NOAA FORM 76-35A

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

DATA ACQUISITION AND PROCESSING REPORT

Type of Survey Hydrographic

Field No. OPR-A366-KR-12

Registry No. H12477, H12478

LOCALITY

State Maine

General Locality Southern Penobscot Bay

Sublocality Large Green Island, Southern Triangles

2012

CHIEF OF PARTY

Kyle A. Fankhauser

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DATE 13 September 2012

NOAA FORM 77-28
(11-72)

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

REGISTRY No H12477, H12478

HYDROGRAPHIC TITLE SHEET

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

FIELD No.

State Maine

General Locality Southern Penebscot Bay

Sub-Locality Large Green Island, Southern Triangles

Scale 20,000 **Date of Survey** 7-05-2012 - 8-20-2012

Instructions dated 05-15-2012 **Project No.** OPR-A366-KR-12

Vessel R/V Resolution, M/V Nooit Volmaakt

Chief of party Kyle Fankhauser

Surveyed by Brian Bunge, Ransom White, Brian Omann, Erin Campbell, Benjamin Perry

Soundings by echo sounder, hand lead, pole Reson 7125 SV2 MBES

Graphic record scaled by N/A

Graphic record checked by N/A **Automated Plot** N/A

Verification by Atlantic Hydrographic Branch

Soundings in fathoms feet at MLW MLLW Meters at MLLW

REMARKS: The purpose of this work is to provide NOAA with modern and accurate hydrographic survey Data for the area in Southern Penobscot Bay.

All times are in UTC.

Projection is UTM (NAD83) Zone 19 N.

NOAA FORM 77-28 SUPERSEDES FORM C&GS-537

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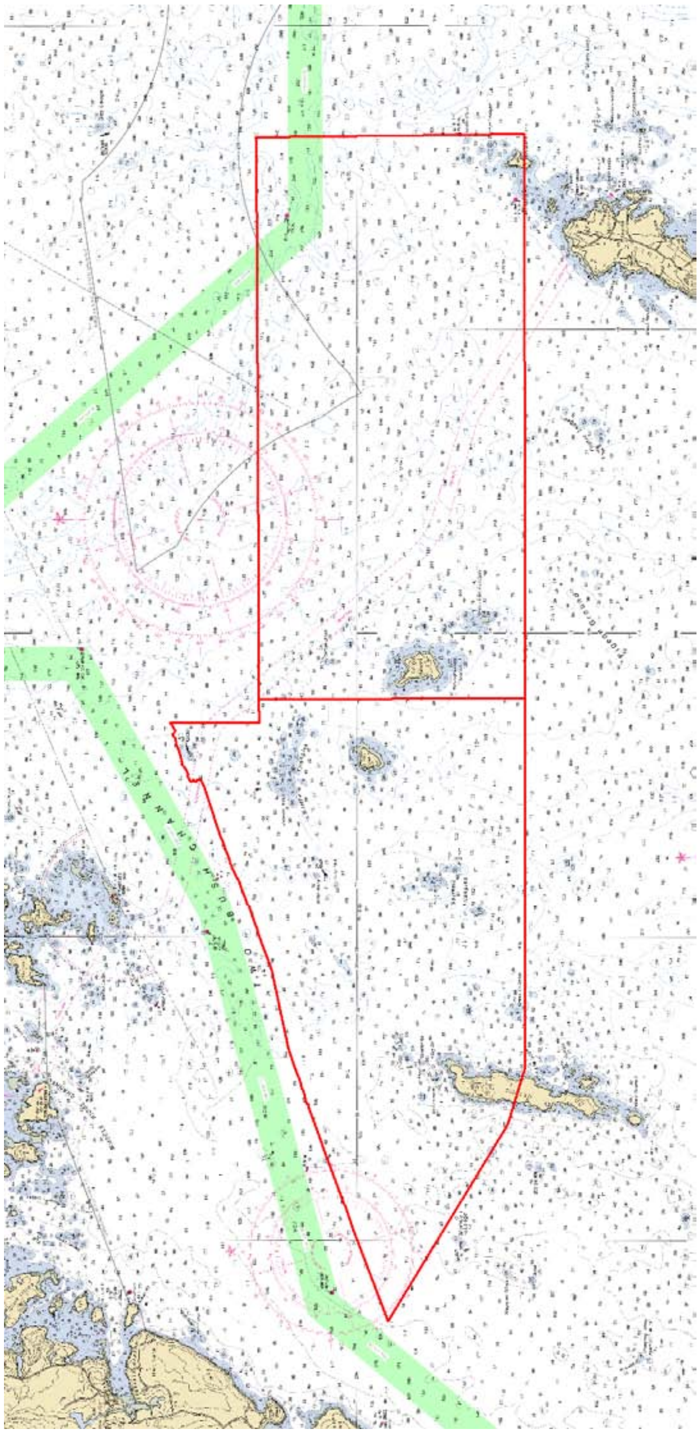


Figure 1: OPR-A366-KR-12 (East Up)

A. EQUIPMENT

A.1. Vessels – M/V Nooit Volmaakt & R/V Resolution

The M/V Nooit Volmaakt is a Hewes Craft 220 OceanPro with an aluminum hull and housing that is 24’3” feet in length with an 8’5” foot beam. The R/V Resolution is Kvichak Defender class aluminum catamaran 55 feet in length with a beam of 20 feet. More vessel information is available in *Appendix A.*

A.2. Sounding Equipment

The M/V Nooit Volmaakt and R/V Resolution were equipped with a pole mounted Reson 7125 multi-beam system during the OPR-A366-KR-12 project. The Reson 7125 system operates at a frequency of 400 and 200 kHz with a max swath angle of 140º and a depth resolution of 6mm. The M/V Nooit Volmaakt operated in the shallow water areas (depths < ~30m) and used the Reson 7125s 400 kHz setting. The 400 kHz setting operates with 512 beams with a 0.5º across track beamwidth and an along-track beamwidth of 1º. The R/V Resolution operated in the deeper water areas (depths > ~30m) and used the Reson 7125s 200 kHz setting. The 200 kHz setting operates with 256 beams with a 1º across track beamwidth and an along-track beamwidth of 2º (*Appendix B*).

A.3. Positioning and Orientation Equipment

The M/V Nooit Volmaakt and R/V Resolution were equipped with a POSMV IMU and 2 associated GPS receivers as well as a secondary DGPS antenna. While using DGPS corrections the POSMV has a heading accuracy 0.02º. Heave, surge and sway measurements are accurate to 5 cm or 5% of amplitude. The dynamic roll and pitch accuracy is 0.02º with a resolution of 0.001º (*Appendix F)*. Position was determined in real time using the DGPS antenna associated with the POSMV. Coast Guard corrections were received by a Hemisphere MBX-4 DGPS beacon receiver and sent to the POSMV via serial cable. More information on the MBX-4 beacon receiver can be found in *Appendix C.*

The survey team on the M/V Nooit Volmaakt and R/V Resolution monitored real-time QC displays in QINSy and POSView throughout the survey to ensure that the positional accuracies specified in the NOS Hydrographic Surveys Specifications and Deliverables were achieved.

A.4. Software

A.4.a Acquisition

Two computers were online aboard the M/V Nooit Volmaakt and R/V Resolution, one acting as an acquisition machine (Reson Sea Bat), the other as a navigation computer (QINSy). The data were collected and stored using QINSy. The QINSy computer operated on a 3.20 GHz AMD Athlon II X3 450 processor running Windows 7. The Reson Sea Bat acquisition PCU operated on 2.86 GHz Intel dual core processor PC running Windows XP service pack 3. Multibeam data was stored in the native QINSy .db format, and exported to .XTF for CARIS processing. The .XTF files contained uncorrected position offsets and uncorrected multibeam bathymetry, attitude, heading and UTC time stamp data required by CARIS to process the soundings. All motion was corrected for during post processing in CARIS.

Two log files were maintained daily aboard the M/V Nooit Volmaakt and R/V Resolution. The SVP log, maintained by the sonar operator, contains daily SVS confidence checks and sound velocity probe deployment operations as well as bi-weekly comparison casts. The Navigation log, also maintained by the sonar operator, was used to record information such as the number and time of each line that was run, navigation information concerning time and location of the current vessel and status updates about the daily operations and weather. The Navigation log also included 2 daily waterline measurements and weekly bar check results.

A.4.b Processing

All Soundings were processed using CARIS (Computer Aided Resource Information System) HIPS (Hydrographic Information Processing System) v7.1.2.

A complete list of software and Hardware used on this project is included in *Appendix D and E*.

GPS and MBE offsets from the vessel were accounted for in the CARIS VCF during processing. The VCF also includes the patch test calibration values, TPU values, dynamic and static draft and waterline measurements. The physical offsets for the GPS and MBES on each vessel were as follows (See Appendix H for vessel survey report and diagrams):

Table 1: M/V Nooit Volmaakt's GPS and Transducer Offsets

M/V Nooit Volmaakt	x ("+" stdb)	y ("+" bow)	z ("+" down)
POS IMU	0	0	0
Primary GPS	-0.2514	-0.4164	-1.8928
MBES	0.5377	3.9441	0.8692

Table 2: R/V Resolution's GPS and Transducer Offsets

R/V Resolution	x ("+" stdb)	y ("+" bow)	z ("+" down)
POS IMU	0	0	0
Primary GPS	0.2645	2.1814	-5.51
MBES	-2.5444	0.1206	2.517

B. QUALITY CONTROL

B.1. Processing Routine

In the CARIS Vessel Configuration File (HVF) for the M/V Nooit Volmaakt and R/V Resolution, error estimates for all survey sensors were entered. These error estimates were used in CARIS to calculate the Total Propagated Uncertainty (TPU) at the 95% confidence level for the horizontal and vertical components for each individual sounding. The values that were input in the CARIS VCF file for the survey sensors are the specified manufacturer accuracy values and were downloaded from the CARIS website http://www.caris.com/tpu/ in July 2012.

The calculated vertical and horizontal uncertainty or TPU values were then used to:

- Build and edit CUBE surfaces in CARIS HIPS and SIPS
- Filter the data to a 95% confidence interval of standard deviations from the CUBE surface using CARIS's surface filter.
- Create finalized BASE surfaces.

The data processing flow was as follows:

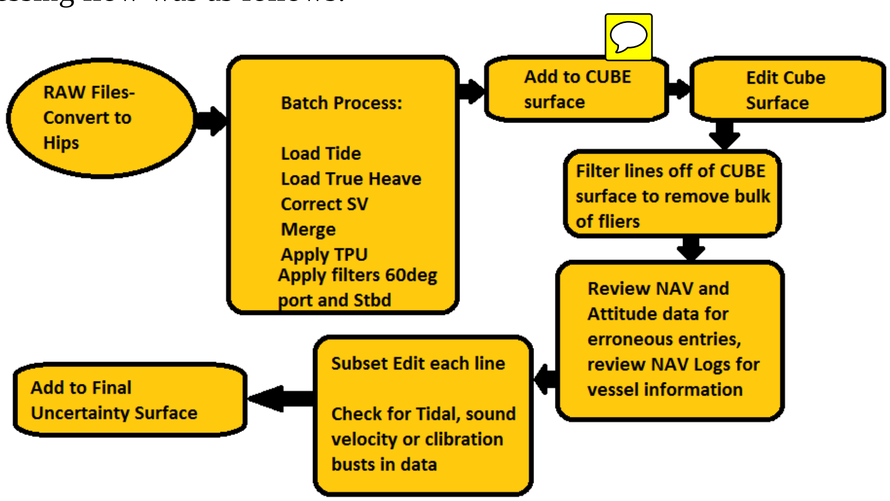


Figure 2: Data Processing Flow

In order for the QINSy XTF files to be used by CARIS, they must be converted to HDCS format using the CARIS conversion wizard. Prior to the conversion, vessel offsets were accounted for the CARIS VCF, along with the patch test calibration values, TPU values, delta draft and waterline measurements. Also prior to conversion, lines were separated by type to be stored in separate projects for final digital delivery. Main scheme lines were simply in a project named by sheet registration number, while cross-lines had the extension "_Xlines". Patch test lines, squat and settlement lines and bar checks were all stored under the project "Patch_SS".

