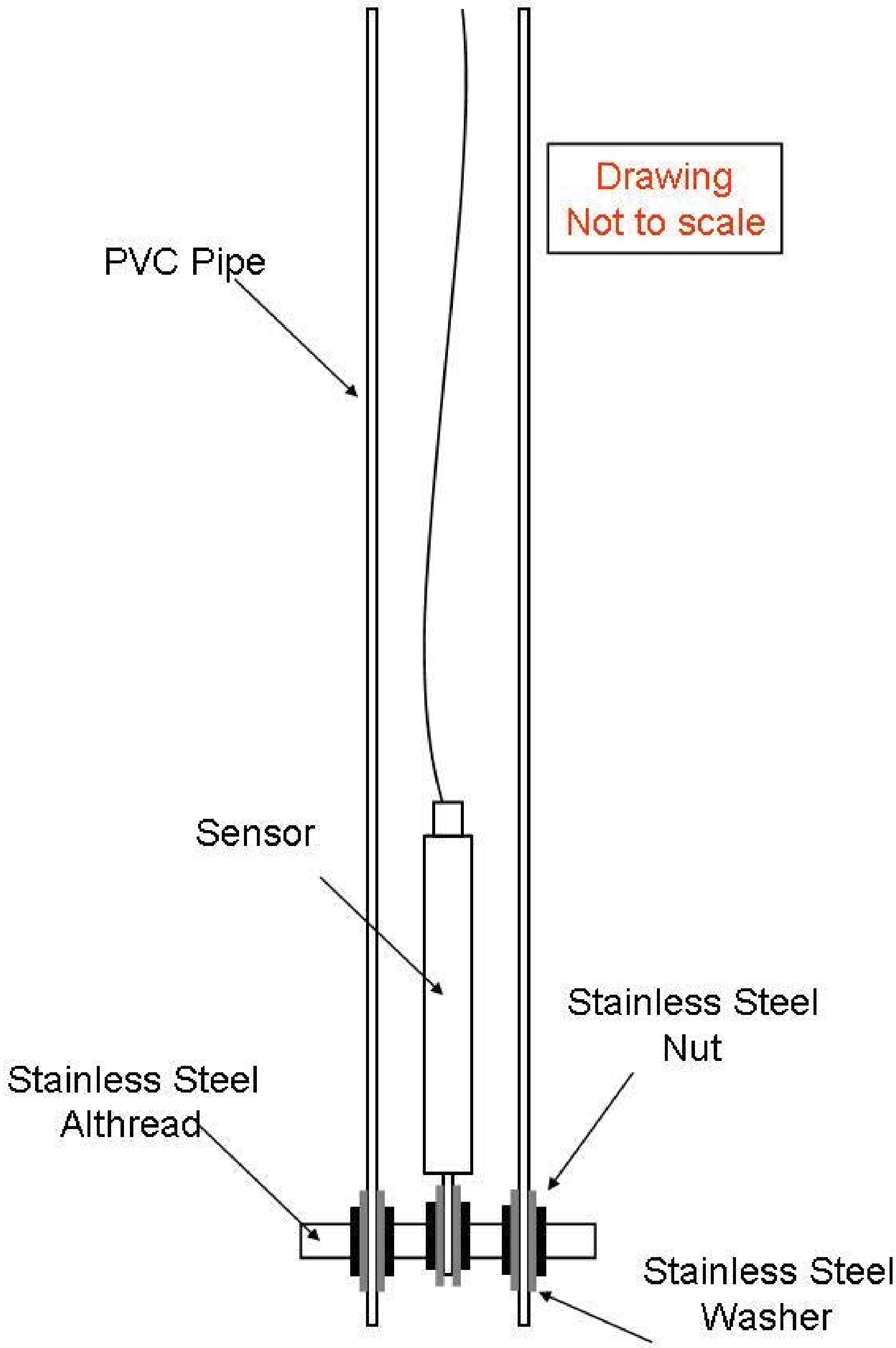


Figure IV.A.1.iii.a – The top plot is a seven day record of both the NOAA and CCOM gauges. The blue line in the bottom plot is the difference between the two gauges. The spike in the data is at 20:18 (UTC) on June 7, 2007 and marks when the Aquatrak controller was replaced in the NOAA gauge. The orange line is a linear fit to the data before the controller was replaced and the black line is a linear fit to the data after the controller was replaced.

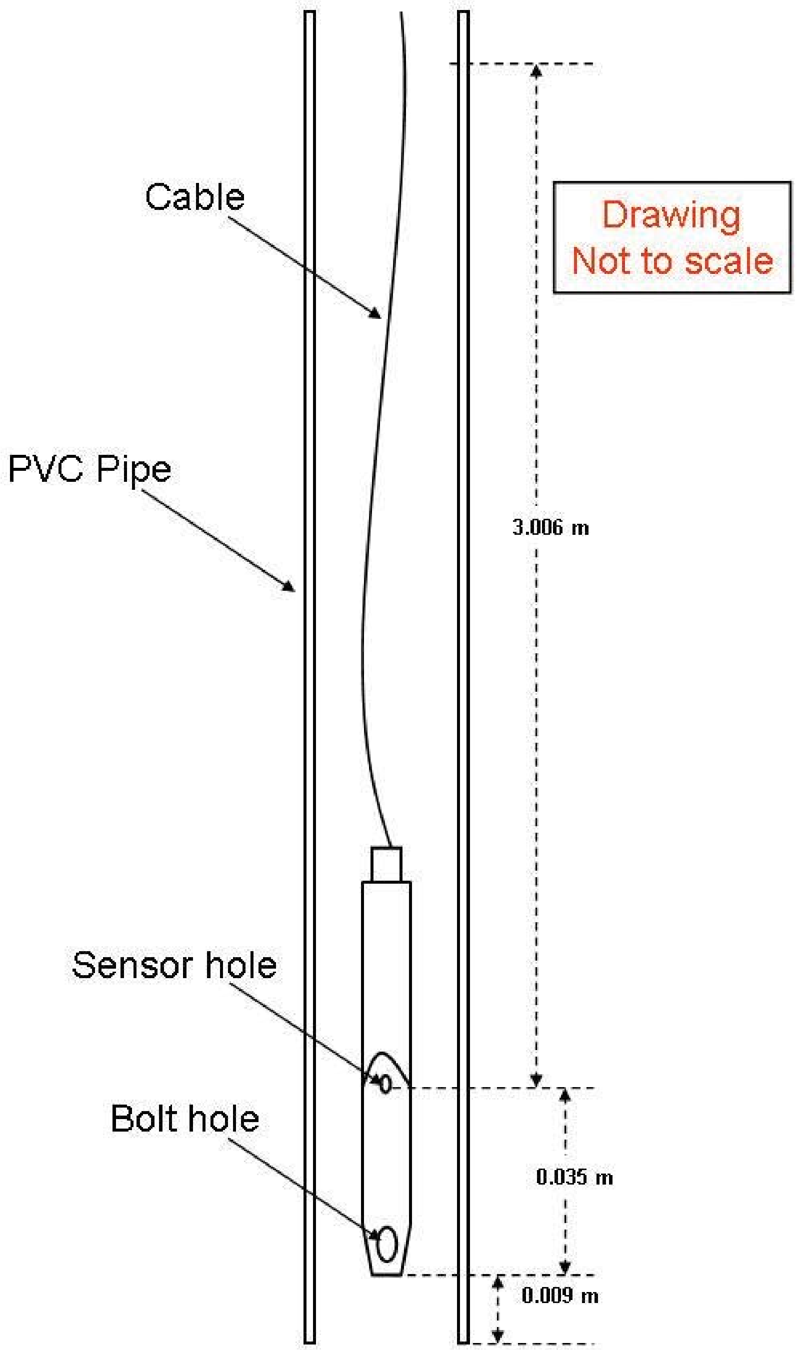
IV.A.1.iv - Tidal zoning

A discrete tidal zoning for Piscatuaqua River Entrance was designed by CO-OPS. This zoning scheme used NOAA gauge 8423898 Fort Point as the reference station. The time and range correctors for the survey area were -6 min and x1.00, respectively. The uncertainty associated with the zoning scheme is approximately 0.2m (personal correspondence with C. Kammerer)

IV.A.2 - SENSOR PVC MOUNT



IV.A.3 - SENSOR OFFSETS



IV.A.4 - ABSTRACT OF LEVELING

Abstract of Leveling (MLLW)

Fort Point, New Hampshire

Date of Levels: 6/6/2007 - 6/8/2007

Benchmarks: CONSTITUTION NO 1 1941, NO 1 1919, NO 6 1944, 842 3898 TIDAL US
Number of benchmarks: 5
PBM: 2 1919

Installation Levels

(all elevations in meters)

From	To	Forward	Backward	Delta	Mean	Elevation	MLLW BM name
						6.690	2 1919
2 1919	CONSTITUTION 147 NO 1 1941	-0.680	0.681	0.001	-0.6805	6.010	CONSTITUTION 147 NO 1 1941
CONSTITUTION 147 NO 1 1941	NO 1 1919	-1.570	1.569	-0.001	-1.5695	4.440	NO 1 1919
NO 1 1919	NO 6 1944	0.052	-0.054	-0.002	0.0530	4.493	NO 6 1944
NO 6 1944	Staff Stop	-1.168	1.168	0.000	-1.1680	3.325	Staff Stop
2 1919	842 3898 TIDAL US	-3.775	3.776	0.001	-3.7755	2.915	842 3898 TIDAL US
842 3898 TIDAL US	Portsmouth USCG 1994	5.963	-5.961	0.002	5.9620	8.877	Portsmouth USCG 1994
NO 6 1944	Aqua Old	0.855	-0.855	0.000	0.8550	5.348	Aqua Old
Staff Stop	PVC Pipe	-1.643	1.644	0.001	-1.6435	1.682	PVC Pipe
PVC Pipe	Backup Orifice	-3.006			-3.0060	-1.325	Backup Orifice

Bench Mark	Elevation from 2007 Levels	Published Elevations	Difference
2 1919	6.690	6.69	0.000
CONSTITUTION 147 NO 1 1941	6.010	6.009	0.001
NO 1 1919	4.440	4.439	0.001
NO 6 1944	4.493	4.491	0.002
842 3898 TIDAL US	2.915	2.915	0.000
Portsmouth USCG 1994	8.877	8.879	-0.002

Note 1) The measurement between PVC Pipe and Backup Orifice was made using a steel tape.
Note 2) Published elevations are from the CO-OPS website tidesandcurrents.gov

IV.A.5 - COMPARISON OF INSTALL AND CHECK LEVELS

Abstract of Leveling (MLLW)

Fort Point, New Hampshire

Date of Levels: 6/6/2007 - 6/8/2007

Benchmarks: CONSTITUTION NO 1 1941, NO 1 1919, NO 6 1944, 842 3898 TIDAL US
Number of benchmarks: 5
PBM: 2 1919

Installation Levels

(all elevations in meters)

From	To	Forward	Backward	Delta	Mean	Elevation	MLLW BM name
						6.690	2 1919
2 1919	CONSTITUTION 147 NO 1 1941	-0.680	0.681	0.001	-0.6805	6.010	CONSTITUTION 147 NO 1 1941
CONSTITUTION 147 NO 1 1941	NO 1 1919	-1.570	1.569	-0.001	-1.5695	4.440	NO 1 1919
NO 1 1919	NO 6 1944	0.052	-0.054	-0.002	0.0530	4.493	NO 6 1944
NO 6 1944	Staff Stop	-1.168	1.168	0.000	-1.1680	3.325	Staff Stop
2 1919	842 3898 TIDAL US	-3.775	3.776	0.001	-3.7755	2.915	842 3898 TIDAL US
842 3898 TIDAL US	Portsmouth USCG 1994	5.963	-5.961	0.002	5.9620	8.877	Portsmouth USCG 1994
NO 6 1944	Aqua Old	0.855	-0.855	0.000	0.8550	5.348	Aqua Old
Staff Stop	PVC Pipe	-1.643	1.644	0.001	-1.6435	1.682	PVC Pipe
PVC Pipe	Backup Orifice[1]	-3.006			-3.0060	-1.325	Backup Orifice1

Check Levels[3]

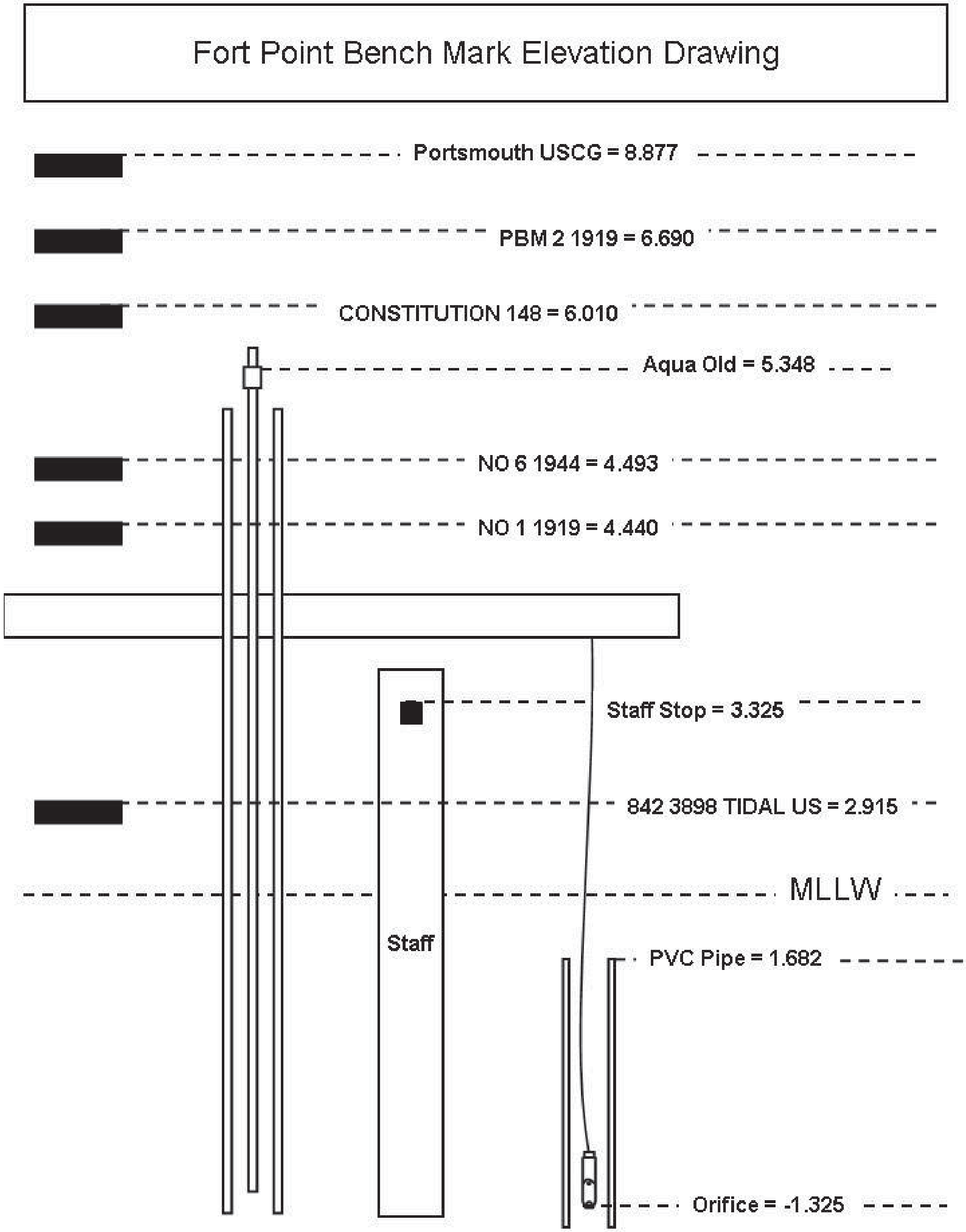
(all elevations in meters)

From	To	Forward	Backward	Delta	Mean	Elevation	MLLW BM name
						4.493	NO 6 1919
NO 6 1919	Staff Stop	-1.169	1.168	-0.001	-1.1685	3.325	Staff Stop
Staff Stop	PVC Pipe	-1.642	1.643	0.001	-1.6425	1.682	PVC Pipe
NO 6 1919	NO 1 1919	-0.055	0.055	0.000	-0.0550	4.438	NO 1 1919
PVC Pipe	Backup Orifice	-3.006			-3.0060	-1.324	Backup Orifice

From	To	Install Diff	Check Diff	Diff
NO 6 1919	Staff Stop	-1.1680	-1.1685	0.0005
Staff Stop	PVC Pipe	-1.6435	-1.6425	-0.0010
NO 6 1919	NO 1 1919	-0.0530	-0.0550	0.0020
PVC Pipe	Backup Orifice	-1.3245	-1.3240	-0.0005

Note 1) The measurement between PVC Pipe and Backup Orifice was made using a steel tape.
Note 2) Elevation of the primary bench mark was obtained from the CO-OPS website tidesandcurrents.gov
Note 3) Check levels were run to monitor the stability of the PVC Pipe that the back up sensor was mounted in.