Once converted, the tide data was loaded into each line as well as the true heave acquired from the POSMV. Then the line was SVP corrected and merged in CARIS HIPS. The TPU was then computed for each sounding and the attitude, navigation and bathymetry data for each individual line were examined for noise, as well as to ensure the completeness and correctness of the data set.

It should be noted that lobster pots were abundant in all survey areas, but more so on shoal areas. The tag lines attaching the pots to the buoys are evident in the data. Special care was taken while cleaning these to not reject any soundings that may be part of or an entire feature. As a result much of this data was left in place so that all features would be represented. The sounding density of these tag lines was not such that the surface was affected by them. See below for an example of these lobster pot tag lines in the data:

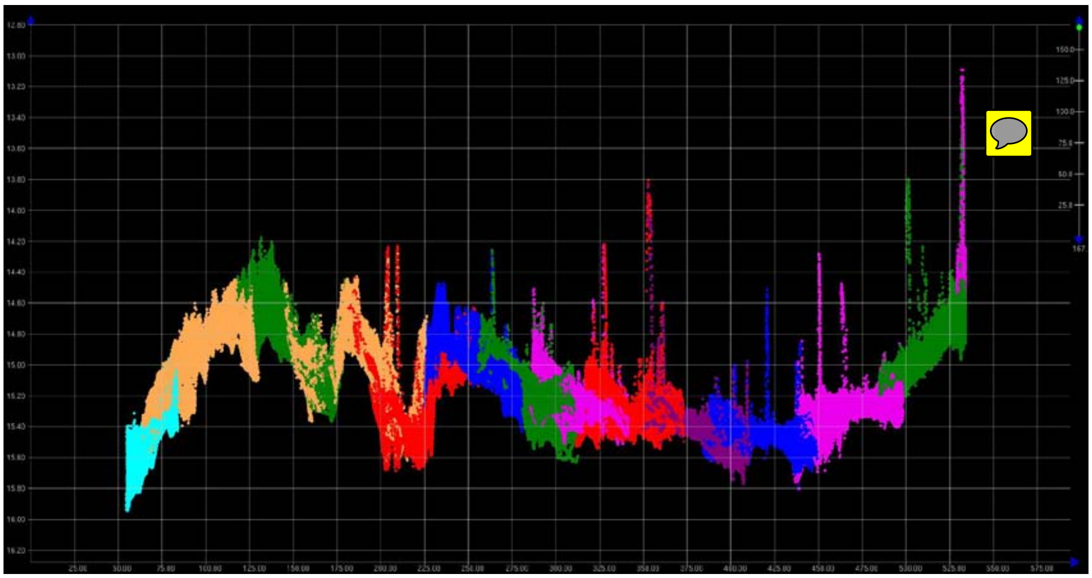
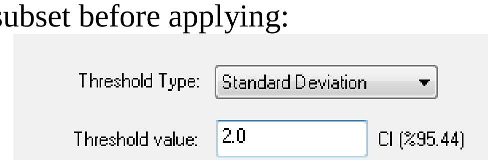


Figure 3: Screen shot of Subset editor show lobster pot tag lines. For the most part these were left unedited to make sure all features were accounted for.

After each individual line was examined and cleaned in CARIS HIPS, the HDCS files were then used to build Combined Uncertainty Bathymetry Estimator (CUBE) surfaces in CARIS. The CUBE surfaces were created using final resolution specs. The following depth thresholds were used on this project for cleaning purposes.

- Depth Threshold: 0 to 20 meters resolution = 1 m
- Depth Threshold: 18 + meters resolution = 2 m

The data was then conservatively filtered using the following settings with CARIS's surface filter which was tested on a subset before applying:



The highest resolution surface was chosen relative to the data depth for filtering. For example, if the data did not contain depths shoaler than 20-30 meters, a 2m surface was chosen for filtering, otherwise data was filtered using a 1m surface. This process decreased the time required for subset editing in CARIS having the main objective of removing obvious flyers and, in areas of high vessel traffic, large amounts of noise.

The data was then subset edited using 20-50 m x 50-200m slices in the along track direction. During subset editing rejected soundings were checked for validity and sound velocity errors as well as calibration changes due to pole motion. Any issues were noted and either accounted for or corrected.

Deviations from these thresholds, if any, are detailed in the appropriate DR.

B.2. Uncertainty Values

Uncertainty is generally lowest near the sonar nadir beams and increases toward the outside of each swath. This is expected and primarily a result of sound velocity error uncertainty.

Higher uncertainty is apparent in areas of steep or rapidly changing bottom topography, areas of variable sound velocity through the water column and areas where outer beams were left to contribute to the surface. Also in areas of rapid shoaling, unaccounted for tidal surging was evident and even felt on the vessels resulting in tidal busts up to 0.5m in areas. However, despite high uncertainty in these areas, data matchup is good and acceptable for nautical charting purposes.

Uncertainty values for computation in CAIRS are as follows:

Tide values:	Measured	0.07	m	Zoning	0.0000	m
Sound Speed values:	Measured	1.5	m/s	Surface	0.5	m/s

Tidal values were obtained from the *Final OPR-A366-KR-12 Southern Penobscot Bay Instructions*, section *1.3.3. Tide Component Error Estimation* which stated: "The estimated tidal error contribution to the survey area is 0.14 meters at the 95% confidence level, and includes the estimated gauge measurement error, tidal datum computation error, and tidal zoning error." The CO-OPS reported error value of 0.14 meters was then divided by 1.96 since CARIS assumes TPU values and to be 1 sigma (*Field Procedures Manual April 2012*). The tidal zoning field was left at zero as per CO-OPS reported error value of 0.14m included the zoning error. The sound speed values were determined using the average spatial and temporal patterns of daily SV casts along with the correlation of comparison casts and daily SVS confidence checks. The recommended values outlined in chapter 4 of the *Field Procedures Manual April 2012* were then considered before settling on the final sound speed TPU values.

The resulting uncertainty for sheets H12477 and H12478 of this survey are described in detail in their respective DR submitted under a separate cover.

B.3. Designated Soundings

While examining the data in subset mode soundings were designated wherever the BASE surface did not adequately depict the shoalest point of a prominent feature. Designations were made on significant features of 30m depth or less. Soundings were designated when they met or exceeded the criteria for designation set forth in the HSSD (April 2012) to ensure they were carried through to the finalized BASE surfaces.

C. CORRECTIONS TO SOUNDINGS

C.1. Sound Velocity Profiles

Sound velocity casts were taken approximately every two hours, or when the sound velocity at the head shifted by more than 2 m/s for a given area. Two Seabird CTDs were used aboard both vessels, each having been calibrated at the Sea Bird headquarters in April of 2012. The CTD used for daily operations was a SBE 19+, while a SBE 19 was used for comparisons and if needed, for backup. For each cast, the probes were held at the surface for 1-2 minutes to allow time for the unit to turn on and reach temperature and pressure equilibrium. The probes were then lowered and raised at an approximate rate of 1 m/s. The SBE 19+ was set to sample the water at a rate of 2Hz while the SBE 19 was set to sample at 1Hz. Only the downcast were used for post processing. The Sea Bird probes were rinsed out with freshwater to minimize salt-corrosion and in some cases to rinse out sediment. A Seabird SBE37 microcat was used at the MBES head for the first five days. The SBE microcat had not been calibrated within the last year, so it was replaced with a calibrated Valeport miniSVS. Before the SBE microcat was returned to the leasing company, sound velocity output from the microcat and the valeport were simultaneously recorded and compared. The data compared well, and it was determined that the previous days of acquisition with the microcat would be acceptable. Results and communications relating to this can be found in Separates II of the DR. Comparison casts were completed every 2 weeks between each probe and confidence checks were completed between the casting probe and the surface sensor with every sound velocity cast taken. These comparisons are located in the SVP log submitted in Separates II of the DR.

C.2. Squat and Settlement

The squat and settlement tests for the M/V Nooit Volmaakt and R/V Resolution were conducted on JD 187 just east of Tenants Harbor (Nooit Volmakt) and on JD 198 just east of Metinic Island (Resolution). It should be noted that data from the 3rd study area for the R/V Resolutions squat and settlement (labeled C) was not used as it did not coincide with the other two study areas (labeled A and B). Also it should be noted that the M/V Nooit Volmakt's squat and settlement test was run just to the north of our tidal boundaries (within 500-1000m) at slack tide. The results showed data quality improvement and were deemed acceptable.

The squat settlement test was performed by first establishing a 1000 meter line up a shallow slope. Three reference areas were then logged at 250m, 500m and 750m with the engines out of gear coasting at 1-2 knots. The full line was then run 5 times with the same heading, North, at incrementing vessel speeds (4, 5, 6, 7 and 8 knots). This data was then compared at each reference point (see squat and settlement spread sheets) by sampling soundings in the subset editor in CARIS. Median depth and average speed were computed for each line at each reference point. The difference in median depth were computed and correlated with the appropriate average speeds to plot overall Squat and Settlement.

All measurements were corrected for pitch, roll, and reduced to the vessel's common reference point (CRP) in the CARIS vessel configuration file, VCF. Procedures were taken from Settlement and Squat Procedures Using the Multibeam Echo Sounder Method (see below for charted and table results).

The results of the squat settlement test for both vessels using the Reson 7125 are shown below:

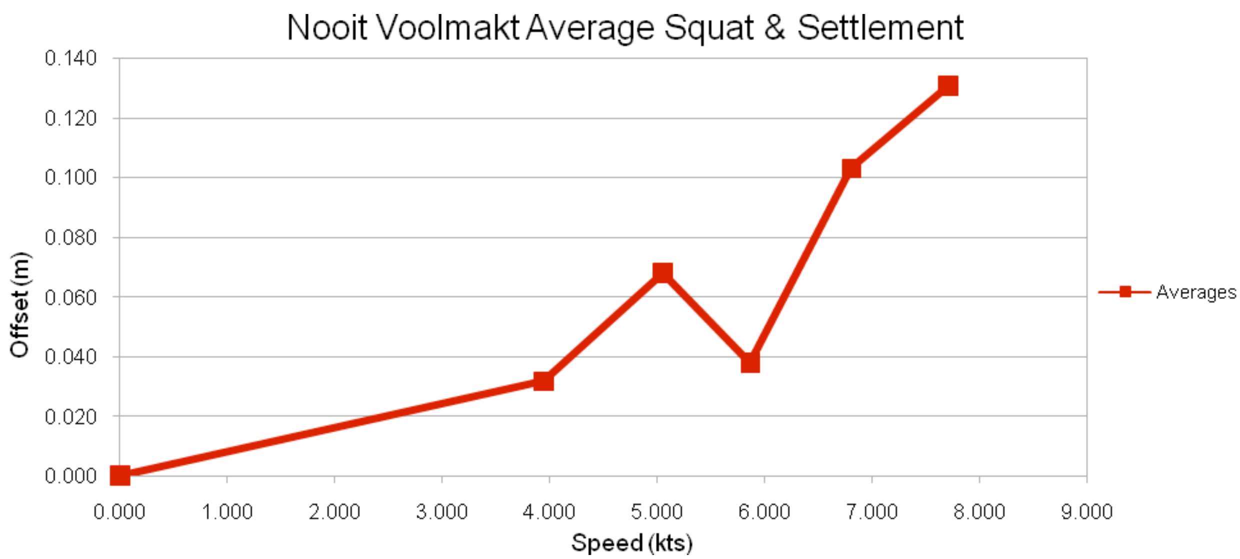


Figure 4 - M/V Nooit Volmaakt Settlement Curve

Table 3 – M/V Nooit Volmaakt Calculated Settlement

M/V Nooit Volmaakt CALCULATED SETTLEMENT	
Offset (m)	Speed (kts)
0.000	0.000
0.032	3.946
0.068	5.055
0.038	5.867
0.103	6.812
0.131	7.713

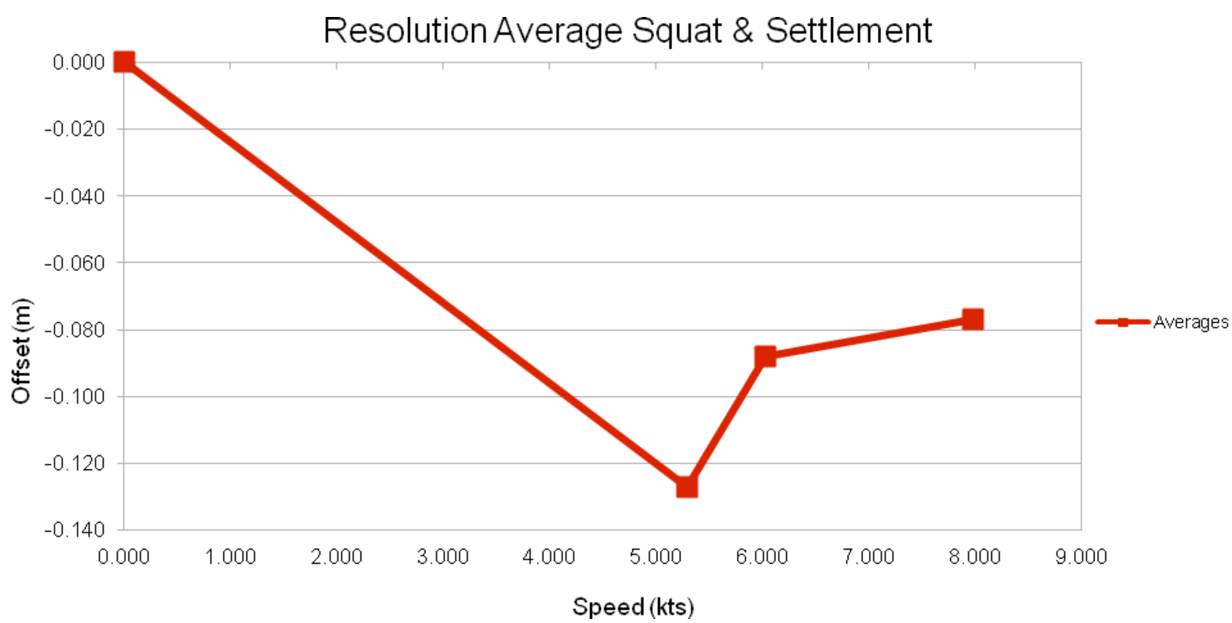


Figure 5 - R/V Resolution Settlement Curve

Table 4 - R/V Resolution Calculated Settlement

R/V Resolution CALCULATED SETTLEMENT	
Offset (m)	Speed (kts)
0.000	0.000
-0.127	5.291
-0.088	6.035
-0.077	7.983

Note: Vessel speed was noted on the survey line logs, and the settlement values were entered into the CARIS HVF so HIPS could perform the correction automatically during merge.

C.3. Static Draft

Static draft was measured immediately prior to starting and after the end of daily survey operations. Onboard the M/V Nooit Volmaakt measurements were acquired from the waterline to the deck on both port and starboard sides, and then referenced to the IMU (also the RP). Onboard the R/V Resolution measurements were acquired from the waterline to the port side rail, and then referenced to the IMU (also the RP). Over the span of the entire survey the average draft for the M/V Nooit Volmaakt was 0.17m with a standard deviation of 0.007m. The R/V Resolution had a average draft of 0.59m with a standard deviation of 0.0218m. Refer to table 5 and 6 below for draft values for each vessel.

Table 5: M/V Nooit Volmaakt Static Draft Measurements

JD (2012)	AM	PM
186	0.16	0.16
187	0.16	0.15
188	0.17	0.17
189	0.17	0.18
190	0.17	0.18
191	0.17	0.17
192	0.16	0.16
193	0.16	0.17
194	0.16	0.17
195	0.17	0.17
196	0.17	0.18
222	0.16	0.16
223	0.16	0.16
224	0.17	0.16
225	0.17	0.17
226	0.16	0.16
227	0.17	0.17
228	0.17	0.17
230	0.16	0.16
231	0.16	0.17
232	0.16	0.15
233	0.16	0.17

Table 6: R/V Resolution Static Draft Measurements

JD (2012)	AM	PM
198	0.61	N/A
199	0.64	0.64
200	0.57	0.58
201	0.58	0.59
202	0.59	0.59
205	0.61	0.63
206	0.61	0.64
207	0.56	0.57
208	0.57	0.58
209	0.57	0.58
210	0.58	0.59
211	0.59	0.60
212	0.60	0.61
215	0.56	0.57
216	0.57	0.58
218	0.58	0.59
219	0.59	0.60
220	0.60	0.61

C.4. Tides

All sounding data were initially adjusted to MLLW using predicted tidal data from the Portland tide station (station id #: 8418150). Predicted tides were used for preliminary processing only. Verified tides were downloaded from the NOAA database for the Portland tidal gauge on August 31st, 2012. Verified tidal data were used for all final base surfaces.

Tidal zoning was deemed acceptable by examining cross line and main scheme lines running on either side and across the zone boundaries. The only tidal busts observed were concentrated around rapidly shoaling areas where tidal surge could not be accounted for by remote tide station data. These busts seem to be surge related as the surge could be felt on the vessels. Comparisons with ellipsoidally referenced data confirmed this speculation. Below is an example of ellipsoidal vs. tidal zoned data in these shoals, surging areas.

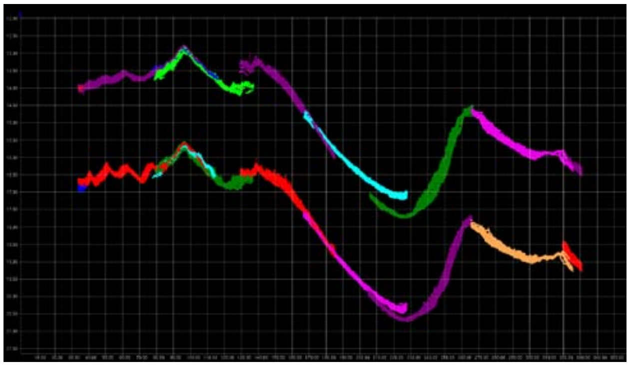


Figure 6: Screen shot of Subset editor in CARIS showing ellipsoidally referenced data on the bottom and tidal zoned data on the top. Notice the bottom data set is more consistent.

C.5. Vessel Attitude

The M/V Nooit Volmaakt and R/V Resolutions heading and dynamic motion were measured by the POSMV. The system calculated heading and motion using 3 fiber optic gyroscopes in conjunction with 3 accelerometers. The POSMV was located similarly in each vessel, just aft and to the port of the vessels COG. The operational accuracy specifications for this system can be found in *Appendix F*.

C.6. Calibrations

Post to the initial MB Calibrations for the M/V Nooit Volmaakt and R/V Resolution, daily calibration checks (and patch tests if needed) were made/run to determine the accuracy of the pitch and roll offsets due to the mounting pole configuration, which was deployed and recovered each day. Both vessels received multiple recalibrations, besides post MOB and re-MOB calibrations; however no value exceeded 1° of change, with the exception of the yaw value after the second MOB of the M/V Nooit Volmaakt (JD222). The M/V Nooit Volmaakt required more attention towards the end of the survey period due to fatigue of the pole hinge. Julian days 191, 230, and 233 had pole shifts during acquisition and were corrected for by using neighboring lines to calibrate from. These calibration results were deemed acceptable and did not affect our confidence level of IHO Order 1.

All calibration lines and vessel files (HVF) are included in the digital data deliverables. Please see *Appendix G* for the calibration report and procedures.

D – APPROVAL SHEET

REGISTRY NUMBERS H12477 & H12478

This report and the accompanying digital data are respectfully submitted.

Field operations contributing to the accomplishment of projects H12477 & H12478 were conducted under my direct supervision with frequent personal checks of progress and adequacy. This report and smooth sheet have been closely reviewed and are considered complete and adequate as per the Statement of Work.

WILLIAMSON AND ASSOCIATES, INCORPORATED

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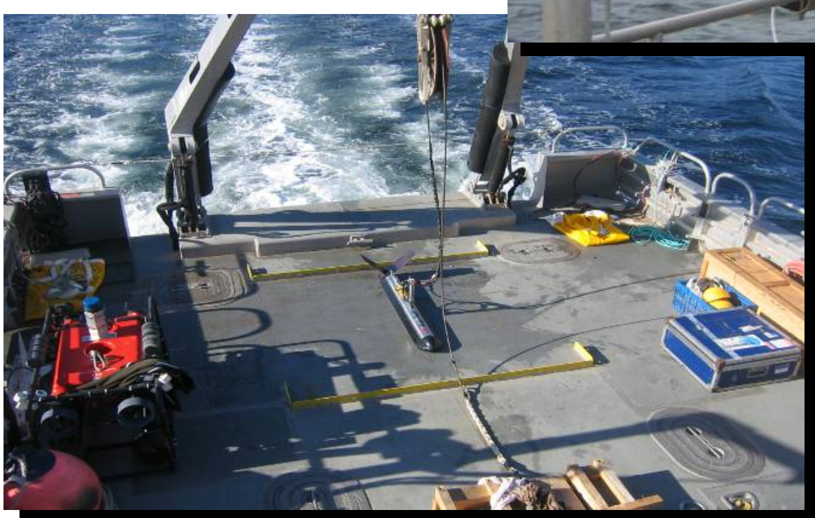

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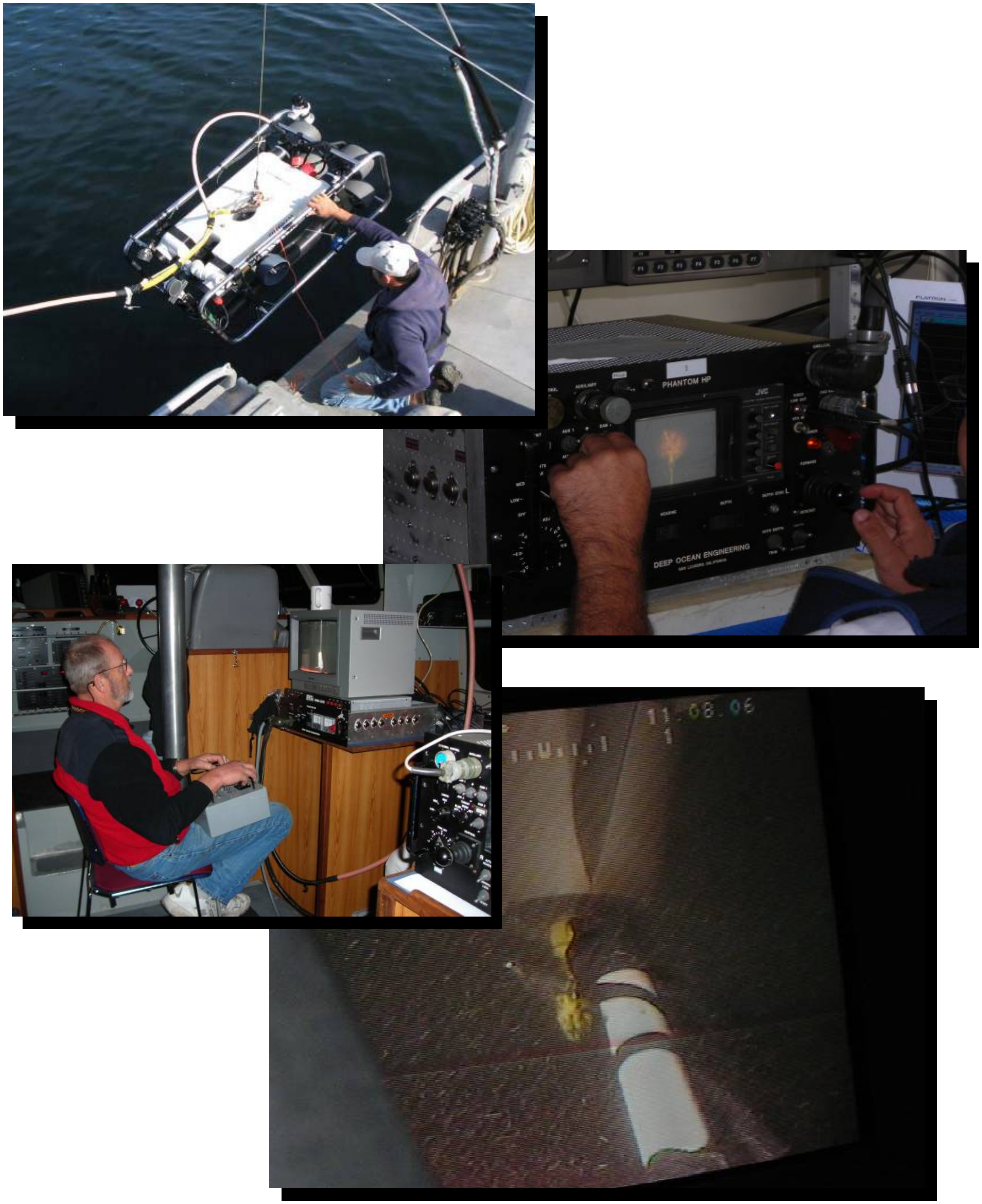
ROVs



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VESSEL SPECIFICATION

54' CATAMARAN PATROL VESSEL
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KMI LEASING CO., LLC SEATTLE, WA • 54' PATROL CATAMARAN • VESSEL SPECIFICATION

I. General Information

A) Principal Characteristics

Length overall	≈58'
Length on deck	54'-9"
Beam	20'-2"
Displacement, full load	≈49,000 lbs.
Fuel capacity	1200 gal.