IV.A.6 - BENCHMARK ELEVATION DRAWING



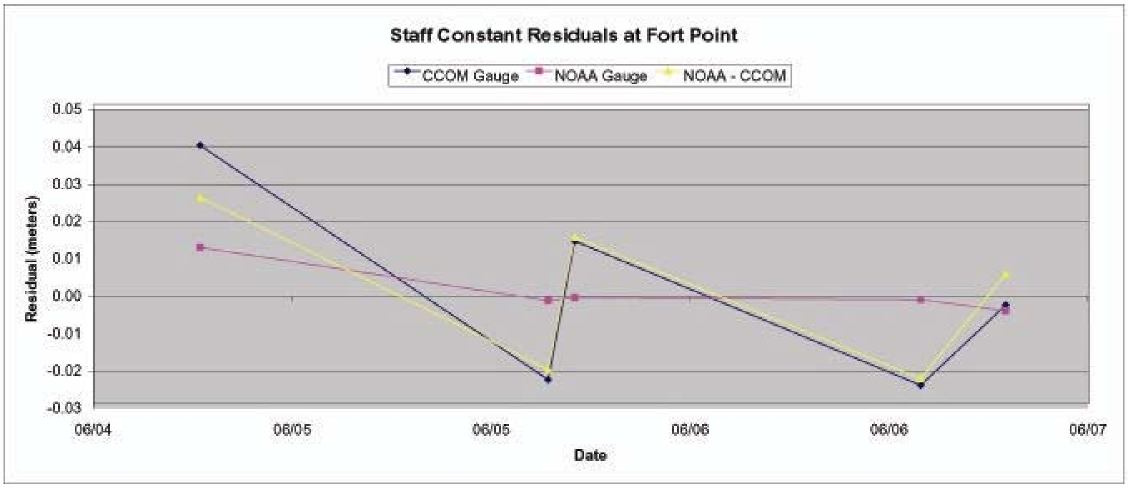
IV.A.7 - STAFF GAUGE COMAPRISON PLOT

Gauge Comparisons

CCOM Gauge			
Date/Time	Gauge Constant	Count	Residual
6/4/2007 18:24	-0.70	5	0.04
6/5/2007 15:24	-0.63	3	-0.02
6/5/2007 17:00	-0.67	87	0.01
6/6/2007 13:52	-0.63	65	-0.03
6/6/2007 19:00	-0.65	22	0.00
Average =	-0.66		
Stdev =	0.03		

NOAA Gauge			
Date/Time	Gauge Constant	Count	Residual
6/4/2007 18:24	0.652	6	0.012
6/5/2007 15:24	0.666	3	-0.003
6/5/2007 17:00	0.665	30	-0.002
6/6/2007 13:52	0.666	22	-0.002
6/6/2007 19:00	0.669	13	-0.005
Average =	0.663		
Stdev =	0.007		

NOAA - CCOM			
Date/Time	Gauge Constant	Count	Residual
6/4/2007 18:24	-1.35	5	0.025
6/5/2007 15:24	-1.30	3	-0.021
6/5/2007 17:00	-1.33	30	0.015
6/6/2007 13:52	-1.30	22	-0.023
6/6/2007 19:00	-1.32	13	0.005
Average =	-1.32		
Stdev =	0.02		



IV.A.8 - TIDE STATION REPORT

Tide Station Report

Station Name:	Fort Point CCOM Gauge	**Physical Location:**	New Castle, New Hampshire
Latitude:	43º 04' 17.8" N	**Longitude:**	070° 42' 38.2" W

Location:

Name:	USCG Portsmouth Station
Owner:	USCG
Address:	25 Wentworth Rd. New Castle, NH 03854
Phone:	603-436-4415

Levels

Date leveled:	6-Jun-07	**Number of Benchmarks:**	6
Primary Benchmark:	2 1919		

Benchmark	MLLW elev (2007)	NAD83(1996) EH	GPS Obs Date
Portsmouth USCG	8.877	-19.23	7/1/2002
CONSTITUTION 147 RM 1	6.010	-22.10	6/22/2001

Remarks: The NAD83(1996) ellipsoid heights for benchmarks PORTSMOUTH USCG (PID AB2631) and CONSTITUTION 147 RM 1 (PID OC0429) were retrieved from the NGS database http://www.ngs.noaa.gov/cgi-bin/datasheet.prl.

Tide Staff

Date Installed:	5-Jun-07	**Graduation:**	metric
Length:	4 meters		
Staff Stop:	Aluminum angle bracket, 2 inches long		
Remarks:	Staff stop is mounted near the 4 meter mark on the staff.		

Gauge:

Data Logger

Date Installed:	5-Jun-07	**Type Manufacture:**	Aanderra
Serial Number:	47	**Calibration Date:**	22-Jun-00

	Time (UTC)			Time (UTC)	
Date	**Datalogger**	**GPS**	**Date**	**Datalogger**	**GPS**
6/4/2007	17:02:00	17:02:00	6/11/2007	20:22:40	20:22:46
6/6/2007	17:26:39	17:26:40	6/13/2007	15:42:53	15:43:00

Compensating UNIT

Serial Number:	3848	**Power:**	9 volt alkaline battery

External Data Logger SN:

Serial Number:	CF2-6992	**Manufacture:**	Persistor Instruments Inc.
Memory Card:	128 MB Compact flash card		

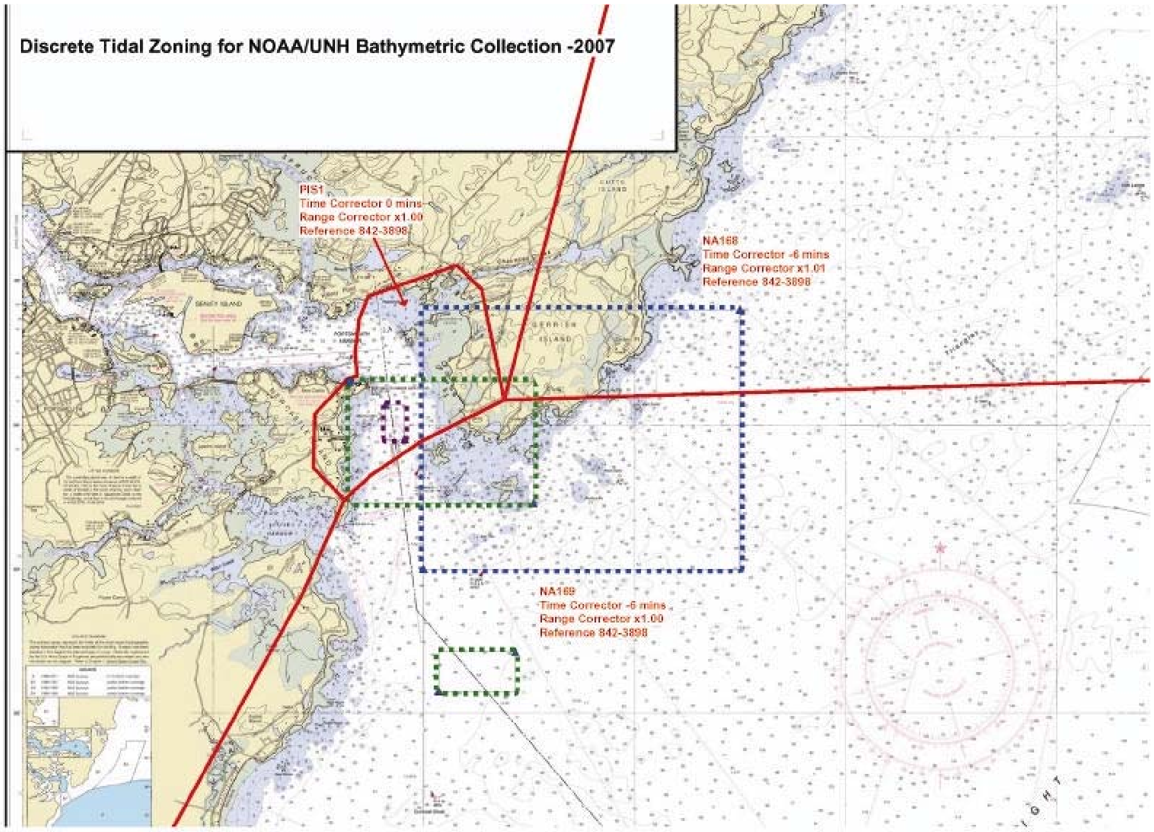
Remarks: The gauge is mounted inside a 10' long PVC pipe that is 4" in diameter. The sensor is fastened to the end of the pipe with a stainless steel rod. Holes were drilled into the pipe at 1 foot intervals. Steel banding was used to secure the pipe to one of the wood pilings suporting the USCG boat house.

Ancillary Sensor:

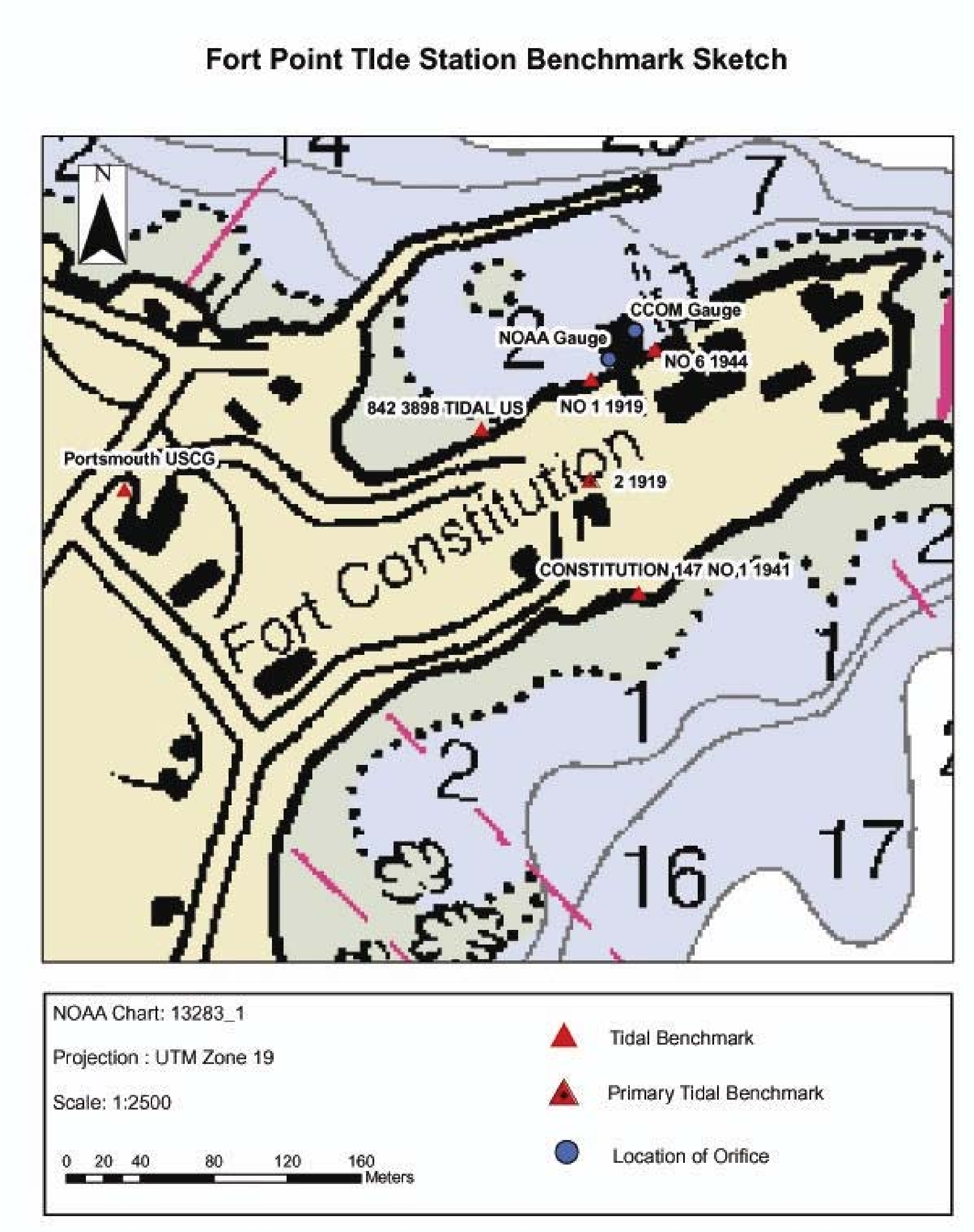
Type:	Temperature	**Serial Number:**	47
Manufacture:	Aanderaa	**Date Installed:**	5-Jun-07

Additional Remarks: The water level and temperature sensor is one unit. The clock in the data logger drifted ????? Sec over the duration of the installation.

IV.A.9 - TIDAL ZONING SCHEME



IV.A.9 - BENCHMARK SKETCH



IV.A.10 - TIDAL BENCH MARK PHOTOS

Stamping: 2 1919
Designation: 842 3898 TIDAL 2
Monument Type: US C&GS disk

Lat: 43° 04’ 18.0” N
Long: 070° 42’ 42.0”W

Figure 1 - Left photo is a close up of benchmark 2 1919. Right photo is looking NE from benchmark 2 1919 and shows NO 1 1919 in the background.

Stamping: NO 1 1919
Designation: 842 3898 TIDAL 1
Monument Type: US C&GS disk

Lat: 43° 04’ 16.8” N
Long: 070° 42’ 39.2”W

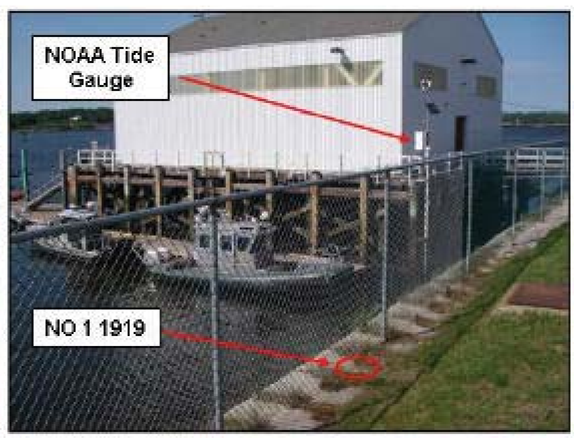


Figure 2 – Left photo is a close up of benchmark NO 1 1919. Right photo is looking NE with benchmark NO 1 1919 in the foreground. Note the NOAA tide gauge (Station number 8423898) at the SWcorner of the covered dock.

Alias: BM 4
Designation: 842 3898 TIDAL 1
Monument Type: Bolt (iron rod in rock)

Lat: 43° 04' 16.8" N
Long: 070° 42' 39.2"W

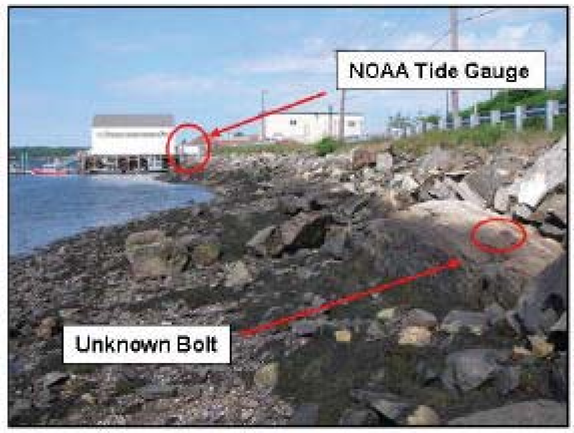


Figure 3 - Left photo shows BM 4 which is an iron bolt drilled into a bedrock out crop. Right photo is looking NE and shows the NOAA tide gauge in the background.

Stamping: NO 6 1944
Designation: 842 3898 TIDAL 6
Monument Type: US C&GS disk

Lat: 43° 04' 17.6" N
Long: 070° 42' 37.6"W

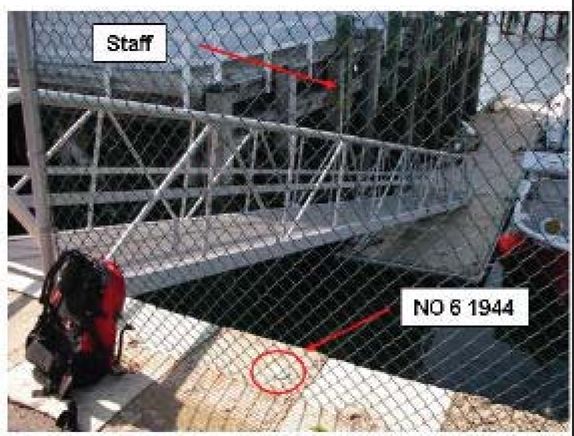


Figure 4 – Left photo is a close up of benchmark NO 6 1944. Right photo is looking NNW and shows the location of the of the benchmark relative to the tide staff, which is mounted on one of the pilings shown. The red arrow at the top of the right photos shows the approximate location of the tide staff. The sensor for the CCOM back up gauge is located a couple pilings seaward of the tide staff.

Stamping: Portsmouth USCG 1994
Designation: Portsmouth USCG
Monument Type: NGS disk
Lat: 43° 04’ 16.8” N
Long: 070° 42’ 39.2”W

Figure 5 – Left photo is a close up of benchmark PORTSMOUTH USCG. Right photo is looking SE over benchmark PORTSMOUTH USCG and towards Went

Stamping: CONSTITUTION 147 NO 1 1941
Designation: CONSTITUTION 147 RM 1
Monument Type: USC&G disk
Lat: 43° 11’ 53.2” N
Long: 070° 52’ 03.9”W

Figure 6 – Left photo is a close up of benchmark CONSTITUTION 147 NO 1 1941. Right photo is looking NNE from benchmark CONSTITUTION 147 NO 1941 and shows the location of the backup tide gauge in the background.

IV.A.11 - FORT POINT BACKUP TIDE GAGE MAINTENANCE PROCEDURES

Location of tide gauge:

Tide gauge is located along the inside of the east wall of the aluminum building covering the USCG pier. It is leaning on the north-side of one of the pilings.

Maintenance Procedures:

1) Call USCG base to notify we will be working there
2) Staff shots
   a. Read the water level on the staff mounted on the Eastside of the USCG pier every six minutes on the hour ex. 18:00, 18:06, 18:12, 18:18, 18:24, 18:30, 18:36, 18:42, 18:48, 18:54
   b. Simultaneously record what the gauge is reading
3) Check the time on the gauge (Compare GPS time to gauge)
   a. Use handheld GPS
   b. Record time on GPS
   c. Record time on Gauge
4) Download data from the gauge
   a. Open gauge
   b. Remove external data logger (black box) in lower left hand corner of gauge
   c. Open logger using small screw driver
   d. Press white button
      i. The LED on the logger should be flashing green while the card is still in
      ii. After pressing button the LED will flash red. This means thed ata is being written to the compact flash card
      iii. When the LED is solid green it is ready to be ejected.
   e. Eject compact flash card using black eject button
   f. Download data using compact flash card adapter.
      i. File will be at *.dat file
   g. After downloading data inspect to make sure it looks reasonable
      i. Times are correct, logging at 30 sec interval
      ii. Battery voltage
      iii. Reference number (76 or 77)
      iv. Water level
      v. Water temperature
   h. Insert compact flash card back into the external logger
   i. Replace screws
   j. Tape the connection back onto logger
5) Copy data to server: \Shared\Tide Data\Fort Point Backup Gauge\Flash Card Data data\Fort Point Backup Gauge\Flash Card Data
   a. Create a folder and name it the date the file was downloaded in the yyyymmdd format ex. 20070604

IV.A.12 - FORT POINT BACKUP GAUGE MAINTENANCE CHECKLIST

Tide Station Maintenance Checklist

Fort Point Backup Gauge

Date of visit: ____________ **Time of visit:** ____________ (UTC)

Location: Portsmouth Station USCG Base

Phone: 603-436-4415 **Address:** 25 Wentworth Rd.
New Castle, NH 03854

Visisting Crew

Observer: ________________________
Observer: ________________________
Observer: ________________________
Observer: ________________________

Gauge Time: ____________ (UTC) ____________________ (Local)
GPS Time: ____________ (UTC) ____________________ (Local)

Battery Voltage: ____________ volts
Memory Remaining: ____________ %

Staff Shots

Time (UTC)	Gauge (m)	Staff	Residual

Average: ____________________

Tide Station Supplies
External data logger
Electrical tape
Small phillips screwdriver
Serial cable for computer

APPENDIX II

SUPPLEMENTAL SURVEY RECORDS AND CORRESPONDENCE

POS M/V offset measurements from primary (port) Zephyr GPS antenna to IMU reference mark.

R/V Coastal Surveyor POS M/V offset measurements were taken on June 1-2, 2007 by UNH graduate students participating the CCOM/JHC summer hydro course. Measurements were taken using metal measuring tape, string and plumb bob, spirit-levels, T-squares, and rulers. When feasible multiple measurements were taken by different personnel. The purpose of these measurements was to calculate the offsets needed for the proper operation of the POS M/V system.

Measurements were broken into separate X, Y, and Z components to minimize possible confusion during measurement taking, recording, and analysis. See Figure 1 for an overview of measurement locations. The IMU reference mark is indicated by a black and white circle on the top of the IMU, where the point of measurement is the junction of the four black and white quarters.

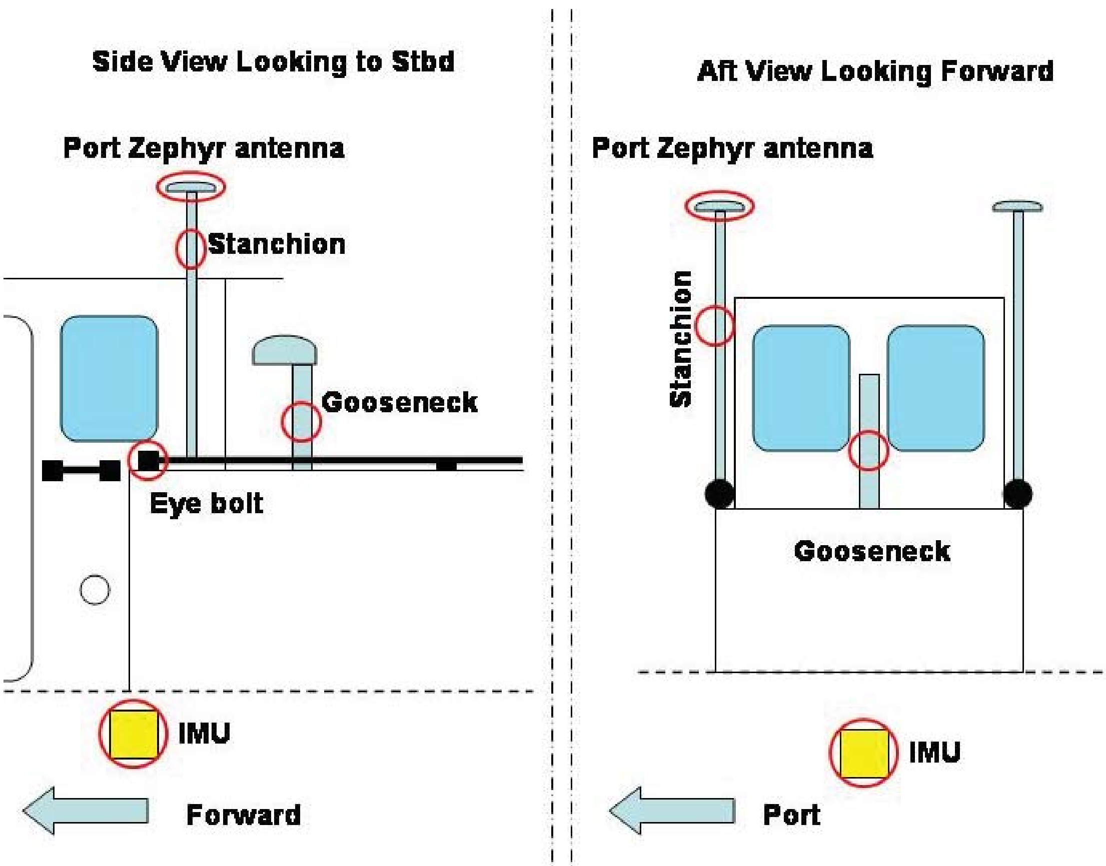


Figure 1: General overview of measurement locations

Measurements including objects with a diameter (gooseneck and support stanchion) were measured taking the average of the near and far sides of the objects. The interior cabin measurements to the gooseneck were taken on the near and far sides of the pipe wall. All measurements are in meters and distances are relative unless otherwise specified.

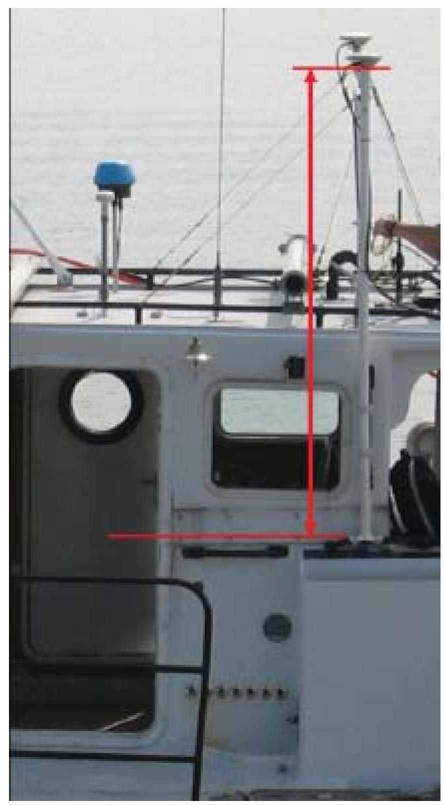
MEASURMENTS

VERTICAL

The vertical offset from the IMU reference mark to port Zephyr GPS antenna were run in the following sequence:
Phase Offset – Offset from base of antenna to phase center provided by Trimble (see Figure 2)
Z1 – Offset from base of Zephyr GPS antenna to top of eyelet on rail (this measurement included the washers under the antenna) – metal tape
Z2 – Offset from top of eyelet on rail to deck on bridge – string, plumb bob, and metal tape
Z3 – Offset from the deck of the bridge to IMU reference mark – spirit level, T-square, and metal tape

Figure 2: Vendor provided Phase offset from base of Antenna

Figure 3: Z1 measurement location



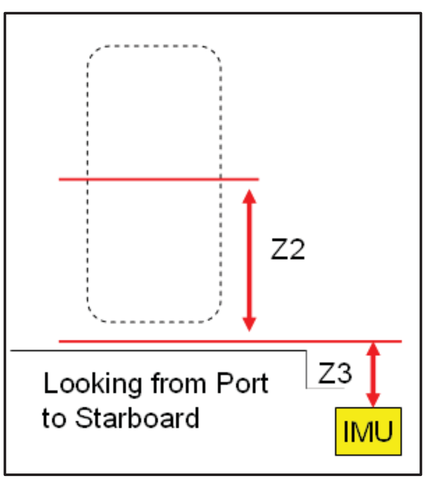


Figure 4: Z2 and Z3 measurement Locations

Phase Offset	0.046
Z1	2.150
Z2	1.14
Z3	0.264
PhaseOffset+Z1+Z2+Z3 =	3.600

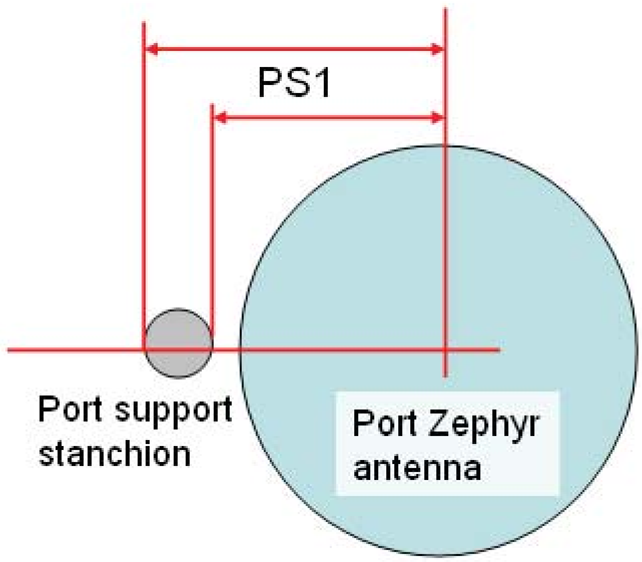
Figure 5: Vertical results

ATHWARTSHIPS

The athwartships offset from the IMU reference mark to port Zephyr GPS antenna were run in the following sequence:

PS1 – Offset from port Zephyr center to center of support stanchion – metal tape
PS2 – Offset from support stanchion to gooseneck – metal tape and T-square
PS3 – Offset from gooseneck to IMU reference mark – metal tape, string, plumb bob, and T-square

Figure 6: PS1 measurement location



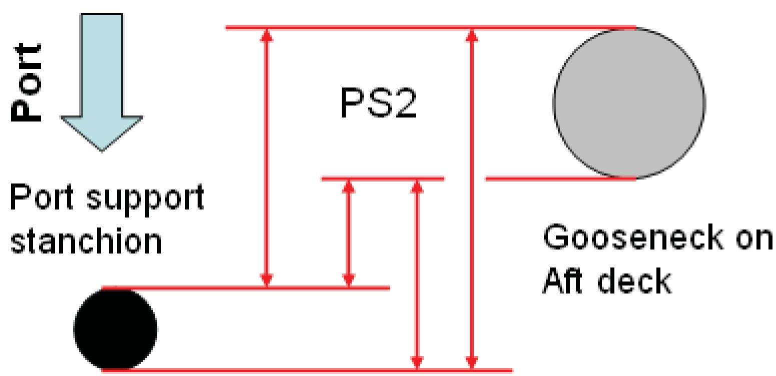


Figure 7: PS2 measurement location

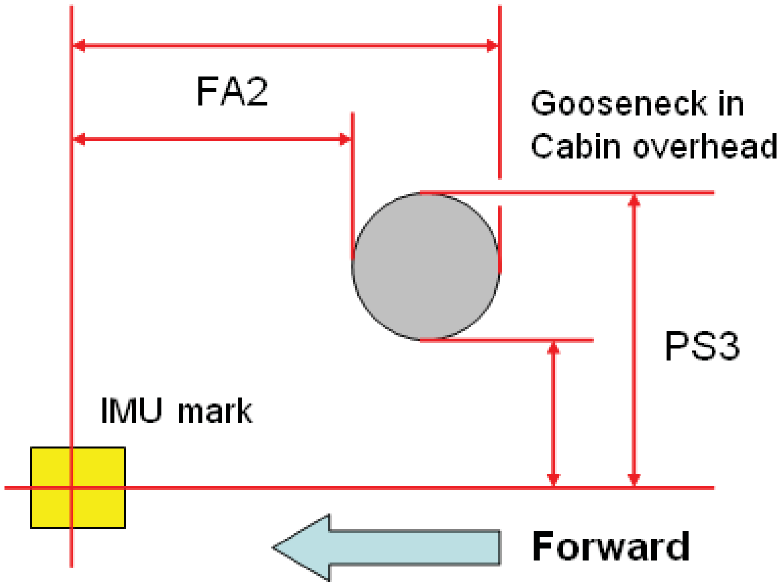


Figure 8: PS3 and FA 2 measurement locations

PS1	0.045
PS2	0.933
PS3	0.264
-(PS1)+PS2+PS3=	1.152

Figure 9: Athwartships results

FORE/AFT

Measurements including objects with a diameter (gooseneck and support stanchion) were measured taking the average of the near and far sides of the objects. The fore/aft offset from the IMU reference mark to port Zephyr GPS antenna were run in the following sequence:

FA1 – Offset from support stanchion to gooseneck. This measurement assumed that there was no fore/aft difference between the stanchion and antenna – metal tape and T-square

FA2 – Offset from gooseneck to IMU reference mark (See Figure 8) – metal tape, T-square, string and plumb bob

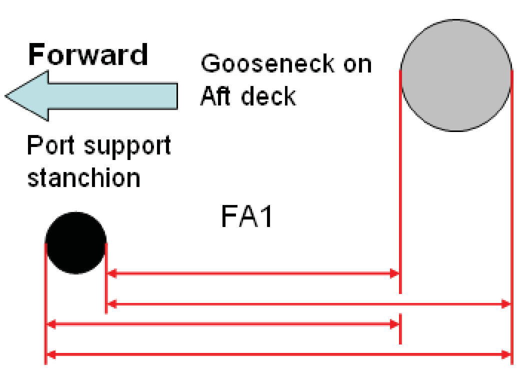


Figure 10: FA1 measurement location

FA1	0.361
FA2	0.459
FA1+FA2=	0.099

Figure 11: Fore/aft results

All values were converted into the POS M/V reference frame, where X is fore/aft positive forward, Y is athwartships positive starboard, and Z is up/down positive down.

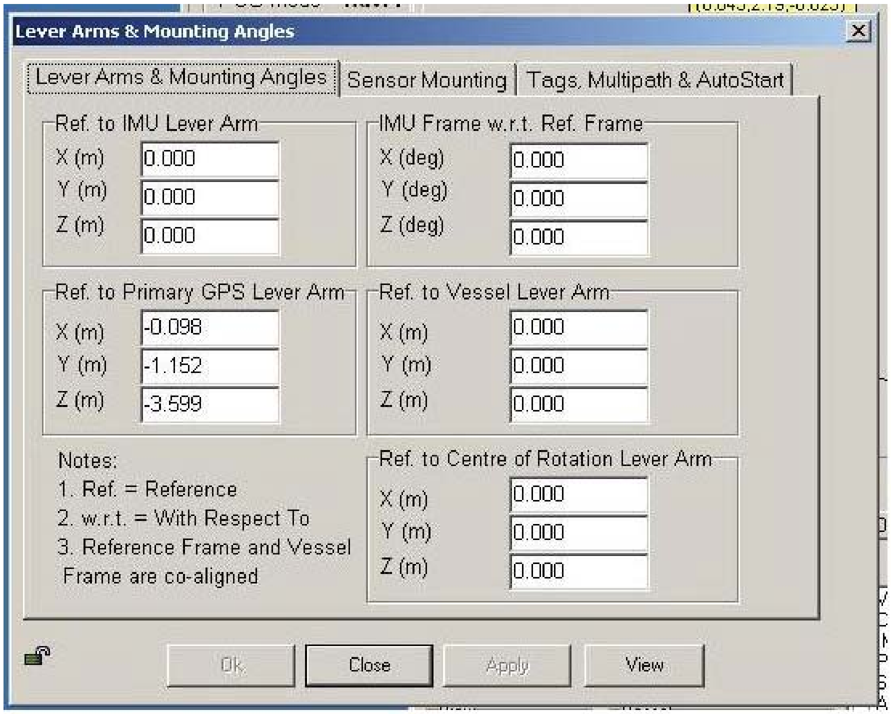


Figure 12: POS M/V reference to IMU GPS lever arm offsets as entered into POS controller program before GAMS calibration.