B) Scantlings, (minimum)

Bottom	.250" plate	Sides	.190" plate
Bulkheads	.190" plate	Longitudinals	.187 and .250 tee bar
Frames	.190" capped plate	Engine girders	.375" plate
House	.190" and .125" plate	Fuel tank	.250" plate
Decks	.190 plate		

C) Fuel Consumption Rates – Gallons per Hour

RPM	SPEED	GAL PER ENG	TOTAL GPH
700	6.2 knots	1.4 GPH	2.8 GPH
1700	17 knots	15 GPH	30 GPH
1850	19.5 knots	17 GPH	34 GPH
2050	22 knots	20 GPH	40 GPH

II. Machinery and Systems

A) Propulsion Engines

The vessel is powered by twin Caterpillar 3196 DITA marine diesel engines rated for 660 BHP at 2300 RPM. Engine instrumentation at the pilothouse station shall include engine groups with tachometer, oil pressure, coolant temperature, hour meter, and start/stop switches. Remote start/stop switches located in the engine rooms on engines. Start/stop switches, tachometer, alarm and synchronizing switch for each propulsion engine will be installed at the flying bridge control station. The engines shall be fitted with 60A 24VDC alternators, auxiliary front pulleys, lube oil change pumps, block heaters, Caterpillar alarm systems, and local instrumentation. Engine output is via Twin Disc MG 5114A marine gears with a 1.92:1 reduction ratio.

B) Drive System

The engines are coupled to 2-1/2" diameter Aquamet 22 propeller shafts. The shafts are fitted with stainless/carbon dripless seals, and supported by water lubricated cutlass bearings as required. The propulsion drive train will incorporate two (2) 5 blade Nibral propellers approximately 30" in diameter.

C) Propulsion Controls

The vessel is equipped with two (2) control stations, one each at the pilothouse and the flying bridge. Engine throttle and shift control will be accomplished via a Hynautic manual hydraulic system, and actuated by four (4) single-function control levers at each station. Shift levers mounted to starboard and throttle levers mounted to port. The system will be laid out with dual reservoirs for redundancy. (One in each engine room)

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D) Cooling System

The engines are heat exchanger cooled to minimize the potential effects of saltwater corrosion. A 50/50 solution of anti-freeze and fresh water circulates through the engine's cooling circuit and associated components. Sea water enters through intake valves protected by external scoop strainers positioned in the machinery spaces. Water passes through single internal strainers, to the engine heat exchangers, and is then discharged overboard via the wet exhaust system. The cooling system is plumbed with wire reinforced neoprene hose.

E) Fuel System

The vessel is equipped with two (2) aluminum 600-gallon diesel fuel tanks designed to USCG standards, with baffles every 30" and designed to maximize space. Each tank is secured with fabricated straps and chocks, and isolated from the hull structure by neoprene padding. Fuel flow is controlled by ball valves mounted on dual Racor fuel filters. The tank fill fittings are 1-1/2" inside diameter, over the tanks and located on the aft deck. The tank vents are located as high as possible. The pilothouse is outfitted with fuel gauges to check the fuel level in each tank. The fuel system is plumbed with USCG approved flexible fuel hose and incorporates a fuel transfer system with fuel transfer pumps. (Note: There are no pollution combings around fuel fills or breathers.)

F) Exhaust System

Engine exhaust is water cooled and routed through the transom. Exhaust piping is stainless steel and FRP tube. The exhaust system is fitted with FRP mufflers, and surge eliminating flappers. All non-water cooled exhaust piping is covered with 1" thick removable fiberglass lagging to prevent injury to personnel, damage to equipment, and excessive heat build-up in the engine room.

G) Steering System

The vessel is equipped with a manual hydraulic steering system actuated from each of the two control stations. The system is fitted with 20" diameter stainless steel wheels, and is plumbed with high pressure, low expansion thermoplastic tubing with ½" copper tube on long straight runs. The rudders are stainless steel plate shapes on stainless steel posts, and are articulated by dual balanced hydraulic cylinders plumbed in series. An indexing valve is provided in the steering circuit for rudder alignment. An autopilot mounted at the main control console. An autopilot control repeater is installed at the flying bridge.

H) Primary and Secondary Drainage Systems (Including Bilge System)

The vessel is equipped with six (6) independent 2000 GPH bilge pumps, one in each watertight space in each hull. Each pump is controlled by two electric switches, one local, and one in the pilothouse. Bilge pump control panels are installed in the pilothouse, and indicate bilge water accumulation beyond acceptable levels.

A hand operated manual bilge pump is provided and installed in way of the house for ready access. There are two 1" hull-docking plugs located in the bilge to facilitate drainage when the vessel is dry-docked. Five (5) round cornered overboard scuppers are cut into the side shell.

I) Hydraulic System

Utilizes a single pressure-compensated, load-sensing hydraulic pump, with mounts, is fixed on the front end of the starboard main engine, and powered via a Cardan shaft and a 24VDC electric clutch. The switches for the electric clutch and the anchor winch solenoid valve are located adjacent to the 120VAC power panel. This pump provides controlled flow to the following hydraulic equipment:

Pair of A-frame cylinders	One (1) crab block davit articulating cylinder
One (1) drum-type anchor winch (Kolstrand 1620)	One (1) A-frame hoisting winch with ¾" quick hydraulic disconnects

Fluid is supplied by a twenty gallon reservoir mounted in the engine room. System return fluid is passed through a shell and tube oil cooler plumbed to the engine raw water discharge piping. The hydraulic pump provides up to 15 GPM of fluid at pressures up to 2400 PSI. Control valves for all equipment are locally mounted. The hydraulic deck circuits are fitted with two (2) high-pressure oil shut-off (isolation) valves.

The hydraulic system is plumbed with marine grade wire reinforced neoprene hose, with a working pressure rating at least as great as the system maximum pressure, and a rated burst pressure approximately five times that amount.

J) Ventilation

Engine combustion air is supplied through large intake ducts located on the side decks above the engine rooms. The ducts are baffled to prevent significant water entry into the machinery spaces. A pair of 24VDC blowers shall be installed at the engine air intakes to increase airflow through the engine rooms. Exhaust fans, discharging to weather, are provided and installed in the head and shower spaces.

K) Freshwater System

A pair of 150 gallon polyethylene freshwater tanks are provided, and plumbed to a pair of pressure pumps and a 20 gallon water heater. Each tank has gauges to monitor levels. A 24VDC pump will be plumbed with an accumulator to supply the fresh water. Cold and hot water are provided in the galley, the head, the shower and the aft sink. Cold water is supplied to each engine room and to a hose bib fitting at the aft sink. Freshwater heating is accomplished using engine waste heat.

An additional 30 gallon polyethylene tank is provided, dedicated to the galley, and discharge cold water through a foot pump and single faucet.

L) Waste System

The head compartment is fitted with marine duty electrical flushing Jabsco #37010-1006 toilet plumbed to a 100-gallon wastewater holding tank installed on the port side. A Y-valve and 24VDC pump are installed to allow for pumping the tank directly overboard in offshore waters. A deck discharge fitting is provided to allow shore-side stripping of the holding tank. A separate gray water drainage system incorporating the same tank and pump shall be installed on the starboard side. A deck drain is installed in the head and discharge to the waste water system.

M) Fire Fighting System

Two (2) fixed FE-241 fire extinguishing systems are installed, one in each engine room. Each of the systems are provided with manual discharge controls and indicator lights for the pilothouse, and automatic discharge sensors for the engine rooms. These systems will be configured to automatically shutdown the main propulsion engines, generator set and engine room ventilation fans when activated.

N) Washdown System

One (1) 120VAC Jacuzzi Model #1RM2 washdown pump with pressure switch is installed on starboard side and plumbed with a through-deck fitting aft of the davit and supply discharge through a one-inch washdown hose. This pump is controlled by a circuit breaker on the 120VAC panel. A separate 24VDC pump is installed in the port engine room with a through-deck hose bib fitting.

III. Electrical

A) Power and Distribution

Primary 24VDC electrical power is provided by six (6) 210 amp-hour, 8D batteries. These batteries are located in the machinery spaces and controlled by vapor-tight selector switches which allow crossover connection. Battery charging is accomplished by engine mounted alternators or shore power. A console mounted breaker panel distributes power to all onboard electrical equipment, and include a voltmeter, an ammeter, and four spare breakers for future installations. A 40A, 24VDC stainless steel battery charger is installed, (providing power equal to an 80A, 12VDC charger).

An auxiliary 12VDC circuit is provided and controlled by a breaker panel. Two (2) 24VDC-12VDC power converters energize this circuit, and power various electronics that require 12VDC power. An additional 12/24VDC auxiliary panel is mounted on the flying bridge.

A 12 kW Northern Lights model #M843NK diesel powered generator, complete with local and remote instrumentation, is installed to provide 120VAC single phase power. A control panel for the 120VAC circuits is mounted in the main cabin.

The following 120VAC GFI outlets are provided as follows:

Galley-	(5) dual	Cabins-	(4) dual, one per cabin space
Head-	(1) dual	Pilothouse	(2) dual
Engine rooms	(4) dual, two per engine room		

A 30A shore power system is installed, and connected to the vessel's 120VAC system. The inlet shall be installed on the aft side of the house to starboard. All conductors are made of thermoplastic insulated stranded copper wire of marine grade, and all DC circuitry is two-wire, negative ground.

B) Lighting

Navigation lighting is provided as required by USCG regulations for vessels of this size and service. Approved lights are arranged to display the correct light signals for free running and anchoring. Vessel illumination is provided and installed as follows:

Pilothouse	(2) 24VDC red/white dome lights (1) 120VAC florescent, in overhead (four foot fixture) (1) 24VDC chart light, starboard dash
Main cabin	(5) 24VDC red/white dome lights (2) 120VAC florescent, in overhead (two-foot fixtures)
Personnel cabins	(3) 24VDC red/white dome lights (2) white dome lights (3) 120VAC/24VDC florescent, in overhead (two-foot fixtures) (7) 24VDC incandescent bunk lights to be mounted at all bunks including storage/bunk room
Head & shower	(2) 24VDC white dome lights
Machinery spaces	(4) 24VDC white dome lights (two per engine room) (2) 120VAC overhead lights (one per engine room)
Deck	(6) 24VDC, 9900CP fixed Halogen floodlights (fore deck, aft deck from flying bridge and aft deck from arch) (2) 24VDC white dome lights over work stations (1) 24VDC 8" remote controlled spotlight (5) 5 120VDC 500 watt Aqua-Signal – Series 10-69 sodium lights (Arch-two forward, two side & one aft deck)

C) Electronics and Navigational Equipment

The following combination of 12VDC and 24VDC compatible electronics and navigation equipment are installed and tested for proper operation:

One (1) Radar set with heading sensor	Auto-pilot	Video fathometer
Digital fathometer (Flying Bridge)	Seawater temp. sensor	VHF with loudhailer
Siren with speaker	Video plotter	EPIRB
Two (2) GPS/Plotters	RDF	VHF (Flying Bridge)

One each (1 each) Magnetic Steering Compass (Flying Bridge & Pilothouse)

D) Miscellaneous Electrical

The following equipment is installed:

Three (5) 24VDC pantograph windshield wipers.
One (1) 24VDC dual electric horn.
Three (3) heater craft 24VDC defrost units with 5 diffusers in pilot house
Seven (7) 24VDC ventilation fans, one at each berthing.
Two (2) 24VDC ventilation fans in pilot house on same circuit.
Two (2) 24VDC ventilation fans, one in each engine room.
Two (2) 24VDC vent fans, one each in head and shower.
Two (2) 24VDC auxiliary power sockets (cigarette lighter type).
(one in pilot house and one on flying bridge)
Two (2) 120VAC heaters in the galley, one port, one stbd.
One (1) Electronic cathodic protection monitor, in console
Two (2) 1/2" x 6" x 12" zinc plates, on the transoms.
Two (2) "tear drop" zincs mounted at each engine intake
Collar zincs on shafts
Zincs on foil
Zincs on rudders
Two (2) Tomar blue strobe lights, on the mast.