BASELINE

The baseline offset between the port and starboard Zephyr GPS antenna were measured using metal tape. The average of six different measurements was 2.198. This value was entered into the POS controller before GAMS calibration.

REMARKS

The X and Y offsets are each different by 0.001 after re-calculating the offset results. Although these values are different from those entered into the POS controller, they are within the tolerances for those offset measurements for RTK as specified in the POS M/V v4 manual (0.005).

APPENDIX

BASELINE MEASURMENTS

Observer	Value	
Leonardo	2.197	m
Lynn	2.198	m
Marc	2.200	m
Janice	2.202	m
Pepe	2.193	m
Yasu	2.198	m
Average	2.198	m

FORE/AFT MEASURMENTS

FA1		
Observer	Value	Goose neck is aft of the Zephyr antenna
Pepe	0.342	Far side of stanchion and nearside of gooseneck
Pepe	0.299	Nearside of stanchion to nearside of goose neck
Pepe	0.422	Farside of stanchion and farside of goose neck
Pepe	0.379	farside of goose neck and nearside of stanchion
Average	0.361	
Observer	Value	Goose neck is aft of the Zephyr antenna
FA2	Inside cabin	
Observer	Value	Goose neck is aft of the IMU reference mark
Unk	0.414	Near side of gooseneck to IMU reference mark
Unk	0.504	Far side of gooseneck to IMU reference mark
Average	0.459	
FA1	0.361	
FA2	0.459	
Total	0.099	Port Zephyr antenna is aft of the IMU refernce mark

ATHWARTSHIPS MEASURMENTS

Offset from support stanchion to Zephyr antenna center

Value	
0.022	Nearside of stanchion to GPS center
0.061	Farside of stanchion to GPS center
0.065	Farside of stanchion to GPS center
0.026	Nearside of stanchion to GPS center
0.068	Farside of stanchion to GPS center
0.027	Nearside of stanchion to GPS center
0.045	Support stanchion is outboard (port) of the Zephyr antenna

Offset from support stanchion to gooseneck on aft deck (outside)

Value	
1.000	Farside of support stanchion and gooseneck
0.911	far side of support stanchion and nearside of gooseneck
0.955	nearside of support stanchion and farside of gooseneck
0.864	nearsid of suppoort stanchion and near side of gooseneck
0.933	Gooseneck is inboard (starboard) of support stanchion

Offset from gooseneck to IMU reference mark (inside cabin)

Value	
0.278	Farside of gooseneck to IMU reference mark
0.250	Nearside of gooseneck to IMU reference mark
0.264	IMU reference mark is outboard (port) of gooseneck

VERTICAL MEASURMENTS

Phase offset 0.046

Z1
Base of Port antenna to top of eye bolt

Observer	Value
Marc	2.150
Lynn	2.152
Vasu	2.149
Yasid	2.152
Nathan	2.149
Janice	2.147
Average	2.150

Z2
Transferred height of top of eyebolt to bridge to bridge deck

Observer	Value
Leonardo	1.143
Pepe	1.138
Vasu	1.139
Average	1.14

Z3
Transferred height of deck using spirit level and T-square to IMU reference mark

Observer	Value	
Leonardo	0.255	
Pepe	~~0.233~~	bad measurment
Vasu	~~0.250~~	bad measurment
Pepe (corrected value)	0.263	Corrected for thickness of T-square
Vasu	0.278	
Thanh	0.260	
Thanh	0.261	
Leonardo	0.267	
Average	0.264	

Offset Report for POS/MV IMU Reference Mark to Port/Starboard Transducers
R/V Coastal Surveyor
1-2 June 2007

R/V Coastal Surveyor sensor offsets for the 2007 Summer Hydrographic Field Course were measured on 1-2 June 2007 by UNH graduate students participating in the course. Measurements were made using metal measuring tape, string and plumb bob, spirit levels, T-squares and rulers. Redundant measurements were made by different field personnel whenever feasible. The purpose of undertaking the measurements was to calculate the offsets needed for the proper integration of EM3002D depth measurements with position and attitude data from the POS/MV system.

Measurements were divided into separate X, Y and Z components to minimize potential confusion during the processes of measurement, recording and analysis. Refer to Figures 2-5 for a general overview of measurement locations. The IMU reference mark is indicated by a black and white circle on the top of the IMU, where the point of measurement is the junction of the four black and white quarters.

Figure 1. R/V Coastal Surveyor.

IMU to Bow Centermark Offsets

Vertical

The vertical offset from the IMU reference mark to the bow centermark was measured in the following sequence:

Z1 – Offset from the IMU reference mark to IMU base
Z2 – Offset from the IMU base to the top of the stairs
Z3 – Offset from top of stairs to top of starboard rail
Z4 – Offset from top of starboard rail to bow centermark

Table I. Vertical offset results

Z1	0.168
Z2	-0.446
Z3	-1.126
Z4	0.501
Total Z Offset (Z1+Z2+Z3+Z4)	-0.903

Athwartships

The athwartships offset from the IMU reference mark to the bow centermark was measured in the following sequence:

Y1 – Offset from the IMU reference mark to mark on top of stairs
Y2 – Offset from mark on top of stairs to mark on bridge floor
Y3 – Offset from mark on bridge floor to starboard door
Y4 – Offset from starboard door to starboard rail
Y5 – Offset from starboard rail to bow centermark

Table II. Athwartships offset results

Y1	0.686
Y2	0.329
Y3	0.108
Y4	0.363
Y5	-1.354
Total Y Offset (Y1+Y2+Y3+Y4+Y5)	0.132

Fore-Aft

The fore-aft offset from the IMU reference mark to the bow centermark was measured in the following sequence:

X1 – Offset from IMU reference mark to bottom of stairs
X2 – Offset from bottom of stairs to mark on starboard cabin door
X3 – Offset from mark on starboard cabin door to mark on starboard rail
X4 – Offset from mark on starboard rail to bow centermark

Table III. Fore-aft offset results

X1	0.110
X2	0.668
X3	5.826
X4	1.531
Total X Offset (X1+X2+X3+X4)	8.135

Figure 2. General overview of IMU to Bow Centermark measurement locations.

Bow Centermark to Port Transducer Offsets

Vertical

The vertical offset from the bow centermark to the phase center of the port transducer was measured in the following sequence:

Z1 – Offset from bow centermark to transfer point
Z2 – Offset from transfer point to top of bow mount lip
Z3 – Offset from top of bow mount lip to mark on black line of bow ram
Z4 – Offset from mark on black line of bow ram to top of bow ram bracket
Z5 – Offset from top of bow ram bracket to top of mounting plate
Z6 – Offset from top of mounting plate to phase center of transducer

Table IV. Vertical offset results

Z1	-0.339
Z2	-0.742
Z3	0.574
Z4	1.543
Z5	1.038
Z6	0.226
Total Z Offset (Z1+Z2+Z3+Z4+Z5+Z6)	2.300

Athwartships

The athwartships offset from the bow centermark to the phase center of the port transducer was measured in the following sequence:

Y1 – Offset from bow centermark to transfer point
Y2 – Offset from transfer point to mark on black line of bow ram
Y3 – Offset from mark on black line of bow ram to bow ram bracket
Y4 – Offset from bow ram bracket to phase center of transducer

Table V. Athwartships offset results

Y1	0.000
Y2	-0.053
Y3	-0.026
Y4	-0.115
Total Y Offset (Y1+Y2+Y3+Y4)	-0.194

Fore-Aft

The fore-aft offset from the bow centermark to the phase center of the port transducer was measured in the following sequence:

X1 – Offset from bow centermark to transfer point
X2 – Offset from transfer point to mark on black line of bow ram
X3 – Offset from mark on black line of bow ram to top of mounting plate
X4 – Offset from top of mounting plate to transducer phase center

Table VI. Fore-aft offset results

X1	0.506
X2	0.401
X3	0.128
X4	-0.193
Total X Offset (X1+X2+X3+X4)	0.843

Bow Centermark to Starboard Transducer Offsets

Vertical

The vertical offset from the bow centermark to the phase center of the starboard transducer was measured in the following sequence:

Z1 – Offset from bow centermark to transfer point
Z2 – Offset from transfer point to top of bow mount lip
Z3 – Offset from top of bow mount lip to mark on black line of bow ram
Z4 – Offset from mark on black line of bow ram to top of bow ram bracket
Z5 – Offset from top of bow ram bracket to top of mounting plate
Z6 – Offset from top of mounting plate to phase center of transducer

Table VII. Vertical offset results

Z1	-0.339
Z2	-0.743
Z3	0.570
Z4	1.552
Z5	1.037
Z6	0.221
Total Z Offset (Z1+Z2+Z3+Z4+Z5+Z6)	2.297

Athwartships

The athwartships offset from the bow centermark to the phase center of the starboard transducer was measured in the following sequence:

Y1 – Offset from bow centermark to transfer point
Y2 – Offset from transfer point to mark on black line of bow ram
Y3 – Offset from mark on black line of bow ram to bow ram bracket
Y4 – Offset from bow ram bracket to phase center of transducer

Table VIII. Athwartships offset results

Y1	0.000
Y2	0.033
Y3	0.047
Y4	0.169
Total Y Offset (Y1+Y2+Y3+Y4)	0.248

Fore-Aft

The fore-aft offset from the bow centermark to the phase center of the starboard transducer was measured in the following sequence:

X1 – Offset from bow centermark to transfer point
X2 – Offset from transfer point to aft point on transducer mount*
(*carried up to mark on black line of bow ram)
X3 – Offset from aft point on transducer mount to phase center of transducer

Table IV. Fore-aft offset results

X1	0.506
X2	0.197
X3	0.185
Total X Offset (X1+X2+X3+X4)	0.888

Figure 3. General overview of Bow Centermark to Port and Starboard Transducer offset measurement locations (see insets A and B).

Figure 4. Inset A.

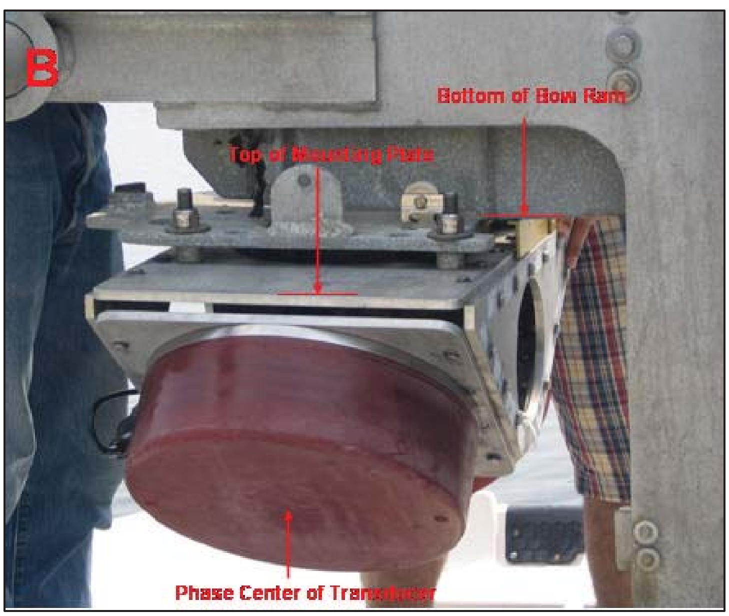


Figure 5. Inset B

Remarks

Due to measurement discrepancies between the offsets from the IMU reference mark to the bow centermark as measured by the 2007 and 2006 Summer Hydrographic Field Course personnel, the more recent set of measurements were rejected in favor of the values obtained in 2006. Therefore, the total offset between IMU reference mark to port and starboard transducers reflects the following:

IMU reference mark to Bow centermark
Measurement from 2006 CCOM Summer Hydrographic Field Course

X	8.211
Y	0.000
Z	-0.844

Bow centermark to Port transducer
Measurement from 2007 CCOM Summer Hydrographic Field Course

X	0.843
Y	-0.194
Z	2.300

Bow centermark to Starboard transducer
Measurement from 2007 CCOM Summer Hydrographic Field Course

X	0.888
Y	0.248
Z	2.297

Final Offsets

All values converted into the SIS – POS/MV reference frame, where X is fore/aft positive forward, Y is athwartships positive starboard, and Z is up/down positive down.

IMU to Port transducer

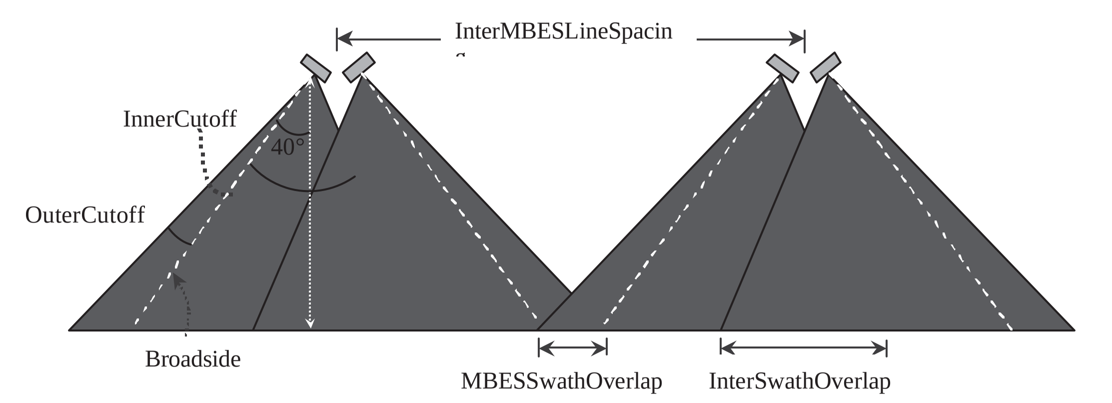
X	9.054
Y	-0.194
Z	1.456

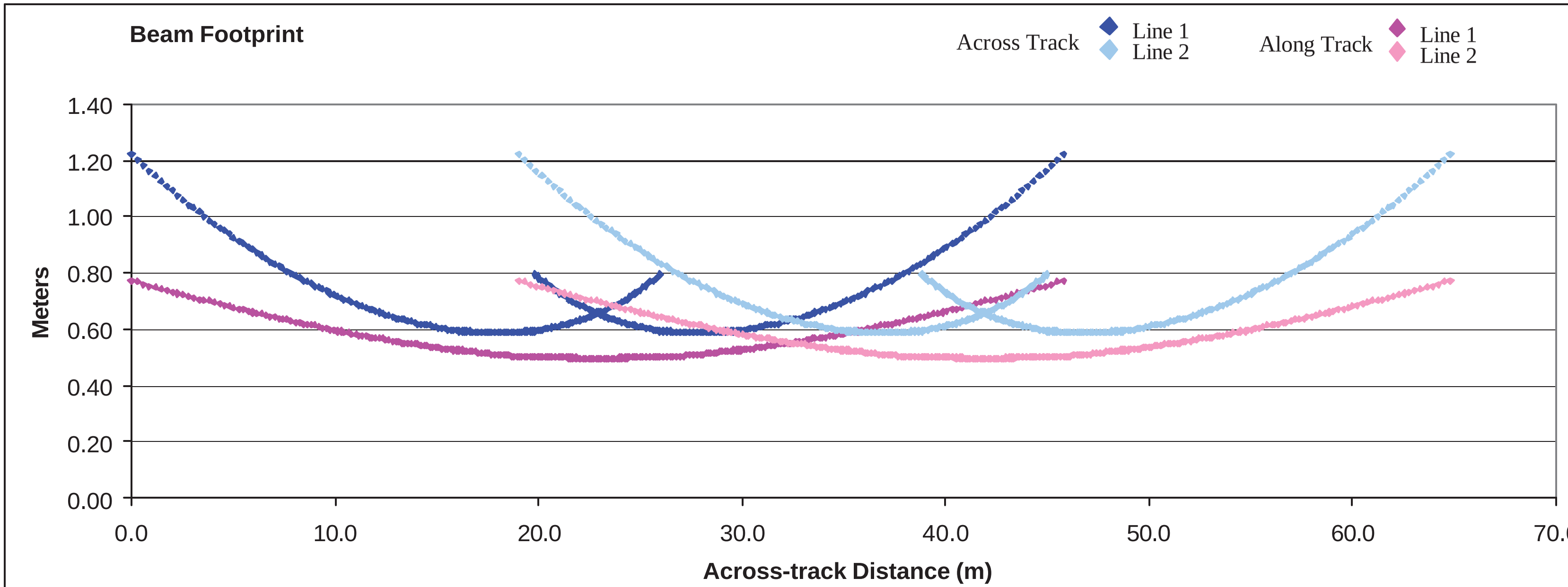
IMU to Starboard transducer

X	9.099
Y	0.248
Z	1.453

EM3002 Beam Footprint Model

Nominal Depth (m)		**19**
Sonar Installation		
TxSeperation (m)		0.50
MountingAngle (°)		40.0
Swath Characteristics		
OperatingMode		EA
PortSonarHead		
Port/Starboard Coverage	50	10
OuterCutoff (°)		*10*
InnerCutoff (°)		*50*
StarboardSonarHead		
Port/Starboard Coverage	10	50
InnerCutoff (°)		*50*
OuterCutoff (°)		*10*
InterSwathOverlap (m)		6.20
UseableTotalSwathWidth (m)		45.79
Survey Area		
SurveyAreaWidth (m)		260
SurveyAreaLength (m)		520
Survey Speed (kts)		**6.00**
Mainscheme Lines		
InterMBESLineSpacing (m)		19.0
MBESSwathOverlap (m)		26.79
NumberOfMBESLines		14
NauticalMilesOfMBESLines		3.93
TotalTimeForMBESLines (hr)		0.66
NumberOfTurns (lines - 1)		13
TimePerTurn (min)		1.50
TotalTimeForTurns (hr)		0.33
Cross Lines		
NumberOfXLs		2.00
LengthOfXLs (m)		260
NauticalMilesOfXLs		0.28
TotalTimeForXLs (hr)		0.05
CTD Casts		
NumberOfCTDs		4
TimePerCTD (min)		5.00
TotalTimeForCTDs (hr)		0.33
TotalTimeForSurvey (hr)		**1.36**


InterMBESLineSpacin
InnerCutoff
40°
OuterCutoff
Broadside
MBESSwathOverlap
InterSwathOverlap


Beam Footprint
Across Track
Line 1
Line 2
Along Track
Line 1
Line 2
Meters
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
Across-track Distance (m)

Beam	Steering Angle	Nadir Angle	Across Distance	Beam Width	Footprint			Beam	Steering Angle	Nadir Angle	Across Distance	Beam Width	Footprint	
					Along	*Across*							*Along*	*Across*
1	10.00	50.00	0.00	1.523	0.7738	*1.22*		**161**	50.00	10.00	19.79	2.334	0.5051	*0.80*
2	9.62	49.62	0.30	1.521	0.7678	*1.20*		**162**	49.62	9.62	19.92	2.315	0.5045	*0.79*
3	9.25	49.25	0.60	1.520	0.762	*1.18*		**163**	49.25	9.25	20.05	2.298	0.504	*0.78*
4	8.87	48.87	0.89	1.518	0.7562	*1.16*		**164**	48.87	8.87	20.18	2.280	0.5034	*0.77*
5	8.49	48.49	1.17	1.517	0.7505	*1.15*		**165**	48.49	8.49	20.31	2.263	0.5029	*0.77*
6	8.11	48.11	1.46	1.515	0.745	*1.13*		**166**	48.11	8.11	20.43	2.247	0.5024	*0.76*
7	7.74	47.74	1.74	1.514	0.7396	*1.11*		**167**	47.74	7.74	20.56	2.230	0.502	*0.75*
8	7.36	47.36	2.01	1.512	0.7343	*1.09*		**168**	47.36	7.36	20.69	2.214	0.5015	*0.75*
9	6.98	46.98	2.28	1.511	0.7291	*1.08*		**169**	46.98	6.98	20.82	2.199	0.5011	*0.74*
10	6.60	46.60	2.55	1.510	0.724	*1.06*		**170**	46.60	6.60	20.94	2.183	0.5007	*0.73*
11	6.23	46.23	2.81	1.509	0.719	*1.05*		**171**	46.23	6.23	21.07	2.168	0.5004	*0.73*
12	5.85	45.85	3.07	1.508	0.7141	*1.03*		**172**	45.85	5.85	21.20	2.153	0.5	*0.72*
13	5.47	45.47	3.33	1.507	0.7093	*1.02*		**173**	45.47	5.47	21.32	2.139	0.4997	*0.72*
14	5.09	45.09	3.58	1.506	0.7046	*1.00*		**174**	45.09	5.09	21.45	2.125	0.4994	*0.71*
15	4.72	44.72	3.83	1.505	0.7	*0.99*		**175**	44.72	4.72	21.58	2.111	0.4991	*0.70*
16	4.34	44.34	4.08	1.504	0.6955	*0.98*		**176**	44.34	4.34	21.70	2.097	0.4988	*0.70*
17	3.96	43.96	4.32	1.504	0.6911	*0.96*		**177**	43.96	3.96	21.83	2.084	0.4986	*0.69*
18	3.58	43.58	4.56	1.503	0.6867	*0.95*		**178**	43.58	3.58	21.95	2.071	0.4984	*0.69*
19	3.21	43.21	4.80	1.502	0.6824	*0.94*		**179**	43.21	3.21	22.08	2.058	0.4982	*0.68*
20	2.83	42.83	5.03	1.502	0.6783	*0.93*		**180**	42.83	2.83	22.20	2.045	0.498	*0.68*
21	2.45	42.45	5.26	1.501	0.6742	*0.91*		**181**	42.45	2.45	22.33	2.033	0.4979	*0.68*
22	2.08	42.08	5.49	1.501	0.6701	*0.90*		**182**	42.08	2.08	22.45	2.021	0.4977	*0.67*
23	1.70	41.70	5.72	1.501	0.6662	*0.89*		**183**	41.70	1.70	22.58	2.009	0.4976	*0.67*
24	1.32	41.32	5.94	1.500	0.6623	*0.88*		**184**	41.32	1.32	22.71	1.997	0.4976	*0.66*
25	0.94	40.94	6.16	1.500	0.6585	*0.87*		**185**	40.94	0.94	22.83	1.986	0.4975	*0.66*
26	0.57	40.57	6.38	1.500	0.6548	*0.86*		**186**	40.57	0.57	22.96	1.975	0.4974	*0.65*
27	0.19	40.19	6.59	1.500	0.6511	*0.85*		**187**	40.19	0.19	23.08	1.964	0.4974	*0.65*
28	-0.19	39.81	6.81	1.500	0.6475	*0.84*		**188**	39.81	-0.19	23.21	1.953	0.4974	*0.65*
29	-0.57	39.43	7.02	1.500	0.644	*0.83*		**189**	39.43	-0.57	23.33	1.942	0.4974	*0.64*
30	-0.94	39.06	7.23	1.500	0.6406	*0.83*		**190**	39.06	-0.94	23.46	1.932	0.4975	*0.64*
31	-1.32	38.68	7.43	1.500	0.6372	*0.82*		**191**	38.68	-1.32	23.58	1.921	0.4976	*0.64*
32	-1.70	38.30	7.64	1.501	0.6339	*0.81*		**192**	38.30	-1.70	23.71	1.911	0.4976	*0.63*
33	-2.08	37.92	7.84	1.501	0.6306	*0.80*		**193**	37.92	-2.08	23.83	1.902	0.4977	*0.63*
34	-2.45	37.55	8.04	1.501	0.6274	*0.79*		**194**	37.55	-2.45	23.96	1.892	0.4979	*0.63*
35	-2.83	37.17	8.24	1.502	0.6242	*0.78*		**195**	37.17	-2.83	24.08	1.882	0.498	*0.63*
36	-3.21	36.79	8.43	1.502	0.6211	*0.78*		**196**	36.79	-3.21	24.21	1.873	0.4982	*0.62*
37	-3.58	36.42	8.63	1.503	0.6181	*0.77*		**197**	36.42	-3.58	24.33	1.864	0.4984	*0.62*
38	-3.96	36.04	8.82	1.504	0.6151	*0.76*		**198**	36.04	-3.96	24.46	1.855	0.4986	*0.62*
39	-4.34	35.66	9.01	1.504	0.6122	*0.76*		**199**	35.66	-4.34	24.59	1.846	0.4988	*0.62*
40	-4.72	35.28	9.20	1.505	0.6094	*0.75*		**200**	35.28	-4.72	24.71	1.838	0.4991	*0.61*
41	-5.09	34.91	9.39	1.506	0.6065	*0.74*		**201**	34.91	-5.09	24.84	1.829	0.4994	*0.61*
42	-5.47	34.53	9.57	1.507	0.6038	*0.74*		**202**	34.53	-5.47	24.96	1.821	0.4997	*0.61*
43	-5.85	34.15	9.75	1.508	0.6011	*0.73*		**203**	34.15	-5.85	25.09	1.813	0.5	*0.61*
44	-6.23	33.77	9.94	1.509	0.5984	*0.72*		**204**	33.77	-6.23	25.22	1.805	0.5004	*0.61*
45	-6.60	33.40	10.12	1.510	0.5958	*0.72*		**205**	33.40	-6.60	25.34	1.797	0.5007	*0.60*

46	-6.98	33.02	10.30	1.511	0.5932	*0.71*		**206**	33.02	-6.98	25.47	1.789	0.5011	*0.60*
47	-7.36	32.64	10.47	1.512	0.5907	*0.71*		**207**	32.64	-7.36	25.60	1.781	0.5015	*0.60*
48	-7.74	32.26	10.65	1.514	0.5882	*0.70*		**208**	32.26	-7.74	25.72	1.774	0.502	*0.60*
49	-8.11	31.89	10.82	1.515	0.5858	*0.70*		**209**	31.89	-8.11	25.85	1.767	0.5024	*0.60*
50	-8.49	31.51	11.00	1.517	0.5834	*0.69*		**210**	31.51	-8.49	25.98	1.759	0.5029	*0.60*
51	-8.87	31.13	11.17	1.518	0.5811	*0.69*		**211**	31.13	-8.87	26.11	1.752	0.5034	*0.60*
52	-9.25	30.75	11.34	1.520	0.5788	*0.68*		**212**	30.75	-9.25	26.24	1.745	0.504	*0.59*
53	-9.62	30.38	11.51	1.521	0.5766	*0.68*		**213**	30.38	-9.62	26.36	1.739	0.5045	*0.59*
54	-10.00	30.00	11.67	1.523	0.5744	*0.67*		**214**	30.00	-10.00	26.49	1.732	0.5051	*0.59*
55	-10.38	29.62	11.84	1.525	0.5722	*0.67*		**215**	29.62	-10.38	26.62	1.726	0.5057	*0.59*
56	-10.75	29.25	12.00	1.527	0.5701	*0.67*		**216**	29.25	-10.75	26.75	1.719	0.5063	*0.59*
57	-11.13	28.87	12.17	1.529	0.568	*0.66*		**217**	28.87	-11.13	26.88	1.713	0.507	*0.59*
58	-11.51	28.49	12.33	1.531	0.566	*0.66*		**218**	28.49	-11.51	27.01	1.707	0.5076	*0.59*
59	-11.89	28.11	12.49	1.533	0.564	*0.65*		**219**	28.11	-11.89	27.14	1.701	0.5083	*0.59*
60	-12.26	27.74	12.65	1.535	0.562	*0.65*		**220**	27.74	-12.26	27.27	1.695	0.509	*0.59*
61	-12.64	27.36	12.81	1.537	0.5601	*0.65*		**221**	27.36	-12.64	27.40	1.689	0.5098	*0.59*
62	-13.02	26.98	12.97	1.540	0.5582	*0.64*		**222**	26.98	-13.02	27.54	1.683	0.5105	*0.59*
63	-13.40	26.60	13.13	1.542	0.5563	*0.64*		**223**	26.60	-13.40	27.67	1.678	0.5113	*0.59*
64	-13.77	26.23	13.28	1.544	0.5545	*0.64*		**224**	26.23	-13.77	27.80	1.672	0.5121	*0.59*
65	-14.15	25.85	13.44	1.547	0.5527	*0.63*		**225**	25.85	-14.15	27.93	1.667	0.513	*0.59*
66	-14.53	25.47	13.59	1.550	0.551	*0.63*		**226**	25.47	-14.53	28.07	1.662	0.5138	*0.59*
67	-14.91	25.09	13.75	1.552	0.5493	*0.63*		**227**	25.09	-14.91	28.20	1.656	0.5147	*0.59*
68	-15.28	24.72	13.90	1.555	0.5476	*0.62*		**228**	24.72	-15.28	28.34	1.651	0.5157	*0.59*
69	-15.66	24.34	14.05	1.558	0.5459	*0.62*		**229**	24.34	-15.66	28.47	1.646	0.5166	*0.59*
70	-16.04	23.96	14.20	1.561	0.5443	*0.62*		**230**	23.96	-16.04	28.61	1.641	0.5176	*0.59*
71	-16.42	23.58	14.35	1.564	0.5428	*0.62*		**231**	23.58	-16.42	28.74	1.637	0.5186	*0.59*
72	-16.79	23.21	14.50	1.567	0.5412	*0.62*		**232**	23.21	-16.79	28.88	1.632	0.5196	*0.59*
73	-17.17	22.83	14.64	1.570	0.5397	*0.61*		**233**	22.83	-17.17	29.01	1.628	0.5206	*0.59*
74	-17.55	22.45	14.79	1.573	0.5382	*0.61*		**234**	22.45	-17.55	29.15	1.623	0.5217	*0.59*
75	-17.92	22.08	14.94	1.577	0.5368	*0.61*		**235**	22.08	-17.92	29.29	1.619	0.5228	*0.59*
76	-18.30	21.70	15.08	1.580	0.5354	*0.61*		**236**	21.70	-18.30	29.43	1.614	0.5239	*0.59*
77	-18.68	21.32	15.23	1.583	0.534	*0.61*		**237**	21.32	-18.68	29.57	1.610	0.5251	*0.60*
78	-19.06	20.94	15.37	1.587	0.5326	*0.60*		**238**	20.94	-19.06	29.71	1.606	0.5263	*0.60*
79	-19.43	20.57	15.51	1.591	0.5313	*0.60*		**239**	20.57	-19.43	29.85	1.602	0.5275	*0.60*
80	-19.81	20.19	15.66	1.594	0.53	*0.60*		**240**	20.19	-19.81	29.99	1.598	0.5287	*0.60*
81	-20.19	19.81	15.80	1.598	0.5287	*0.60*		**241**	19.81	-20.19	30.13	1.594	0.53	*0.60*
82	-20.57	19.43	15.94	1.602	0.5275	*0.60*		**242**	19.43	-20.57	30.27	1.591	0.5313	*0.60*
83	-20.94	19.06	16.08	1.606	0.5263	*0.60*		**243**	19.06	-20.94	30.42	1.587	0.5326	*0.60*
84	-21.32	18.68	16.22	1.610	0.5251	*0.60*		**244**	18.68	-21.32	30.56	1.583	0.534	*0.61*
85	-21.70	18.30	16.36	1.614	0.5239	*0.59*		**245**	18.30	-21.70	30.70	1.580	0.5354	*0.61*
86	-22.08	17.92	16.50	1.619	0.5228	*0.59*		**246**	17.92	-22.08	30.85	1.577	0.5368	*0.61*
87	-22.45	17.55	16.64	1.623	0.5217	*0.59*		**247**	17.55	-22.45	31.00	1.573	0.5382	*0.61*
88	-22.83	17.17	16.77	1.628	0.5206	*0.59*		**248**	17.17	-22.83	31.14	1.570	0.5397	*0.61*
89	-23.21	16.79	16.91	1.632	0.5196	*0.59*		**249**	16.79	-23.21	31.29	1.567	0.5412	*0.62*
90	-23.58	16.42	17.05	1.637	0.5186	*0.59*		**250**	16.42	-23.58	31.44	1.564	0.5428	*0.62*
91	-23.96	16.04	17.18	1.641	0.5176	*0.59*		**251**	16.04	-23.96	31.59	1.561	0.5443	*0.62*
92	-24.34	15.66	17.32	1.646	0.5166	*0.59*		**252**	15.66	-24.34	31.74	1.558	0.5459	*0.62*