Manufacturer:	Hewescraft
Model:	220OP HT
Length:	24’3”
Beam:	102”
Side Height:	35”
Person/Weight Capacity:	10/1425 lbs
Max Weight Capacity:	2476
Fuel Capacity:	52 Gallons
Year:	2008
Motor:	Yamaha Outboard F200TXR
Motor:	Yamaha Outboard 8hp High Thrust
Batteries:	Dual 12vdc
Inverter:	12vdc to 120vac 800 Watts
Electro Mechanical Trim Tabs:	
GPS/Echosounder/Chartplotter:	Humminbird 997c SI Combo (sidescan)
Radar:	Furuno
Radio:	Marine VHF

SeaBat® 7125

ULTRA HIGH RESOLUTION MULTIBEAM ECHOSOUNDER

The new generation SeaBat 7125 builds on the field experience and feedback from many users around the world and brings unparalleled resolution and installation flexibility. The system is available in three separate configurations; one designed specifically for installation on small survey vessels and a 6000m depth rated system for either ROV or AUV use.

Each of these configurations utilise the same transducer set and provide identical high performance, superlative data quality, features and ease of use over depths from 0.5m to 500m.

Special emphasis has been put on maximizing operational efficiency and features such as variable swath width and roll stabilisation combined with a high ping rate and excellent data quality .

Surface Vessel Installation - SV2
The new SeaBat 7125-SV2 is a highly integrated single or dual frequency system designed with ease of installation and operation as a high priority. The system consists of a surface transceiver with integrated multiport card and a standard 25m cable run to the transducers. The transceiver hardware is suitable for running data acquisition software and is available with RESON PDS2000 software pre-installed and configured.

ROV2
For deep-water use the ROV version of the SeaBat 7125 has a 6000m depth rating and includes a 6000m rated titanium interface bottle. The system performance and feature set is identical to the other members of the 7125 family thus providing commonality and ease of use.

PRODUCT LOGBOOK

RESON

BEAM DENSITY	Up to 512 beams in selectable modes optimises operations for any survey type
ROLL STABILIZATION	Real-time roll stabilization maximizing usable swath
DEPTH	Dual frequency provides seamless coverage from 0.5 to 400m typical depth
IHO	Compliance with IHO SP44Ed5 over entire depth range
DIAGNOSTICS	Advanced diagnostics
HIGH SPEED	High ping rate allows high-speed operations without compromising data density
WATER COLUMN DATA	Allows collection of high density water column data for advanced processing

AUV
The AUV version of the 7125 provides on-board data processing and logging as well as interface to third party sensors. The electronics are supplied mounted on an aluminium frame for ease of integration and an optional 6000m depth-rated titanium electronics housing is available. The 7125-AUV provides high quality data and performance commensurate with the other versions of the 7125.

RESON

SEABAT 7125 SYSTEM SPECIFICATIONS

	7125 SV2	7125 ROV2	7125 AUV
POWER REQUIREMENT	111/220 VAC, 50/60 Hz 500W average	48V DC (±10%) 110W max	48V DC (± 10%) 200W max
TRANSDUCER CABLE LENGTH	25m standard	3m standard 10m optional	3m standard 10m optional
LCU TO PROCESSOR CABLE LENGTH	N/A	25m (ST), 6m, 5m (pigtail)	N/A
SYSTEM DEPTH RATING	25m	6000m	6000m optional
FREQUENCY	200kHz or 400kHz (dual frequency available)		
ALONG-TRACK TRANSMIT BEAMWIDTH	2° at 200kHz & 1° at 400kHz		
ACROSS-TRACK RECEIVE BEAMWIDTH	1° at 200kHz & 0.5° at 400kHz		
MAX PING RATE	50Hz (±1Hz)		
PULSE LENGTH	33μsec to 300μsec		
NUMBER OF BEAMS	512EA/ED at 400kHz, 256EA/ED at 200kHz		
MAX SWATH ANGLE	140° (165°)		
TYPICAL DEPTH	0.5m to 150m at 400kHz, 0.5m to 400m at 200kHz		
MAX DEPTH	175m at 400kHz, 450m at 200kHz		
DEPTH RESOLUTION	6mm		
DATA OUTPUT	Bathmetry, sidescan and snippets 7K data format		
TEMPERATURE:	-2° to +35°C		
FLEXMODE:	Optional		

COMPONENT	7125 SV2	7125 ROV2	7125 AUV
EM 7216 RECEIVER	✓	✓	✓
TC 2181 DUAL FREQUENCY 200/ 400 kHz PROJECTOR	✓		
TC 2160 400kHz PROJECTOR		✓	✓
TC 2163 200kHz PROJECTOR (OPTIONAL)		✓	✓
7-LINK CONTROL UNIT		✓	
SONAR PROCESSOR UNIT WITH MONITOR, KEYBOARD AND POINTER DEVICE		✓	
SV TRANSCEIVER WITH MONITOR, KEYBOARD AND POINTER DEVICE	✓		
7-I INTEGRATED CONTROL AND PROCESSOR UNIT			✓

For more details visit www.reson.com or contact your local RESON Office.

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RESON

SEABAT 7125 SYSTEM SPECIFICATIONS

	Height [mm]	Width [mm]	Depth [mm]	Weight [kg/air]	Weight [kg/water]
TC 2181 DF 200/ 400 kHz PROJECTOR	87	93	280	4.5	3.4
TC 2160 400 kHz PROJECTOR	77	62	285	2.7	1.7
TC 2163 200kHz PROJECTOR	115	100	280	7.5	5
EM 7216 200/400 kHz RECEIVER	137	496	102	10.7	5.7
SURFACE TRANSCEIVER	5U	19"	557	20	N/A
LCU BOTTLE	530	Ø174	N/A	15.7	5.2
ICPU FRAME	172	166	497	10	N/A
SONAR PROCESSOR	5U	19"	630	30	N/A

OPTIONS:
Mounting Bracket with Fairing
SVP-70 sound velocity probe with 25m cable
Extended warranty/ support & maintenance contracts
Fiber-optic conversion for ROV installations

7125SV2

7125 ROV2

WHY CHOOSE A SEABAT 7125 SYSTEM?

- Maximum Productivity during data collection
  - Up to165degree swath
  - Roll Stabilization
  - Up to 512 beams in operator selectable modes
- Uncompromised clean data sets
  - Quality Filters/flags
  - Interactive, Comprehensive GUI
  - Industry leading bottom detect methods
- Ease of Installation and Use
  - Fully automatic operation
  - Single highly integrated topside transceiver
  - Integrated Multibeam acquisition and processing software
  - Extremely portable wet-end
- Maximum Operational Flexibility
  - 400 and 200kHz operation for seamless data collection from 0.5m to 500m
  - Variable and Steerable swath
  - Simultaneous output of bathymetry, Sidescan, Snippets backscatter, and raw water column data
  - Adaptive gates
  - Uncertainty Output

For more details visit www.reson.com or contact your local RESON Office. RESON reserves the right to change specifications without notice. 2011©RESON

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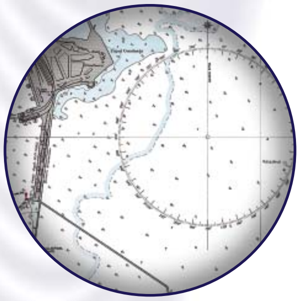
Front cover photograph © Armstrong

MBX-4

Reliable Auto-Tracking Differential Beacon Receiver



Provide a reliable source of free differential corrections with the MBX-4 Differential Beacon Receiver that augments a separate GPS receiver with free accuracy-improving correction data from networks of beacon stations located throughout the world. With automatic dual-channel tracking, the MBX-4 ensures the best beacon station is always being decoded. Beacon stations are automatically tracked based on signal strength or station distance and can also be manually selected.

Hemisphere GPS' MBX-4 has been optimized for high performance reception and proves reliable even in noisy environments. It outputs the industry standard RTCM SC-104 format accepted by differential-ready GPS receivers and can be configured and monitored with NMEA 0183 protocol. Hemisphere GPS' MBX-4 receiver kit includes an integrated GPS and beacon antenna.

Key MBX-4 Advantages

- Supplements GPS systems with free beacon differential corrections, capable of sub-meter accuracy (depending on GPS receiver quality)
- Dual-channel design allows strongest signal or closest station selection
- Integrated signal splitter outputs GPS signal from combined GPS / differential antenna
- Simple to monitor and configure through menu system and display
- Patented ceramic filter blocks out-of-band signals, optimizing reception

MBX-4 Beacon Receiver

Receiver Specifications

Channels:	2-channel, parallel tracking
Channel Spacing:	500 Hz
Frequency Range:	283.5 to 325.0 Hz
MSK Bit Rates:	50, 100, 200 bps
Operating Modes:	Manual, Automatic and Database
Cold Start Time:	<1 min
Warm Start Time:	<2 seconds
Demodulation:	Minimum Shift Keying (MSK)
Sensitivity:	2.5 μV/m for 6 dB SNR
Dynamic Range:	100 dB
Frequency Offset:	±8 Hz (27 ppm)
Adjacent Channel Rejection:	61 dB @ ± 400 Hz
Correction Output Protocol:	RTCM SC-104
Input Status Protocol:	NMEA 0183

Communications

Interface:	RS-232C or RS-422
Baud Rates:	2400, 4800, 9600

Environmental Specifications

Operating Temperature:	-30°C to +70°C (-22°F to 158°F)
Storage Temperature:	-40°C to +80°C (-40°F to 176°F)
Humidity:	95% non-condensing
EMC:	CISPR22 EN 61000-6-1 CE

Power Specifications

Input Voltage Range:	9 to 40 VDC
Nominal Power:	2.5 W
Nominal Current:	210 mA @ 12 VDC
Antenna Voltage Output:	10 VDC (5 VDC optional)
Antenna Input Impedance:	50

Mechanical Specifications

Dimensions:	150 mm L x 125 mm W x 51 mm H (5.9 L x 4.9 W x 2.0 H inches)
Weight:	0.64 kg (1.4 lb)
Display:	2-line x 16-character LCD
Keypad:	3-key switch membrane
Power Connector:	2-pin circular locking
Data Connector:	DB9-S
Antenna Connector:	BNC-S
Optional GPS Output Port:	TNC-S

NMEA 0183 I/O

- Receiver Automatic, Database and Manual tune command
- Frequency and data rate query
- Receiver performance and operating status queries
- Automatic search almanac queries (proprietary)
- Baud rate selection command
- Receiver tune command
- Force cold start command (proprietary)
- Software upgrade command (proprietary)
- Configuration up-load command (proprietary)

Back Panel Configuration

Authorized Distributor:

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Software		Serial Number	Version
QPS Navigation	QINSy		8.10 Release 8.10.2012.05.06.1
Seabird	Sea Term		1.59
	SBE Data Processing		7.21j
CARIS	HIPS	CW9606260	7.1 SP2 HF2
Microsoft Office 2007	Word, Excel,Publisher		
POSView			5.1.0.2
AlwaySync			10.5.1
SeaBat	7K UI		4.5.1.0.5
	7K Center		4.5.1.0.5
	7K IO		3.4.1.11
Global Mapper			11.02

Equipment	Model	Serial Number
Applanix POSMV	POS MV V4	3148
Applanix IMU	LN 200	545
Trimple	BD950	60244941
Trimple	BD950	60242957
Navigation Computer	Windows 7	
Processing Computer	Windows 7	
Hemisphere Beacon Receiver	MBX 4	0923-9416-0006
Reson SeaBat Topside computer	Windows XP SP3	
Reson Receiver		4010056
Reson Projector		4010156
Seabird CTD	SBE 19+	19P46434-5077
Seabird CTD	SBE 19	1911651-1488
Valeport	miniSVS	26649

POS MV™ **marine vessels**

DATASHEET

The New POS MV - Providing the Marine Industry with robust, reliable, and repeatable position and orientation solutions

The new POS MV V4 - a tightly-coupled system utilizing advanced Inertially-Aided Real-Time Kinematic (IARTK) technology designed to increase your operational capability and reduce downtime.

Tightly integrated inertial navigation – Continuous positioning data can be generated while surveying in areas where GPS reception is compromised by multipath effect and signal loss, such as close to offshore structures, or in ports, harbors, near-shore coastal waters and rivers. Raw GPS data from as few as one satellite can now be processed directly within the POS MV reducing position drift and RTK re-acquisition time.

The V4 Advantage

The Major Benefits

- Faster, more robust heading aiding from GPS Azimuth Measurement Subsystem (GAMS) when compared to V3
- Proprietary Inertially Aided RTK providing almost instantaneous reacquisition of RTK following a GPS outage
- Superior low elevation tracking performance using lighter, smaller Trimble Zephyr ™ geodetic antenna technology
- Faster initial system calibration
- Maintains heading accuracy longer when in a high multipath environment
- Increased component reliability
- Automatic identification and error estimation for lever arm distances and angles

The Latest Technology
V4 uses the latest Trimble BD950 receivers with the following attributes:

- Extremely fast response time
- Latency of less than 20 milliseconds (at 20 times per second)
- Very low noise L1 and L2 carrier phase measurements
- Uses the Maxwell 4 Custom Survey GPS chip for enhanced tracking capability

Straightforward Installation and Operation

- All components mounted and installed using a straightforward, one-time-only, systematic procedure.

Faster, More Reliable Networking Potential

- An improved Ethernet raw data logging capability for streamlined data acquisition of all motion variables with microsecond-accurate time stamping

Upgradeability*

- Convenient upgrade program for PCS and antennas, to allow for maximum interoperability when moving from L1 only to a full L1/L2 RTK unit

The Most Accurate Position and Orientation Solution
POS MV V4 maintains positioning accuracy under the most demanding conditions regardless of vessel dynamics. With its high data update rate, the system delivers a full six degree-of-freedom position and orientation solution to provide the following:

- Position (latitude, longitude and elevation)
- Velocity (north, east and vertical)
- Attitude (roll, pitch and true heading)
- Heave (real-time, delayed)
- Acceleration Vectors
- Angular Rate Vectors

** For detailed upgrade information please call your Applanix Marine office*

SYSTEM COMPONENTS

POS Computer System (PCS) – A rugged, compact computer system contains the core POS processor and IMU interface electronics, plus two GPS receivers and an optional removable PC-card disk drive. The PCS provides system timing, position and velocity aiding, together with GPS raw observables for use with GAMS.

POS Inertial Measurement Unit – The system's primary sensor allows for the continuous output of position and orientation data.

Primary GPS Receiver Antenna – A dual frequency antenna for use with GAMS.

Secondary GPS Receiver Antenna – A dual frequency antenna for use with GAMS.

APPLANIX
A TRIMBLE COMPANY

POS MV™ marine vessels

SPECIFICATIONS

Accuracy

POS MV 320 Main Specifications (with Differential Corrections)

Roll, Pitch accuracy:	0.02° (1 sigma with GPS or DGPS)
	0.01° (1 sigma with RTK)
Heave Accuracy:	5 cm or 5% (whichever is greater) for periods of 20 seconds or less
Heading Accuracy:	0.02° (1 sigma) with 2 m antenna baseline, 0.01 (1 sigma) with 4 m baseline
Position Accuracy:	0.5 - 2 m (1 sigma) depending on quality of differential corrections
	0.02 - 0.10 m (RTK) with input from auxiliary RTK or optional internal RTK receiver
Velocity Accuracy:	0.03 m/s horizontal

POS MV 320 during GPS Outages

Roll, Pitch accuracy:	0.02° (1 sigma)
Heave accuracy:	5 cm or 5% (whichever is greater) for wave periods of 18s or less
Heading accuracy:	Drift less than 1° per hour (negligible for outages < 60s)
Position accuracy degradation:	2.5 m (1 sigma) for 30 s outages <6 m (1 sigma) for 60 s outages

POS MV 220 Main Specifications (with Differential Corrections)

Roll, Pitch accuracy:	0.05° (1 sigma with GPS or DGPS)
	<0.05° (1 sigma with RTK)
Heave Accuracy:	5 cm or 5% (whichever is greater) for periods of 20 seconds or less
Heading Accuracy:	0.1° (1 sigma) with 2 m antenna baseline, 0.05° (1 sigma) with 4 m baseline
Position Accuracy:	0.5 - 4 m (1 sigma) depending on quality of differential corrections
	0.02 – 0.10 m (RTK) with input from auxiliary RTK or optional internal RTK receiver
Velocity Accuracy:	0.05 m/s horizontal DPGS, .03 m/s horizontal RTK

POS MV 220 during GPS Outages

Roll, Pitch accuracy:	0.05° (1 sigma)
Heave accuracy:	5 cm or 5% (whichever is greater) for wave periods of 18s or less
Heading accuracy:	Drift less than 3° per hour (negligible for outages < 60s)
Position accuracy degradation:	2.5 m (1 sigma) for 30 s outages <6 m (1 sigma) for 60 s outages

Physical Characteristics

Size

IMU:	204 mm X 204 mm X 168 mm	7.95 in X 7.95 in X 6.55 in
PCS:	432 mm X 89 mm X 356 mm	17.00 in X3.50 in X 14.05 in
	2.0U 19 in rack mount	
GPS Antenna (x2):	187 mm X 53 mm	7.4 in X 2.1 in

Weight

IMU:	3.5 kg	7.7 lb (international)
Processor:	5 kg	11.0 lb (international)
GPS Antenna:	<0.5 kg	<1.1 lb (international)

Power

Processor:	110/230 Vac, 50/60 Hz, auto-switching 80 Watt
IMU:	Power provided by PCS
GPS Antennas:	Power provided by PCS

Environmental

Temperature Range (Operating)

IMU:	-40 °C to +60 °C	-40 °F to +140 °F
Processor:	0 °C to +55 °C	+32 °F to +131 °F
GPS Antenna:	-40 °C to +70 °C	-40 °F to +158 °F

Temperature Range (storage)

IMU:	-40 °C to +60 °C	-40 °F to +140 °F
Processor:	-25 °C to +85 °C	-13 °F to +185 °F
GPS Antenna:	-50 °C to +70 °C	-58 °F to +158 °F

Humidity

IMU:	10 - 80% RH, Ingress Protection of 65
Processor:	10 - 80% RH, non-condensing
GPS Antenna:	0 - 100% RH

Shock & Vibration (IMU)

Operating:	90 g, 6 ms terminal saw tooth
Non-Operating:	220 g, 5 ms half-sine

Applanix Marine Offices

Applanix Corporation
85 Leek Crescent
Richmond Hill, Ontario
Canada L4B-3B3

Tel: +1 905-709-4600
Fax: +1 905-709-6027

Applanix LLC
17461 Village Green Drive
Houston, TX
USA 77040

Tel: +1 713-896-9900
Fax: +1 713-896-9919

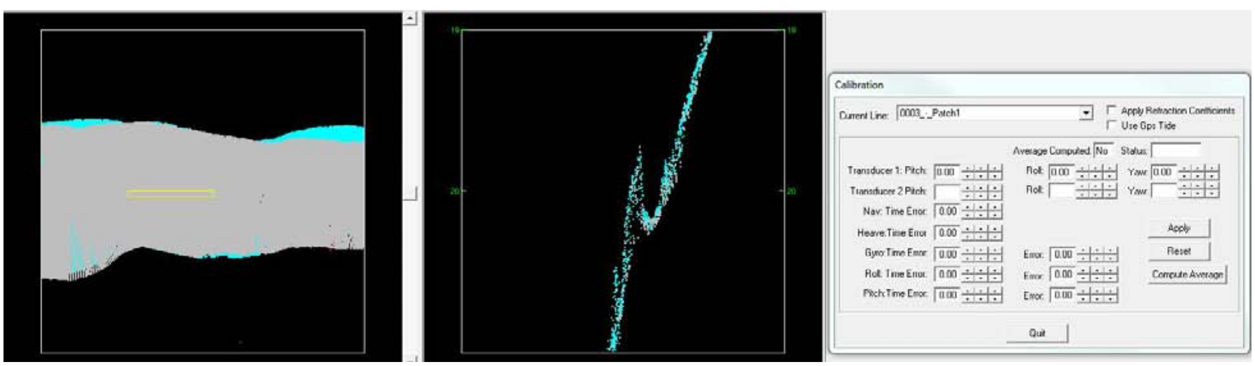
Applanix United Kingdom
Forester's House,
Old Racecourse, Oswestry
SY10 7PW UK

Tel: +44 1691 659359
Fax: +44 1691 659299

Reson 7125 Calibration Report

Navigation Timing Calibration:

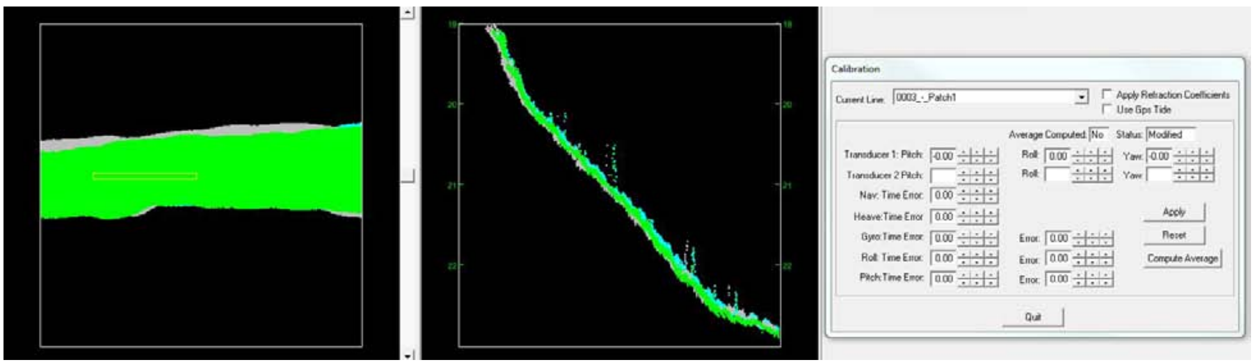
In order to isolate navigation timing errors, two lines were run in the same direction at different speeds with matching nadirs. No navigation timing errors were found in either vessel (M/V Nooit Volmakt and R/V Resolution). See Below:



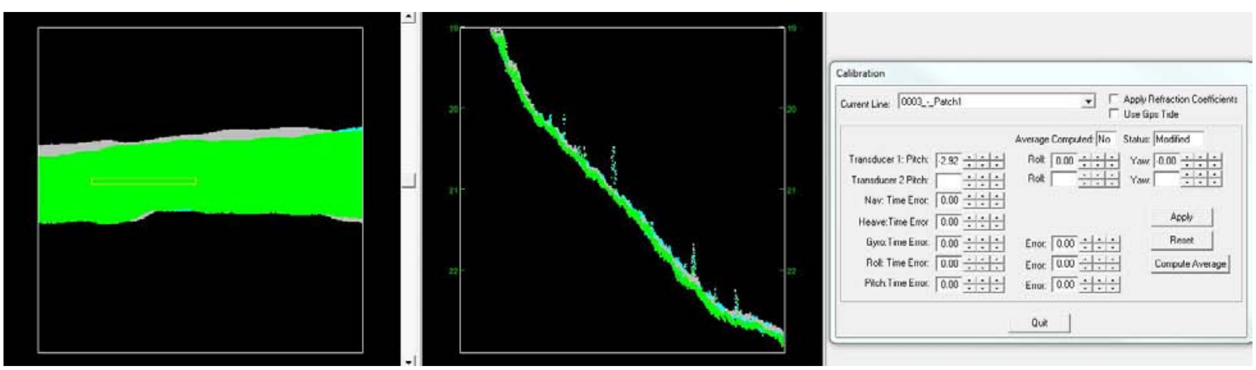
Calibration Tool in CARIS showing Navigation Timing Corrections

Pitch Calibrations:

In order to isolate pitch errors, two lines were run at similar speeds in opposite with matching nadirs. Pitch errors were found for each vessel (M/V Nooit Volmakt and R/V Resolution). These were corrected for in the CAIRS Vessel Configuration File (digitally submitted).