93	-24.72	15.28	17.45	1.651	0.5157	*0.59*		**253**	15.28	-24.72	31.89	1.555	0.5476	*0.62*
94	-25.09	14.91	17.59	1.656	0.5147	*0.59*		**254**	14.91	-25.09	32.04	1.552	0.5493	*0.63*
95	-25.47	14.53	17.72	1.662	0.5138	*0.59*		**255**	14.53	-25.47	32.19	1.550	0.551	*0.63*
96	-25.85	14.15	17.85	1.667	0.513	*0.59*		**256**	14.15	-25.85	32.35	1.547	0.5527	*0.63*
97	-26.23	13.77	17.99	1.672	0.5121	*0.59*		**257**	13.77	-26.23	32.50	1.544	0.5545	*0.64*
98	-26.60	13.40	18.12	1.678	0.5113	*0.59*		**258**	13.40	-26.60	32.66	1.542	0.5563	*0.64*
99	-26.98	13.02	18.25	1.683	0.5105	*0.59*		**259**	13.02	-26.98	32.82	1.540	0.5582	*0.64*
100	-27.36	12.64	18.38	1.689	0.5098	*0.59*		**260**	12.64	-27.36	32.97	1.537	0.5601	*0.65*
101	-27.74	12.26	18.51	1.695	0.509	*0.59*		**261**	12.26	-27.74	33.13	1.535	0.562	*0.65*
102	-28.11	11.89	18.64	1.701	0.5083	*0.59*		**262**	11.89	-28.11	33.29	1.533	0.564	*0.65*
103	-28.49	11.51	18.77	1.707	0.5076	*0.59*		**263**	11.51	-28.49	33.46	1.531	0.566	*0.66*
104	-28.87	11.13	18.90	1.713	0.507	*0.59*		**264**	11.13	-28.87	33.62	1.529	0.568	*0.66*
105	-29.25	10.75	19.03	1.719	0.5063	*0.59*		**265**	10.75	-29.25	33.78	1.527	0.5701	*0.67*
106	-29.62	10.38	19.16	1.726	0.5057	*0.59*		**266**	10.38	-29.62	33.95	1.525	0.5722	*0.67*
107	-30.00	10.00	19.29	1.732	0.5051	*0.59*		**267**	10.00	-30.00	34.11	1.523	0.5744	*0.67*
108	-30.38	9.62	19.42	1.739	0.5045	*0.59*		**268**	9.62	-30.38	34.28	1.521	0.5766	*0.68*
109	-30.75	9.25	19.55	1.745	0.504	*0.59*		**269**	9.25	-30.75	34.45	1.520	0.5788	*0.68*
110	-31.13	8.87	19.68	1.752	0.5034	*0.60*		**270**	8.87	-31.13	34.62	1.518	0.5811	*0.69*
111	-31.51	8.49	19.81	1.759	0.5029	*0.60*		**271**	8.49	-31.51	34.79	1.517	0.5834	*0.69*
112	-31.89	8.11	19.93	1.767	0.5024	*0.60*		**272**	8.11	-31.89	34.96	1.515	0.5858	*0.70*
113	-32.26	7.74	20.06	1.774	0.502	*0.60*		**273**	7.74	-32.26	35.14	1.514	0.5882	*0.70*
114	-32.64	7.36	20.19	1.781	0.5015	*0.60*		**274**	7.36	-32.64	35.31	1.512	0.5907	*0.71*
115	-33.02	6.98	20.32	1.789	0.5011	*0.60*		**275**	6.98	-33.02	35.49	1.511	0.5932	*0.71*
116	-33.40	6.60	20.44	1.797	0.5007	*0.60*		**276**	6.60	-33.40	35.67	1.510	0.5958	*0.72*
117	-33.77	6.23	20.57	1.805	0.5004	*0.61*		**277**	6.23	-33.77	35.85	1.509	0.5984	*0.72*
118	-34.15	5.85	20.70	1.813	0.5	*0.61*		**278**	5.85	-34.15	36.03	1.508	0.6011	*0.73*
119	-34.53	5.47	20.82	1.821	0.4997	*0.61*		**279**	5.47	-34.53	36.22	1.507	0.6038	*0.74*
120	-34.91	5.09	20.95	1.829	0.4994	*0.61*		**280**	5.09	-34.91	36.40	1.506	0.6065	*0.74*
121	-35.28	4.72	21.08	1.838	0.4991	*0.61*		**281**	4.72	-35.28	36.59	1.505	0.6094	*0.75*
122	-35.66	4.34	21.20	1.846	0.4988	*0.62*		**282**	4.34	-35.66	36.78	1.504	0.6122	*0.76*
123	-36.04	3.96	21.33	1.855	0.4986	*0.62*		**283**	3.96	-36.04	36.97	1.504	0.6151	*0.76*
124	-36.42	3.58	21.45	1.864	0.4984	*0.62*		**284**	3.58	-36.42	37.16	1.503	0.6181	*0.77*
125	-36.79	3.21	21.58	1.873	0.4982	*0.62*		**285**	3.21	-36.79	37.35	1.502	0.6211	*0.78*
126	-37.17	2.83	21.70	1.882	0.498	*0.63*		**286**	2.83	-37.17	37.55	1.502	0.6242	*0.78*
127	-37.55	2.45	21.83	1.892	0.4979	*0.63*		**287**	2.45	-37.55	37.75	1.501	0.6274	*0.79*
128	-37.92	2.08	21.95	1.902	0.4977	*0.63*		**288**	2.08	-37.92	37.95	1.501	0.6306	*0.80*
129	-38.30	1.70	22.08	1.911	0.4976	*0.63*		**289**	1.70	-38.30	38.15	1.501	0.6339	*0.81*
130	-38.68	1.32	22.21	1.921	0.4976	*0.64*		**290**	1.32	-38.68	38.35	1.500	0.6372	*0.82*
131	-39.06	0.94	22.33	1.932	0.4975	*0.64*		**291**	0.94	-39.06	38.56	1.500	0.6406	*0.83*
132	-39.43	0.57	22.46	1.942	0.4974	*0.64*		**292**	0.57	-39.43	38.77	1.500	0.644	*0.83*
133	-39.81	0.19	22.58	1.953	0.4974	*0.65*		**293**	0.19	-39.81	38.98	1.500	0.6475	*0.84*
134	-40.19	-0.19	22.71	1.964	0.4974	*0.65*		**294**	-0.19	-40.19	39.19	1.500	0.6511	*0.85*
135	-40.57	-0.57	22.83	1.975	0.4974	*0.65*		**295**	-0.57	-40.57	39.41	1.500	0.6548	*0.86*
136	-40.94	-0.94	22.96	1.986	0.4975	*0.66*		**296**	-0.94	-40.94	39.63	1.500	0.6585	*0.87*
137	-41.32	-1.32	23.08	1.997	0.4976	*0.66*		**297**	-1.32	-41.32	39.85	1.500	0.6623	*0.88*
138	-41.70	-1.70	23.21	2.009	0.4976	*0.67*		**298**	-1.70	-41.70	40.07	1.501	0.6662	*0.89*
139	-42.08	-2.08	23.33	2.021	0.4977	*0.67*		**299**	-2.08	-42.08	40.30	1.501	0.6701	*0.90*

140	-42.45	-2.45	23.46	2.033	0.4979	*0.68*		**300**	-2.45	-42.45	40.52	1.501	0.6742	*0.91*
141	-42.83	-2.83	23.58	2.045	0.498	*0.68*		**301**	-2.83	-42.83	40.76	1.502	0.6783	*0.93*
142	-43.21	-3.21	23.71	2.058	0.4982	*0.68*		**302**	-3.21	-43.21	40.99	1.502	0.6824	*0.94*
143	-43.58	-3.58	23.83	2.071	0.4984	*0.69*		**303**	-3.58	-43.58	41.23	1.503	0.6867	*0.95*
144	-43.96	-3.96	23.96	2.084	0.4986	*0.69*		**304**	-3.96	-43.96	41.47	1.504	0.6911	*0.96*
145	-44.34	-4.34	24.09	2.097	0.4988	*0.70*		**305**	-4.34	-44.34	41.71	1.504	0.6955	*0.98*
146	-44.72	-4.72	24.21	2.111	0.4991	*0.70*		**306**	-4.72	-44.72	41.96	1.505	0.7	*0.99*
147	-45.09	-5.09	24.34	2.125	0.4994	*0.71*		**307**	-5.09	-45.09	42.21	1.506	0.7046	*1.00*
148	-45.47	-5.47	24.46	2.139	0.4997	*0.72*		**308**	-5.47	-45.47	42.46	1.507	0.7093	*1.02*
149	-45.85	-5.85	24.59	2.153	0.5	*0.72*		**309**	-5.85	-45.85	42.71	1.508	0.7141	*1.03*
150	-46.23	-6.23	24.72	2.168	0.5004	*0.73*		**310**	-6.23	-46.23	42.97	1.509	0.719	*1.05*
151	-46.60	-6.60	24.84	2.183	0.5007	*0.73*		**311**	-6.60	-46.60	43.24	1.510	0.724	*1.06*
152	-46.98	-6.98	24.97	2.199	0.5011	*0.74*		**312**	-6.98	-46.98	43.50	1.511	0.7291	*1.08*
153	-47.36	-7.36	25.10	2.214	0.5015	*0.75*		**313**	-7.36	-47.36	43.78	1.512	0.7343	*1.09*
154	-47.74	-7.74	25.22	2.230	0.502	*0.75*		**314**	-7.74	-47.74	44.05	1.514	0.7396	*1.11*
155	-48.11	-8.11	25.35	2.247	0.5024	*0.76*		**315**	-8.11	-48.11	44.33	1.515	0.745	*1.13*
156	-48.49	-8.49	25.48	2.263	0.5029	*0.77*		**316**	-8.49	-48.49	44.61	1.517	0.7505	*1.15*
157	-48.87	-8.87	25.61	2.280	0.5034	*0.77*		**317**	-8.87	-48.87	44.90	1.518	0.7562	*1.16*
158	-49.25	-9.25	25.74	2.298	0.504	*0.78*		**318**	-9.25	-49.25	45.19	1.520	0.762	*1.18*
159	-49.62	-9.62	25.86	2.315	0.5045	*0.79*		**319**	-9.62	-49.62	45.49	1.521	0.7678	*1.20*
160	-50.00	-10.00	25.99	2.334	0.5051	*0.80*		**320**	-10.00	-50.00	45.79	1.523	0.7738	*1.22*

POS/MV Calibration Report

Field Unit:GROUP 1

SYSTEM INFORMATION

Vessel: R/V COASTAL SURVEYOR

Date: 6/6/2007 **Dn:** 157

Personnel: MORGAN, YAZID, GIANELLA, BUGUCKI

PCS Serial # 2171

IP Address: 192.168.0.50

POS controller Version (Use Menu Help > About) 3.1.0.1

POS Version (Use Menu View > Statistics) MV320 Ver4

GPS Receivers

Primary Receiver SN4452A44285

Secondary Receiver SN 4447A44091

CALIBRATION AREA

Location: South Gerrish Island

Approximate Position:

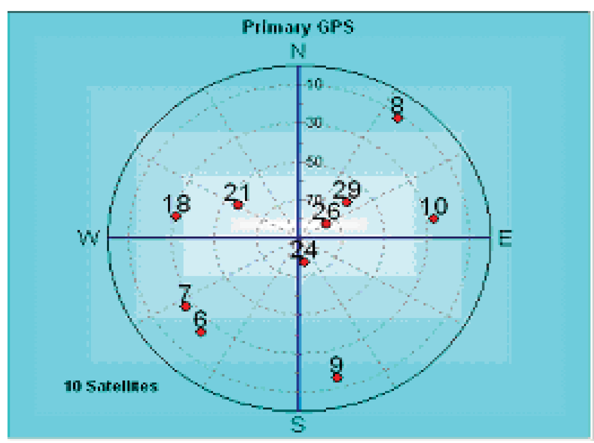
	D	M	S
Lat	43	3	57.63
Lon	70	40	53.85

DGPS Fixed RTK

Satellite Constellation

(Use View> GPS Data)

Primary GPS (Port Antenna)



HDOP: 0.924

VDOP: 1.178

Sattelites in Use: 10

6,7,8,9,10,18,21,24,26,29

PDOP 1.197 (Use View> GAMS Solution)

Note: Secondary GPS satellite constellation and number of satellites were exactly the same as the Primary GPS

POS/MV CONFIGURATION

Settings

Gams Parameter Setup (Use Settings > Installation > GAMS Intallation)

User Entries, Pre-Calibration

2.198	Two Antenna Separation (m)
0.50	Heading Calibration Threshold
0	Heading Correction

Baseline Vector

0	X Component (m)
0	YComponent (m)
0	Z Component (m)

Configuration Notes:

POS/MV CALIBRATION

Calibration Procedure:

(Refer to POS MV V3 Installation and Operation Guide, 4-25)

Start time: 14:30

End time:

Heading accuracy achieved for calibration: 0.047

Calibration Results:

Gams Parameter Setup (Use Settings > Installation > GAMS Intallation)

POS/MV Post-Calibration Values

2.198	Two Antenna Separation (m)
0.500	Heading Calibration Threshold
0	Heading Correction

Baseline Vector

0.043	X Component (m)
2.19	YComponent (m)
-0.023	Z Component (m)

GAMS Status Online? YES

Save Settings? YES

Calibration Notes: GAMS Ready Offline in ~5min by doing tight figure eights.

Save POS Settings on PC (Use File > Store POS Settings on PC)

File Name: POS_Settings_157.nvm

GENERAL GUIDANCE

The POS/MV uses a Right-Hand Orthogonal Reference System

The right-hand orthogonal system defines the following:

- The x-axis is in the fore-aft direction in the appropriate reference frame.
- The y-axis is perpendicular to the x-axis and points towards the right (starboard) side in the appropriate reference frame.
- The z-axis points downwards in the appropriate reference frame.

The POS/MV uses a Tate-Bryant Rotation Sequence

Apply the rotation in the following order to bring the two frames of reference into complete alignment:

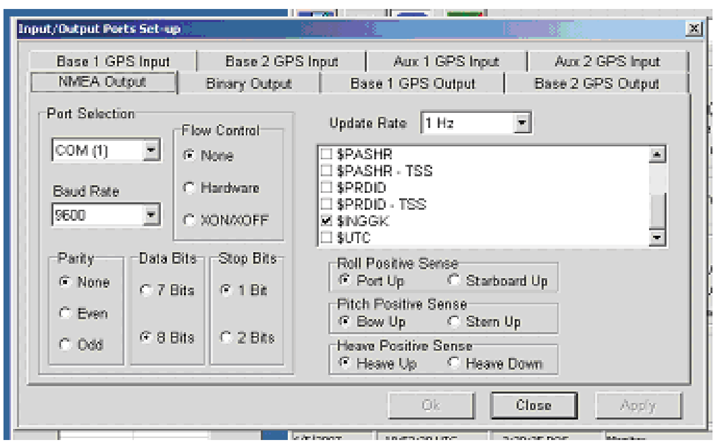
a) Heading rotation - apply a right-hand screw rotation ?z about the z-axis to align one frame with the other.

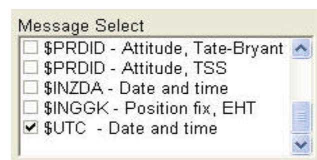
b) Pitch rotation - apply a right-hand screw rotation ?y about the once-rotated y-axis to align one frame with the other.

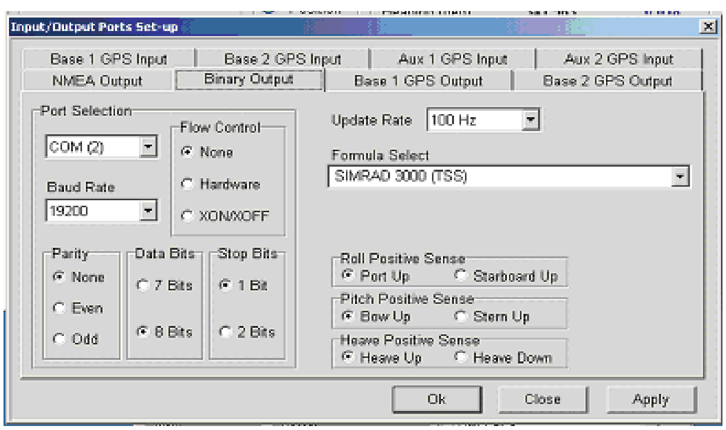
c) Roll rotation - apply a right-hand screw rotation ?x about the twice-rotated x-axis to align one frame with the other.

SETTINGS (insert screen grabs)

Input/Output Ports (Use Settings > Input/Output Ports)

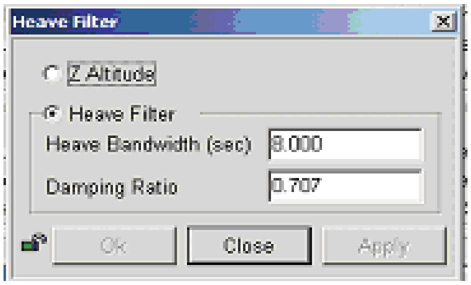




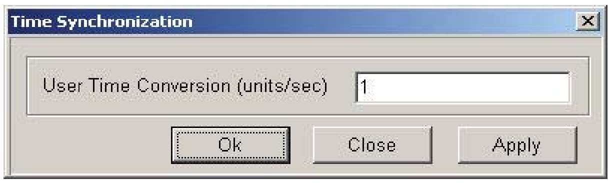


NOTE: COM3 and Analog are not used.