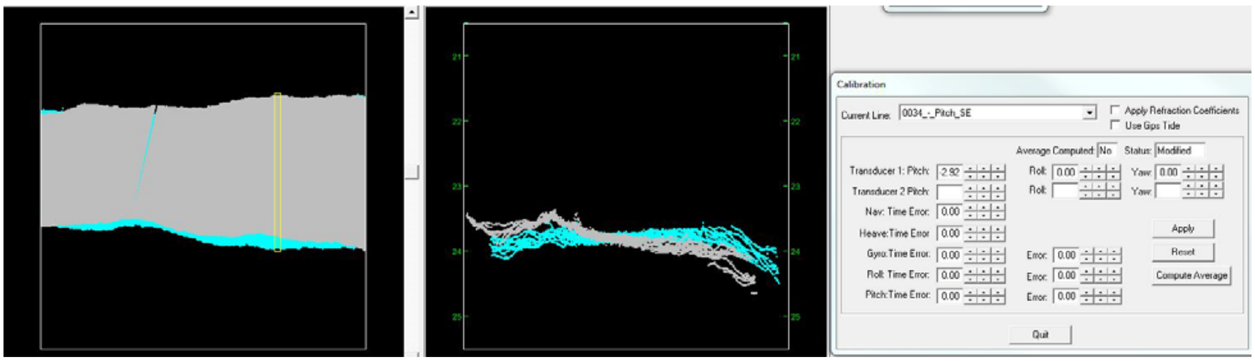
Calibration Tool in CARIS showing uncorrected Pitch (above)



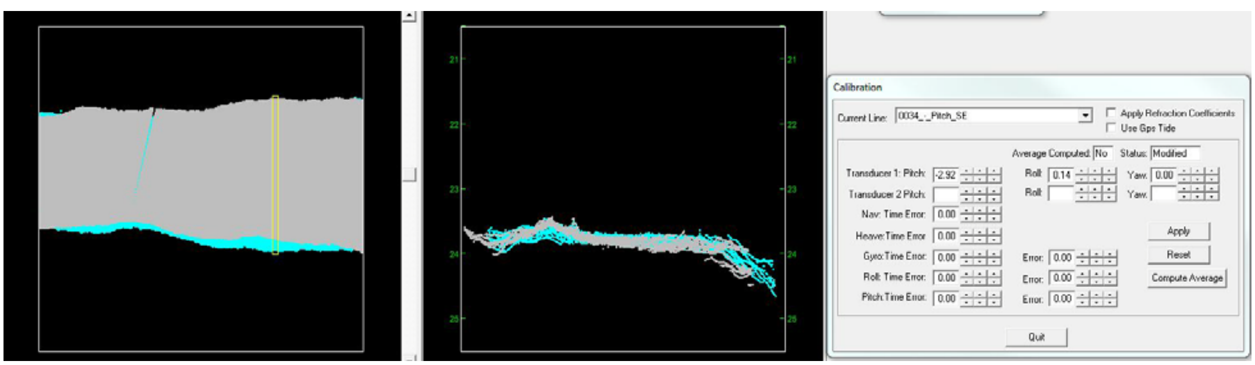
Calibration Tool in CARIS showing corrected Pitch (above)

Roll Calibrations:

In order to isolate roll errors, two lines were run at similar speeds in opposite with matching nadirs. Roll errors were found for each vessel (M/V Nooit Volmakt and R/V Resolution). These were corrected for in the CAIRS Vessel Configuration File (digitally submitted).



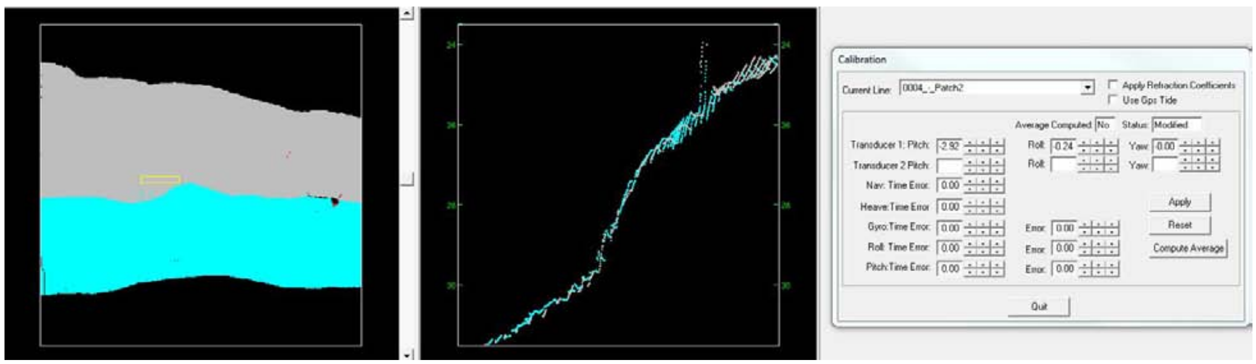
Calibration Tool in CARIS showing uncorrected Roll (above)



Calibration Tool in CARIS showing corrected Roll (above)

Yaw Calibrations:

In order to isolate yaw errors, two lines were run at similar speeds in opposite with overlapping swath edges. Yaw errors were found for each vessel (M/V Nooit Volmakt and R/V Resolution). These were corrected for in the CAIRS Vessel Configuration File (digitally submitted).



Calibration Tool in CARIS showing corrected Yaw (above)

R/V
NOOIT VOLMAAKT
BOAT SURVEY

PREPARED FOR:

Williamson & Associates
1124 NW 53rd Street Seattle, Washington 98107

PREPARED BY:

LANDMARK CORPORATION
SURVEYORS & ENGINEERS

219 Meadow Street Rockport, Maine 04856
(207) 236-6757

July 10, 2012

LANDMARK CORPORATION

SURVEYORS & ENGINEERS

MARK W. INGRAHAM, PLS   K. MARK BARBOUR, PLS   MICHAEL J. SABATINI, P.E.

July 10, 2012

Kyle Fankhauser
Williamson & Associates
1124 53rd Street
Seattle, WA 98107

Re: Nooit Volmaakt
Boat Survey Report
LC Proj. No. 12-080

Dear Kyle:

The following is a Boat Survey Report as requested.
Measurements:

Measurements were taken on the 22 foot research vessel *Nooit Volmaakt* which is a Hewescraft 220 Ocean Pro at Snow Marine Park on Mechanic Street in Rockland Maine on July 3, 2012. The boat was parked and leveled prior to measuring. A Sokkia Set 5-30R 5-second total station and mini reflector prism were used to measure spot elevations at certain locations on the boat. (See Exhibit A). A base line was setup using two stations. Angles and distances were then measured from this baseline and recorded with an Allegro CE data collector. Station 1 was assigned a beginning coordinate of N 5000 E 5000 and an assumed elevation of 100.00.

Point Data:

The field data was downloaded from the data collector into an AutoCAD drawing. Point #3 (reference point C) was created in the drawing with a Northing and Easting (X,Y) of (0,0) and an elevation (Z) of (0.00). All points in the drawing were then moved to reference point (C) and rotated such that a line between Reference points A & B is pointing north zero degrees east (N 0° E) and perpendicular to reference point C.

The coordinates of these points were then converted from U.S. feet to meters by a factor of (0.3048). Elevations were also adjusted from U.S. feet to meters with positive pointing to the water side or downside of the boat. (See Exhibit B). Reference point (C) was inaccessible and therefore could not be located directly by the total station from a setup. The horizontal and vertical position of Point (C) was measured manually by an offset from reference points (A) & (B). A photo of where each point data was measured is provided in Exhibit (C).

219 MEADOW STREET   ROCKPORT, MAINE   04856
PHONE: (207) 236-6757   FAX: (207) 470-7020
WWW.LANDMARKMAINE.COM

Company Profile:

Landmark Corporation Surveyors & Engineers has provided land surveying services, including, boundary, topographic, hydrographic surveys, and FEMA elevation certificates for various clients in Maine since 1988. Civil engineering services were added in 2000. Our staff consists of two licensed Professional Land Surveyors (PLS), two licensed Professional Engineers (PE), and one licensed surveyor in training (LSIT) along with other support staff.

I hope this information is helpful. Please let me know if we can be of further service.

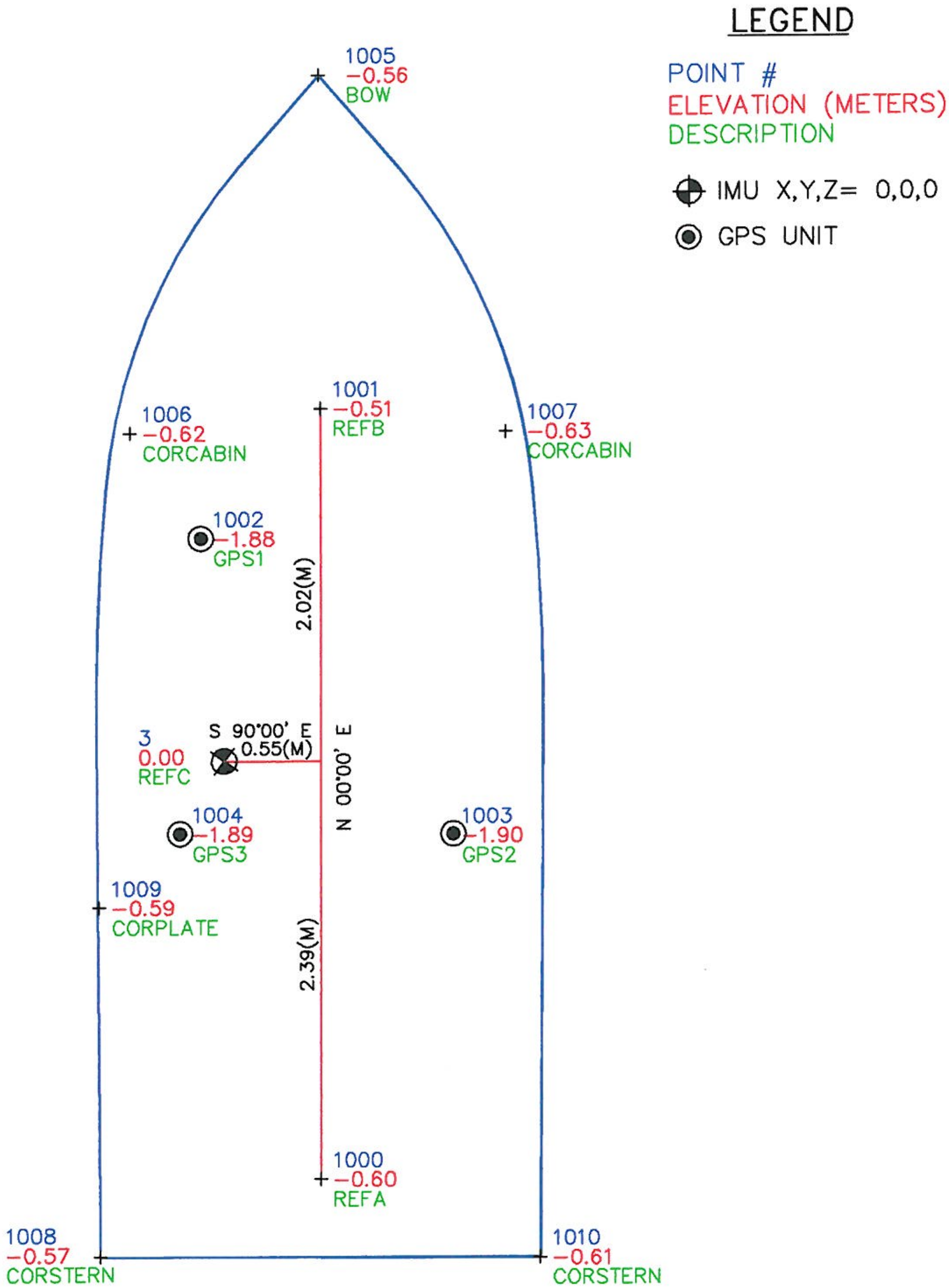
Sincerely,

Landmark Corporation Surveyors & Engineers

Mark W. Ingraham, III
PLS #1339

EXHIBIT A

R/V NOOIT VOLMAAKT



LANDMARK CORPORATION
SURVEYORS & ENGINEERS
219 MEADOW STREET ROCKPORT, MAINE 04856 PHONE: (207) 236-6757 WWW.LANDMARKMAINE.COM