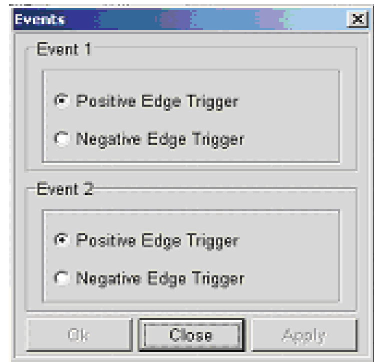
Heave Filter (Use Settings > Heave)



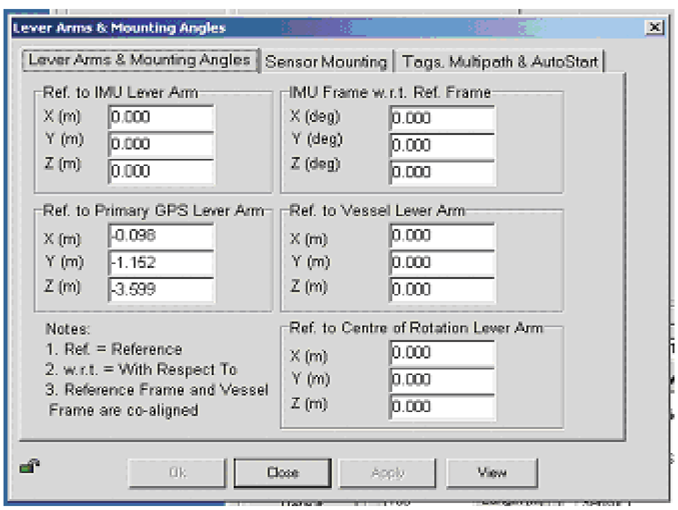
Time Sync (Use Settings > Time Sync)



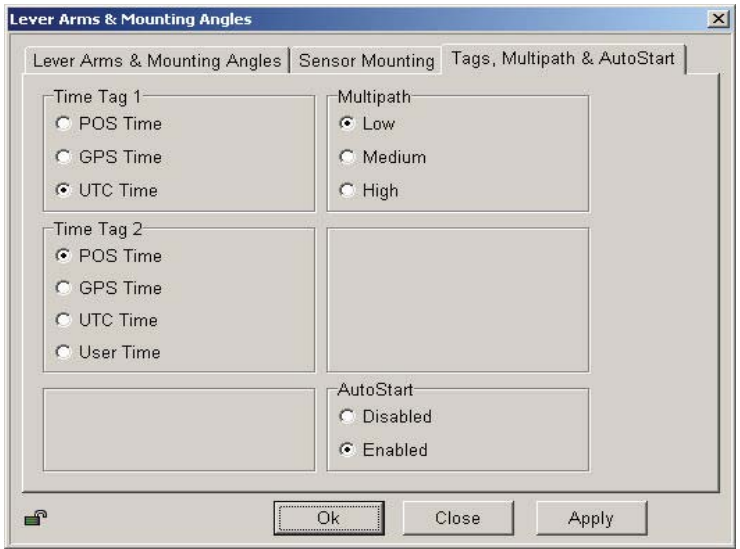
Events (Use Settings > Events)



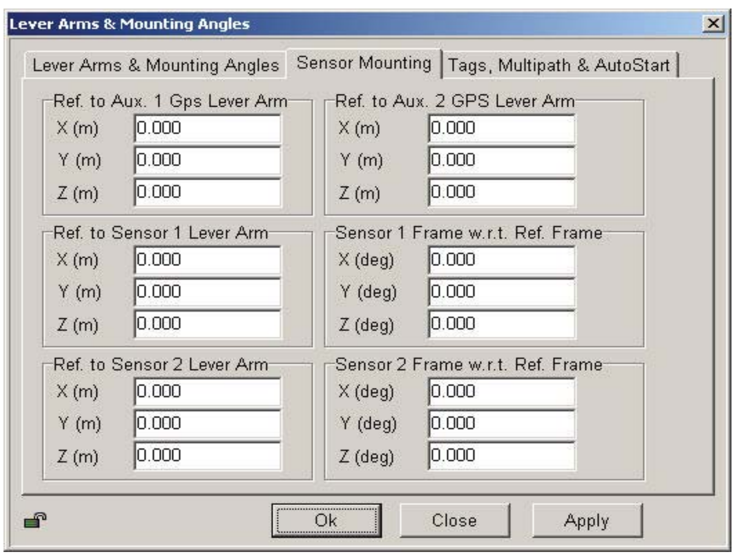
Installation (Use Settings > Installation)



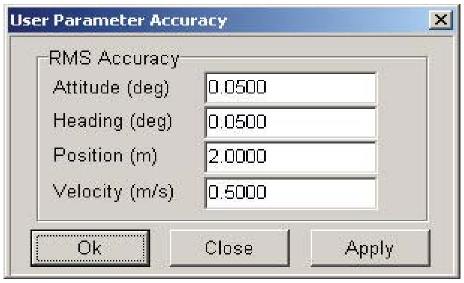
Tags, Multipath and Auto Start (Use Settings > Installation > Tags, Multipath and Auto Start)



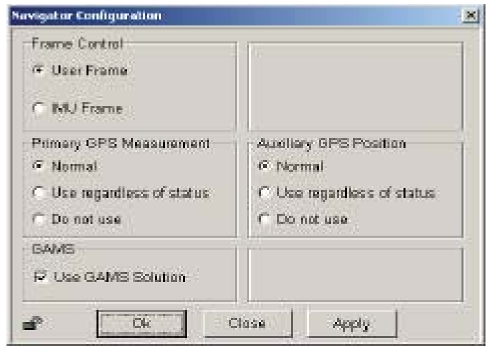
Sensor Mounting (Use Settings > Installation > Sensor Mounting)



User Parameter Accuracy (Use Settings > Installation > User Accuracy)

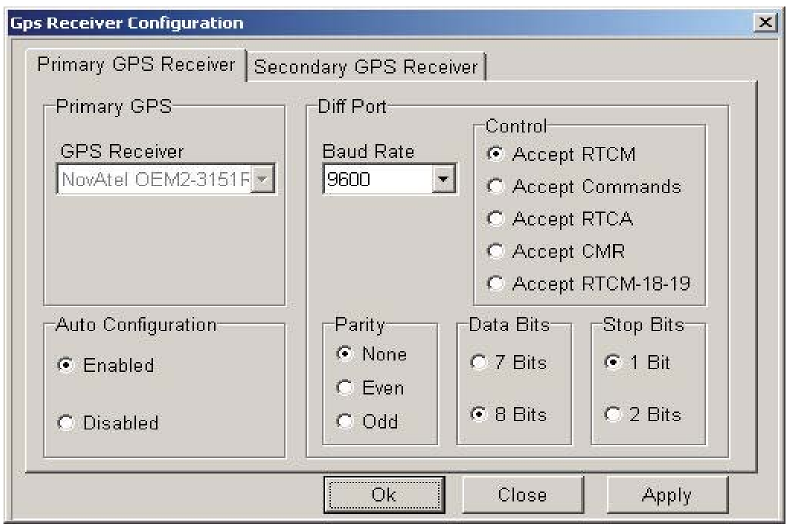


Frame Control (Use Tools > Config)

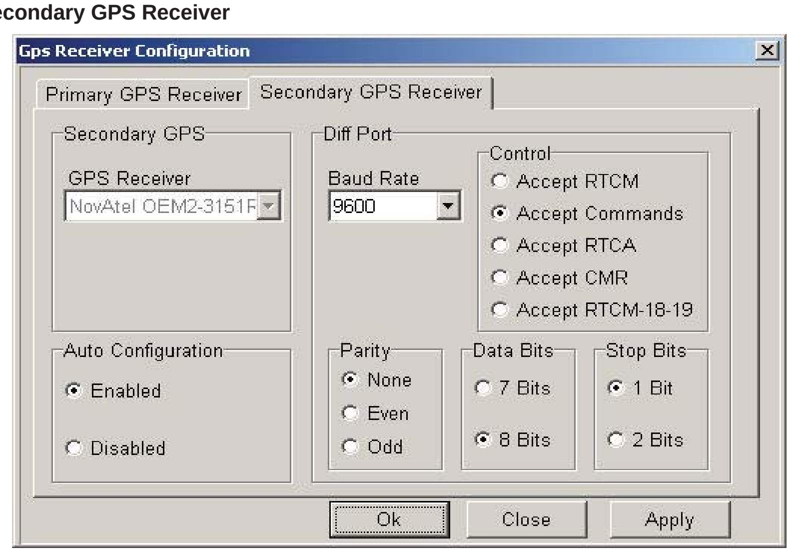


GPS Receiver Configuration (Use Settings> Installation> GPS Receiver Configuration)

Primary GPS Receiver



Secondary GPS Receiver



Multibeam Echosounder Calibration

Field Unit: Group 1

Date of Test: 06/06/2007

Calibrating Hydrographer(s): L. Morgan, R. Bogucki, M. Yazid, J. Gianella

MULTIBEAM SYSTEM INFORMATION

Multibeam Echosounder System: Kongsberg EM3002D

System Location: Bow mounting

Sonar Serial Number: Port head: 481. Starboard head: 322

Processing Unit Serial Number: kongsberg HWS 10 SN: 230

Date of Most Recent EED / Factory Checkout: Unknown

VESSEL INFORMATION

Sonar Mounting Configuration: pole mount on the bow of the vessel

Date of Current Vessel Offset Measurement / Verification: Unknown

Description of Positioning System: Pos MV Applanix: SN 2171

Date of Most Recent Positioning System Calibration: 06/06/2007

TEST INFORMATION

Test Date(s) / DN(s): 06/06/2007

System Operator(s): R. Bogucki

Wind / Seas / Sky: 4 knots / seastate 1 / clear sky

Locality: Gulf of Maine,

Sub-Locality: Odiorne Point

Bottom Type: Rocky, sandy

Approximate Average Water Depth: 16 meters

DATA ACQUISITION INFORMATION

Line Number	Heading	Speed
0002	225	6.0
0003	045	5.8
0004	225	5.9
0005	045	6.1
0006	045	5.9
0007	045	6.5
0008	019	3.5
0009	199	4.3

0010	019	7.8
0011	199	7.8
0012	199	7.5
0013	019	5.7
0014	199	5.9
0015	283	5.0
0016	103	6.0
0017	283	5.0
0018	103	5.8
0019	283	5.8
0020	103	6.0
0021	283	6.0
0022	103	6.3
0023	283	5.4
0024	103	5.4
0025	283	5.4
0026	103	5.4

TEST RESULTS

Navigation Timing Error: 0.11 seconds

Pitch Timing Error:

Roll Timing Error:

Pitch Bias: Head #1 (port): 1.81 Head #2 (starboard): 1.29

Roll Bias: Head #1 (port): -0.99 Head #2 (starboard): -1.60

Heading Bias: Head #1 (port): -0.58 Head #2 (starboard): 0.01

Resulting CARIS HIPS HVF File Name: CoastalSurveyor_EM3002D_2007.hvf

NARRATIVE

Timing: lines 0008 to 0014 were used to calculate timing, in three set of a pair of lines, the sets were 0008 and 0010, 0009 and 0012 (0011 was ruled out) and 0013 with 0014. The lines ran over a slope bottom. Pitch: the same lines 0008 to 0014 were used to calculate pitch in three set of a pair of lines, the sets were 0008 and 0009, 0010 and 0012 (0011 was ruled out) and 0013 with 0014. From line 0015 to 0026 lines were ran to obtain a single feature that permit solve heading bias. Roll: lines 0002 to 0007 were used to solve roll bias in both transducers, two set of three lines each were used to solve both heads. the first set were lines 0002, 0003 and 0005, and the second set were lines 0004, 0006 and 0007. In both cases, the comparison was done transducer by transducer. The sea bottom used was flat and the distance between lines were 70 m. After the data was posted in the server, all members of the group calculated their own values and after a meeting, the final values were defined.

```
#// Database Parameters

#// Seafloor Information System
#// Kongsberg Maritime AS
#// Saved:  2007.06.14 13:05:28

#// Build info:
#* SIS:                [Version: 3.4.1, Build: 112, CD generated: Tue May  1 07:21:42 2007]
[Fox ver = 1.4.34]
[db ver = 13, proc = 13.0]
[OTL = 4.0.118]
[ACE ver = 5.4.10]
[Coin ver = 2.4.4]
[Simage ver = 1.6.2a]
[Dime ver = DIME v0.9]
[STLPort ver = 461]
[FreeType ver = 2.1.9]
[TIFF ver = 3.8.2]
[GeoTIFF ver = 1230]
[GridEngine ver = ???]

#* Language           [3] #// Current language, 1-Norwegian, 2-German,3-English, 4-Spanish

#* Type               [3020]
#* Serial no.          [322]
#* Number of heads      [2]
#* System descriptor    [33554432] #// 02000000

#// ******************************************************************
#// Installation parameters


#{ Input Setup #// All Input setup parameters

  #{ COM1 #// Link settings.

    #{ Com. settings #// Serial line parameter settings.
      #* Baud rate:          [9600]
      #* Data bits           [8]
      #* Stop bits:          [1]
      #* Parity:             [NONE]
    #} Com. settings

    #{ Position #// Position input settings.
      #* None                [1] [0]
      #* GGK                 [1] [1]
      #* GGA                 [1] [0]
      #* GGA_RTK             [1] [0]
      #* SIMRAD90            [1] [0]
    #} Position

    #{ Input Formats #// Format input settings.
```

```
      #* Attitude            [0] [0]
      #* ZDA Clock           [1] [1]
      #* HDT Heading         [1] [0]
      #* SKR82 Heading       [0] [0]
      #* DBS Depth           [1] [0]
      #* DBT Depth           [1] [0]
      #* EA500 Depth         [0] [0]
      #* ROV. depth          [1] [0]
      #* Height, special purp [1] [0]
   #} Input Formats

#} COM1

#{ COM2 #// Link settings.

   #{ Com. settings #// Serial line parameter settings.
      #* Baud rate:          [19200]
      #* Data bits           [8]
      #* Stop bits:          [1]
      #* Parity:             [NONE]
   #} Com. settings

   #{ Position #// Position input settings.
      #* None                [0] [1]
      #* GGK                 [0] [0]
      #* GGA                 [0] [0]
      #* GGA_RTK             [0] [0]
      #* SIMRAD90            [0] [0]
   #} Position

   #{ Input Formats #// Format input settings.
      #* Attitude            [1] [1]
      #* ZDA Clock           [0] [0]
      #* HDT Heading         [0] [0]
      #* SKR82 Heading       [0] [0]
      #* DBS Depth           [0] [0]
      #* DBT Depth           [0] [0]
      #* EA500 Depth         [0] [0]
      #* ROV. depth          [0] [0]
      #* Height, special purp [0] [0]
   #} Input Formats

#} COM2

#{ COM3 #// Link settings.

   #{ Com. settings #// Serial line parameter settings.
      #* Baud rate:          [9600]
      #* Data bits           [8]
      #* Stop bits:          [1]
      #* Parity:             [NONE]
   #} Com. settings
```

```
  #{ Position #// Position input settings.
    #* None               [1] [1]
    #* GGK                [1] [0]
    #* GGA                [1] [0]
    #* GGA_RTK            [1] [0]
    #* SIMRAD90           [1] [0]
  #} Position

  #{ Input Formats #// Format input settings.
    #* Attitude           [1] [0]
    #* ZDA Clock          [0] [0]
    #* HDT Heading        [1] [0]
    #* SKR82 Heading      [1] [0]
    #* DBS Depth          [1] [0]
    #* DBT Depth          [1] [0]
    #* EA500 Depth        [0] [0]
    #* ROV. depth         [1] [0]
    #* Height, special purp [1] [0]
  #} Input Formats

#} COM3

#{ COM4 #// Link settings.

  #{ Com. settings #// Serial line parameter settings.
    #* Baud rate:         [9600]
    #* Data bits          [8]
    #* Stop bits:         [1]
    #* Parity:            [NONE]
  #} Com. settings

  #{ Position #// Position input settings.
    #* None               [1] [1]
    #* GGK                [0] [0]
    #* GGA                [0] [0]
    #* GGA_RTK            [0] [0]
    #* SIMRAD90           [0] [0]
  #} Position

  #{ Input Formats #// Format input settings.
    #* Attitude           [0] [0]
    #* ZDA Clock          [0] [0]
    #* HDT Heading        [1] [0]
    #* SKR82 Heading      [1] [0]
    #* DBS Depth          [1] [0]
    #* DBT Depth          [1] [0]
    #* EA500 Depth        [0] [0]
    #* ROV. depth         [1] [0]
    #* Height, special purp [1] [0]
  #} Input Formats
```

```
#} COM4

#{ UDP2 #// Link settings.

  #{ Com. settings #// Serial line parameter settings.
    #// N/A
  #} Com. settings

  #{ Position #// Position input settings.
    #* None             [1] [0]
    #* GGK              [1] [1]
    #* GGA              [1] [0]
    #* GGA_RTK          [1] [0]
    #* SIMRAD90         [1] [0]
  #} Position

  #{ Input Formats #// Format input settings.
    #* Attitude           [0] [0]
    #* ZDA Clock          [0] [0]
    #* HDT Heading        [0] [0]
    #* SKR82 Heading      [0] [0]
    #* DBS Depth          [0] [0]
    #* DBT Depth          [0] [0]
    #* EA500 Depth        [1] [0]
    #* ROV. depth         [0] [0]
    #* Height, special purp [0] [0]
  #} Input Formats

#} UDP2

#{ UDP3 #// Link settings.

  #{ Com. settings #// Serial line parameter settings.
    #// N/A
  #} Com. settings

  #{ Position #// Position input settings.
    #* None             [0] [1]
    #* GGK              [0] [0]
    #* GGA              [0] [0]
    #* GGA_RTK          [0] [0]
    #* SIMRAD90         [0] [0]
  #} Position

  #{ Input Formats #// Format input settings.
    #* Attitude           [0] [0]
    #* ZDA Clock          [0] [0]
    #* HDT Heading        [1] [0]
    #* SKR82 Heading      [0] [0]
    #* DBS Depth          [1] [0]
    #* DBT Depth          [1] [0]
    #* EA500 Depth        [0] [0]
```

```
      #* ROV. depth          [1] [0]
      #* Height, special purp [1] [0]
    #} Input Formats

  #} UDP3

  #{ UDP4 #// Link settings.

    #{ Com. settings #// Serial line parameter settings.
      #// N/A
    #} Com. settings

    #{ Position #// Position input settings.
      #* None                [0] [1]
      #* GGK                 [0] [0]
      #* GGA                 [0] [0]
      #* GGA_RTK             [0] [0]
      #* SIMRAD90            [0] [0]
    #} Position

    #{ Input Formats #// Format input settings.
      #* Attitude            [1] [0]
      #* ZDA Clock           [0] [0]
      #* HDT Heading         [1] [0]
      #* SKR82 Heading       [0] [0]
      #* DBS Depth           [1] [0]
      #* DBT Depth           [1] [0]
      #* EA500 Depth         [0] [0]
      #* ROV. depth          [1] [0]
      #* Height, special purp [1] [0]
    #} Input Formats

  #} UDP4


  #{ Misc. #// Misc. input settings.
    #* External Trigger    [1] [0]
  #} Misc.

#} Input Setup

#{ Output Setup #// All Output setup parameters

  #* PU broadcast enable  [1] [1]

  #{ Host UDP1 #// System port (PU controll) Port: 16115

    #{ Datagram subscription on UDP port #//
      #* Depth               [0] [0]
      #* Raw range and beam a [0] [0]
      #* Seabed Image        [0] [0]
      #* Central Beams       [0] [0]
```

```
    #* Position            [0] [0]
    #* Attitude            [0] [0]
    #* Heading             [0] [0]
    #* Height              [0] [0]
    #* Clock               [0] [0]
    #* Single beam echosoun [0] [0]
    #* Sound Speed Profile  [0] [1]
    #* Runtime Parameters   [0] [1]
    #* Installation Paramet [0] [1]
    #* BIST Reply          [0] [1]
    #* Status parameters    [0] [1]
    #* PU Broadcast        [0] [0]
    #* Stave Display       [0] [0]
    #* Water Column        [0] [0]
    #* Internal, Range Data [0] [0]
    #* Internal, Scope Data [0] [0]
  #} Datagram subscription on UDP port

#} Host UDP1


#{ Host UDP2 #// User controlled (Logging) Port: 16116

  #{ Datagram subscription on UDP port #//
    #* Depth               [1] [1]
    #* Raw range and beam a [1] [1]
    #* Seabed Image        [1] [1]
    #* Central Beams       [0] [0]
    #* Position            [1] [1]
    #* Attitude            [1] [1]
    #* Heading             [1] [1]
    #* Height              [1] [1]
    #* Clock               [1] [1]
    #* Single beam echosoun [1] [1]
    #* Sound Speed Profile  [0] [1]
    #* Runtime Parameters   [0] [1]
    #* Installation Paramet [0] [1]
    #* BIST Reply          [1] [1]
    #* Status parameters    [0] [1]
    #* PU Broadcast        [1] [0]
    #* Stave Display       [0] [1]
    #* Water Column        [0] [1]
    #* Internal, Range Data [1] [0]
    #* Internal, Scope Data [1] [0]
  #} Datagram subscription on UDP port

#} Host UDP2


#{ Host UDP3 #// System port (Displays) Port: 16117

  #{ Datagram subscription on UDP port #//
```

```
    #* Depth                [0] [1]
    #* Raw range and beam a [0] [0]
    #* Seabed Image         [0] [0]
    #* Central Beams        [0] [0]
    #* Position             [0] [0]
    #* Attitude             [0] [1]
    #* Heading              [0] [0]
    #* Height               [0] [1]
    #* Clock                [0] [0]
    #* Single beam echosoun [0] [1]
    #* Sound Speed Profile  [0] [1]
    #* Runtime Parameters   [0] [0]
    #* Installation Paramet [0] [1]
    #* BIST Reply           [0] [0]
    #* Status parameters    [0] [0]
    #* PU Broadcast         [0] [0]
    #* Stave Display        [0] [0]
    #* Water Column         [0] [0]
    #* Internal, Range Data [0] [0]
    #* Internal, Scope Data [0] [1]
  #} Datagram subscription on UDP port

#} Host UDP3


#{ Host UDP4 #// User controlled (Subscription) Port 16118

  #{ Datagram subscription on UDP port #//
    #* Depth                [1] [0]
    #* Raw range and beam a [1] [0]
    #* Seabed Image         [1] [0]
    #* Central Beams        [0] [0]
    #* Position             [1] [0]
    #* Attitude             [1] [0]
    #* Heading              [1] [0]
    #* Height               [1] [0]
    #* Clock                [1] [0]
    #* Single beam echosoun [1] [0]
    #* Sound Speed Profile  [1] [0]
    #* Runtime Parameters   [1] [0]
    #* Installation Paramet [1] [0]
    #* BIST Reply           [1] [0]
    #* Status parameters    [1] [0]
    #* PU Broadcast         [1] [0]
    #* Stave Display        [1] [0]
    #* Water Column         [1] [0]
    #* Internal, Range Data [1] [0]
    #* Internal, Scope Data [1] [0]
  #} Datagram subscription on UDP port

#} Host UDP4
```

```
#} Output Setup

#{ Clock Setup #// All Clock setup parameters

  #{ Clock #// All clock settings.
    #* Source:              [1] #// External ZDA Clock
    #* 1PPS Clock Synch.    [1] [1]
    #* Offset (sec.):       [0]
  #} Clock

#} Clock Setup

#{ Settings #// Sensor setup parameters

  #{ Positioning System Settings #// Position related settings.

    #{ COM1 #// Positioning System Ports:
      #* P1T                [0] #// System
      #* P1M                [1] #// Enable position motion correction
      #* P1D                [0] #// Position delay (sec.):
      #* P1G                [WGS84] #// Datum:
    #} COM1

    #{ UDP2 #// Positioning System Ports:
      #* P3S                [0] #// Ethernet
      #* P3T                [0] #// System
      #* P3M                [0] #// Enable position motion correction
      #* P3D                [0.00] #// Position delay (sec.):
      #* P3G                [WGS84] #// Datum:
    #} UDP2

  #} Positioning System Settings

  #{ Motion Sensor Settings #// Motion related settings.

    #{ COM2 #// Motion Sensor Ports:
      #* MRP                [RP] #// Rotation (POSMV/MRU)
      #* MSD                [0] #// Motion Delay (msec.):
      #* MAS                [1.00] #// Motion Sensor Roll Scaling:
    #} COM2

  #} Motion Sensor Settings

  #{ Active Sensors #//
    #* APS                [0] [COM1] #// Position:
    #* ARO                [2] [COM2] #// Motion:
    #* AHE                [2] [COM2] #// Motion:
    #* AHS                [2] [COM2] #// Heading:
  #} Active Sensors

#} Settings
```

```
#{ Locations #// All location parameters

  #{ Location offset (m) #//

    #{ Pos, COM1: #//
      #* P1X            [0.00] #// Forward (X)
      #* P1Y            [0.00] #// Starboard (Y)
      #* P1Z            [0.00] #// Downward (Z)
    #} Pos, COM1:

    #{ Pos, COM3: #//
      #* P2X            [0.00] #// Forward (X)
      #* P2Y            [0.00] #// Starboard (Y)
      #* P2Z            [0.00] #// Downward (Z)
    #} Pos, COM3:

    #{ Pos, COM4/UDP2: #//
      #* P3X            [0.00] #// Forward (X)
      #* P3Y            [0.00] #// Starboard (Y)
      #* P3Z            [0.00] #// Downward (Z)
    #} Pos, COM4/UDP2:

    #{ Sonar head 1: #//
      #* S1X            [9.054] #// Forward (X)
      #* S1Y            [-0.194] #// Starboard (Y)
      #* S1Z            [1.456] #// Downward (Z)
    #} Sonar head 1:

    #{ Sonar head 2: #//
      #* S2X            [9.099] #// Forward (X)
      #* S2Y            [0.248] #// Starboard (Y)
      #* S2Z            [1.453] #// Downward (Z)
    #} Sonar head 2:

    #{ Attitude 1, COM2: #//
      #* MSX            [0.00] #// Forward (X)
      #* MSY            [0.00] #// Starboard (Y)
      #* MSZ            [0.00] #// Downward (Z)
    #} Attitude 1, COM2:

    #{ Attitude 2, COM3: #//
      #* NSX            [0.00] #// Forward (X)
      #* NSY            [0.00] #// Starboard (Y)
      #* NSZ            [0.00] #// Downward (Z)
    #} Attitude 2, COM3:

    #{ Waterline: #//
      #* WLZ            [0.509] #// Downward (Z)
    #} Waterline:

    #{ Depth Sensor: #//
      #* DSX            [0.00] #// Forward (X)
```

```
        #* DSY                  [0.00] #// Starboard (Y)
        #* DSZ                  [0.00] #// Downward (Z)
      #} Depth Sensor:

    #} Location offset (m)

  #} Locations

  #{ Angular Offsets #// All angular offset parameters

    #{ Offset angles (deg.) #//

      #{ Sonar head 1: #//
        #* S1R                  [40] #// Roll
        #* S1P                  [0.00] #// Pitch
        #* S1H                  [0.00] #// Heading
      #} Sonar head 1:

      #{ Sonar head 2: #//
        #* S2R                  [-40] #// Roll
        #* S2P                  [0.00] #// Pitch
        #* S2H                  [0.00] #// Heading
      #} Sonar head 2:

      #{ Attitude 1, COM2: #//
        #* MSR                  [0.00] #// Roll
        #* MSP                  [0.00] #// Pitch
        #* MSG                  [0.00] #// Heading
      #} Attitude 1, COM2:

      #{ Attitude 2, COM3: #//
        #* NSR                  [0.00] #// Roll
        #* NSP                  [0.00] #// Pitch
        #* NSG                  [0.00] #// Heading
      #} Attitude 2, COM3:

      #{ Stand-alone Heading: #//
        #* GCG                  [0.00] #// Heading
      #} Stand-alone Heading:

    #} Offset angles (deg.)

  #} Angular Offsets

  #{ ROV. Specific #// All ROV specific parameters

    #{ Depth/Pressure Sensor #//
      #* DSF                  [1.00] #// Scaling:
      #* DSO                  [0.00] #// Offset:
      #* DSD                  [0.00] #// Delay:
      #* DSH                  [NI] #// Disable Heave Sensor
    #} Depth/Pressure Sensor
```

```
#} ROV. Specific

#{ System Parameters #// All system parameters

   #{ BS Offset and TX Freq. #//

      #{ Sonar head 1: #//
         #* GO1                  [0.0] #// BS Offset (dB)
         #* FX1                  [1] #// TX Freq. (kHz) 293
      #} Sonar head 1:

      #{ Sonar head 2: #//
         #* GO2                  [0.0] #// BS Offset (dB)
         #* FX2                  [3] #// TX Freq. (kHz) 307
      #} Sonar head 2:

   #} BS Offset and TX Freq.

#} System Parameters

#// **********************************************************************
#// Runtime parameters


#{ Sounder Main #//

   #{ Sector Coverage #//

      #{ Sonar Head 1 angle (deg.): #//
         #* MPA                  [60] #// Port
         #* MSA                  [10] #// Starboard
      #} Sonar Head 1 angle (deg.):
      #{ Sonar Head 2 angle (deg.): #//
         #* MP2                  [10] #// Port
         #* MS2                  [60] #// Starboard
      #} Sonar Head 2 angle (deg.):
      #{ Coverage (m): #//
         #* MPC                  [300] #// Port
         #* MSC                  [300] #// Starboard
      #} Coverage (m):

      #* ACM                  [0] #// Angular Coverage mode: MANUAL
      #* BSP                  [1] #// Beam Spacing: EQANGLE

   #} Sector Coverage

   #{ Depth Settings #//
      #* FDE                  [0] #// Force Depth (m)
      #* MID                  [1.000] #// Min. Depth (m):
      #* MAD                  [50.000] #// Max. Depth (m):
   #} Depth Settings
```

```
  #{ Transmit Control #//
    #* YPS                  [1] #// Pitch stabilization
    #* BMW                    [0] #// Beam Width: NORMAL
    #* TXA                  [0.0] #// Along Direction (deg.):
    #* PRF                  [40] #// Max. Ping Freq. (Hz):
  #} Transmit Control

#} Sounder Main

#{ Sound Speed #//

  #{ Sound Speed at Transducer #//
    #* Sound velocity probe [1] [0]
    #* SHS                   [0] #// Source SENSOR
    #* SST                  [14847] #// Sound Speed (dm/sec.):
    #* Sensor Offset (m/sec [0.0] #//
    #* Filter (sec.):       [2] #//
  #} Sound Speed at Transducer


#// The ROV Specific parameters Offset and Scale is located in the Installation Parameters part of this l
#} Sound Speed

#{ Filter and Gains #//

  #{ Filtering #//
    #* SFS                  [2] #// Spike Filter Strength: MEDIUM
    #* RGS                   [1] #// Range Gate: NORMAL
  #} Filtering

  #{ Absorption Coefficient #//
    #* ABC                  [70.134] #// 300.0 kHz
  #} Absorption Coefficient

  #{ Normal incidence sector #//
    #* TCA                  [10] #// Angle from nadir (deg.):
  #} Normal incidence sector

#} Filter and Gains

#{ Data Cleaning #//
  #* Used set:           [AUTOMATIC1] #//
  #{ AUTOMATIC1 #//
    #* PingProc.maxPingCountRadius                      [10]
    #* PingProc.radiusFactor                        [0.050000]
    #* PingProc.medianFactor                          [1.500000]
    #* PingProc.beamNumberRadius                        [3]
    #* PingProc.sufficientPointCount                  [40]
    #* PingProc.neighborhoodType                        [Elliptical]
    #* PingProc.timeRule.use                        [false]
    #* PingProc.overhangRule.use                         [false]
```

```
    #* PingProc.medianRule.use                    [false]
    #* PingProc.medianRule.depthFactor              [0.050000]
    #* PingProc.medianRule.minPointCount              [6]
    #* PingProc.quantileRule.use                    [false]
    #* PingProc.quantileRule.quantile                [0.100000]
    #* PingProc.quantileRule.scaleFactor              [6.000000]
    #* PingProc.quantileRule.minPointCount            [40]
    #* GridProc.minPoints                         [8]
    #* GridProc.depthFactor                        [0.200000]
    #* GridProc.removeTooFewPoints                   [false]
    #* GridProc.surfaceFitting.surfaceDegree           [1]
    #* GridProc.surfaceFitting.tukeyConstant           [6.000000]
    #* GridProc.surfaceFitting.maxIteration            [10]
    #* GridProc.surfaceFitting.convCriterion           [0.010000]
    #* GridProc.surfaceDistanceDepthRule.use           [false]
    #* GridProc.surfaceDistanceDepthRule.depthFactor     [0.050000]
    #* GridProc.surfaceDistancePointRule.use           [false]
    #* GridProc.surfaceDistancePointRule.scaleFactor     [1.000000]
    #* GridProc.surfaceDistanceUnitRule.use            [false]
    #* GridProc.surfaceDistanceUnitRule.scaleFactor      [1.000000]
    #* GridProc.surfaceDistanceStDevRule.use           [false]
    #* GridProc.surfaceDistanceStDevRule.scaleFactor     [2.000000]
    #* GridProc.surfaceAngleRule.use                 [false]
    #* GridProc.surfaceAngleRule.minAngle             [20.000000]
    #* GridProc.saveAllPings                       [false]
    #* SonarProc.use                             [false]
    #* SonarProc.gridSizeFactor                     [4]
    #* SonarProc.mergerType                        [Average]
    #* SonarProc.interpolatorType                   [TopHat]
    #* SonarProc.interpolatorRadius                  [1]
    #* SonarProc.fillInOnly                        [true]
  #} AUTOMATIC1

  #{ Seabed Image Processing #//
    #* Seabed Image Process [1] [0]
  #} Seabed Image Processing
#} Data Cleaning

#{ Advanced param. #//

  #{ Manual control #//
    #* TPL           [3] #// Pulse length (us) 150
    #* BAW            [1] #// Bandwidth (kHz) 8
    #* RVF           [0] #// Special TVG
    #* RV1           [0.0] #// RX gain offset (dB)
    #* RV2           [0.0] #// TVG ramp level (dB)
  #} Manual control

#} Advanced param.
```

APPENDIX III

FEATURES REPORT

(NO AWOIS ITEMS, DTONS, WRECKS, OR MARITIME BOUNDARIES)

APPROVAL PAGE

W00275

Data meet or exceed current specifications as certified by the OCS survey acceptance review process. Descriptive Report and survey data except where noted are adequate to supersede prior surveys and nautical charts in the common area.

The following products will be sent to NGDC for archive

- W00275_DR.pdf
- Collection of depth varied resolution BAGS
- Processed survey data and records
- W00275_GeoImage.pdf

The survey evaluation and verification has been conducted according current OCS Specifications, and the survey has been approved for dissemination and usage of updating NOAA's suite of nautical charts.

Approved: ______________________________

LT Matthew Jaskoski
Chief, Atlantic Hydrographic Branch