SKETCH PLAN FOR
WILLIAMSON & ASSOCIATES
MECHANIC STREET ROCKLAND, MAINE

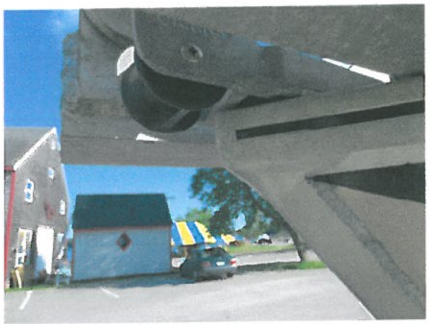
SCALE: N.T.S.	JOB # 12-080	JULY 10, 2012

EXHIBIT B

Williamson & Associates
Nooit Volmaakt
Boat Survey
Rockland, Maine
7/3/2012

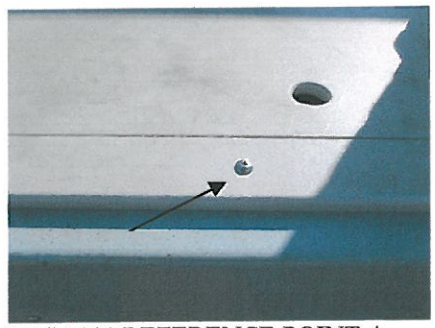
Number	Northing	Easting	Elevation	Desc
3	0	0	0	REFC
1000	-2.3927	0.5456	-0.6	REFA
1001	2.0218	0.5456	-0.51	REFB
1002	1.2787	-0.1306	-1.88	GPS1
1003	-0.4188	1.3029	-1.9	GPS2
1004	-0.4164	-0.2514	-1.89	GPS3
1005	3.9341	0.5377	-0.56	BOW
1006	1.8839	-0.5357	-0.62	CORCABIN
1007	1.8864	1.602	-0.63	CORCABIN
1008	-2.8343	-0.7071	-0.57	CORSTERN
1009	-0.8367	-0.7129	-0.59	CORPLATE
1010	-2.8401	1.7953	-0.61	CORSTERN

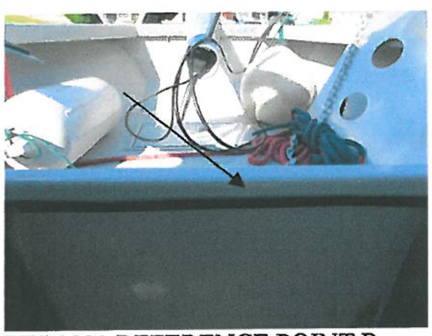
EXHIBIT C
LOCATION OF SPOT ELEVATIONS TAKEN ON BOAT


PT # 1005 BOW

PT# 1008 CORNER STERN (PORT)

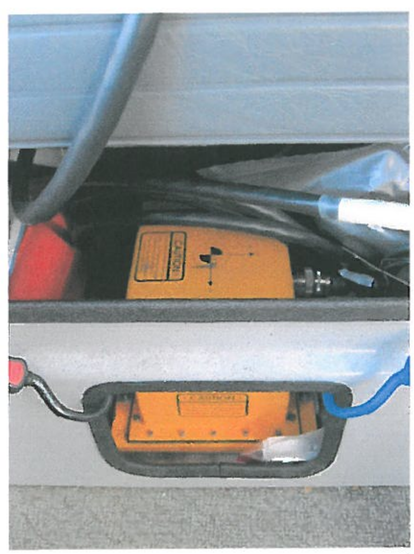
PT # 1008 CORNER STERN (STARBOARD)


PT # 1000 REFERENCE POINT A


PT# 1001 REFERENCE POINT B


PT# 1009 CORNER OF PLATE (PORT)


PT# 1003 GPS UNIT (TYP.)


PT #3 REFERENCE PT. C (IMU)

R/V
RESOLUTION
BOAT SURVEY

PREPARED FOR:

Williamson & Associates
1124 NW 53rd Street Seattle, Washington 98107

PREPARED BY:

LANDMARK CORPORATION
SURVEYORS & ENGINEERS

219 Meadow Street Rockport, Maine 04856
(207) 236-6757

July 23, 2012

LANDMARK CORPORATION

SURVEYORS & ENGINEERS

MARK W. INGRAHAM, PLS K. MARK BARBOUR, PLS MICHAEL J. SABATINI, P.E.

July 22, 2012

Kyle Fankhauser
Williamson & Associates
1124 53rd Street
Seattle, WA 98107

Re: R/V Resolution
Boat Survey Report
LC Proj. No. 12-085

Dear Kyle:

The following is a Boat Survey Report as requested.
Measurements:

Measurements were taken on the 54 foot research vessel *Resolution* at Journey's End Marina, located at Tillson Avenue in Rockland Maine on July 15, 2012. The boat was in the water and measurements were taken at low tide, 3:04 pm (EST). A Sokkia Set 5-30R 5-second total station and mini reflector prism were used to measure spot elevations at certain locations on the boat (See Exhibit A). A base line was setup using two stations. Angles and distances were then measured from this baseline and recorded with an Allegro CE data collector. Station 1 was assigned a beginning coordinate of N 5000 E 5000 and an assumed elevation of 100.00. It should be noted that several boats entered the marina causing a wake which made the vessel pitch and roll at the time of measurements

Point Data:

The field data was downloaded from the data collector into an AutoCAD drawing. Point #100 (reference point C) was created in the drawing with a Northing and Easting (X,Y) of (0,0) and an elevation (Z) of (0.00). All points in the drawing were then moved to reference point (C) and rotated such that a line between Reference points A & B is pointing north zero degrees east (N 0° E) and perpendicular to reference point C.

The coordinates of these points were then converted from U.S. feet to meters by a factor of (0.3048). Elevations were also adjusted from U.S. feet to meters with positive pointing to the water side or hull of the boat. (See Exhibit B). The location of where each point was measured is shown in Exhibit (C).

219 MEADOW STREET ROCKPORT, MAINE 04856
PHONE: (207) 236-6757 FAX: (207) 470-7020
WWW.LANDMARKMAINE.COM

Company Profile:

Landmark Corporation Surveyors & Engineers has provided land surveying services, including, boundary, topographic, hydrographic surveys, and FEMA elevation certificates for various clients in Maine since 1988. Civil engineering services were added in 2000. Our staff consists of two licensed Professional Land Surveyors (PLS), two licensed Professional Engineers (PE), and one licensed surveyor in training (LSIT) along with other support staff.

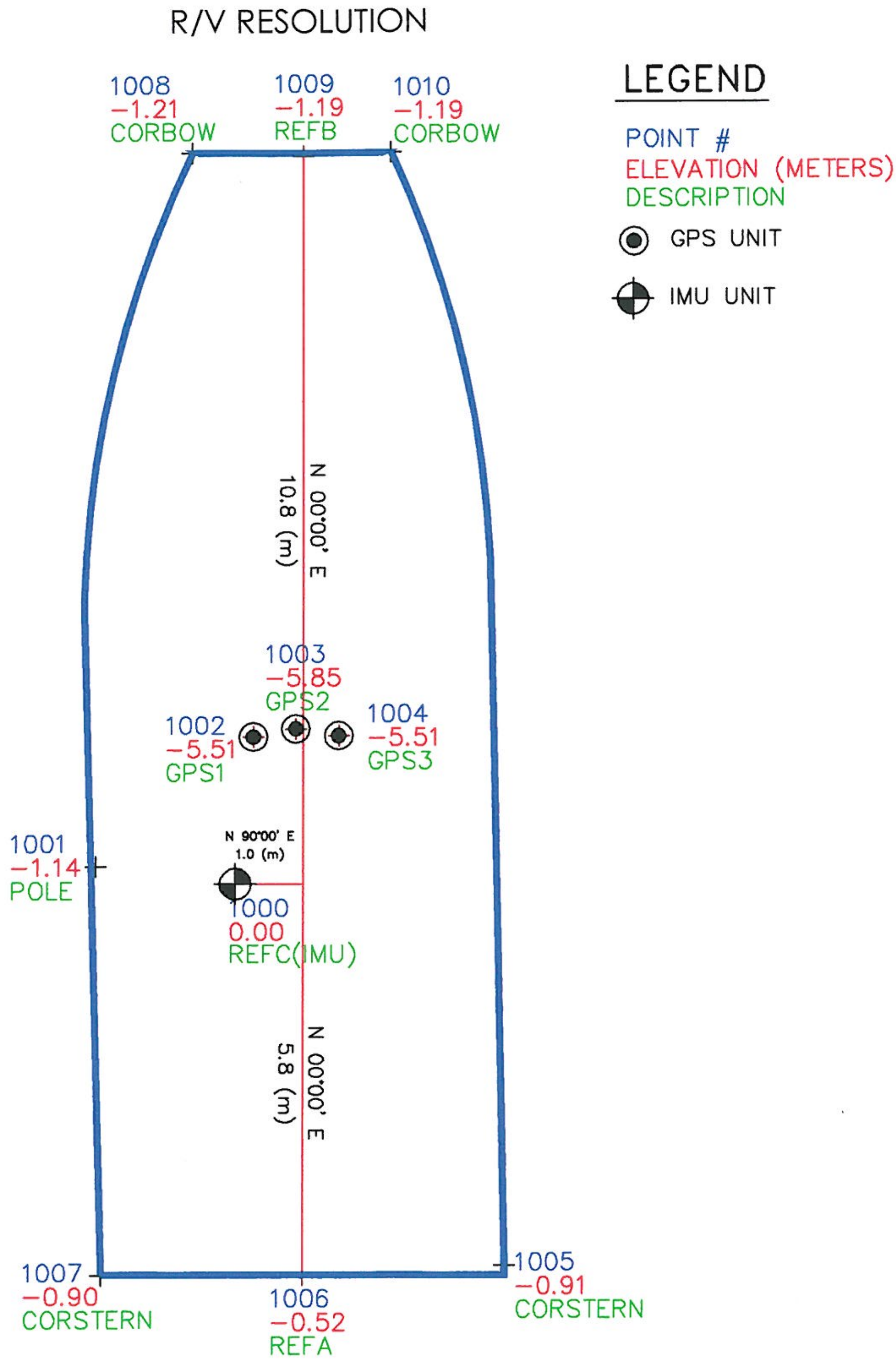
I hope this information is helpful. Please let me know if we can be of further service.

Sincerely,

Landmark Corporation Surveyors & Engineers

Mark W. Ingraham, III
PLS #1339

EXHIBIT A



LANDMARK CORPORATION
SURVEYORS & ENGINEERS
219 Meadow Street Rockport, Maine 04856 Phone: (207) 236-6757 www.landmarkmaine.com

SKETCH PLAN FOR WILLIAMSON & ASSOCIATES JOURNEY'S END MARINA ROCKLAND, MAINE		
SCALE: N.T.S.	JOB # 12-085	JULY 22, 2012

EXHIBIT B

Williamson & Associates
R/V Resolution
Boat Survey
Rockland, Maine
7/15/2012

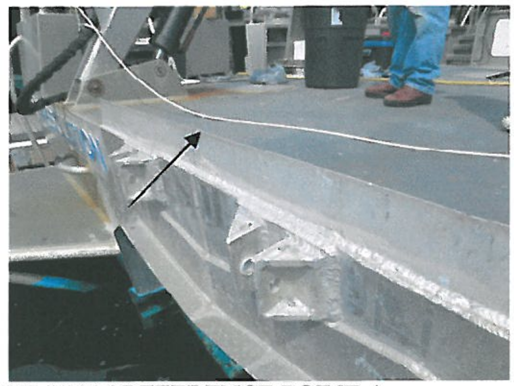
Number	Northing	Easting	Elevation	Raw Desc	Full Desc
1000	0	0	0	REFC	REFC
1001	0.2606	-2.0684	-1.14	POLE	POLE
1002	2.1814	0.2645	-5.51	GPS1	GPS1
1003	2.3014	0.8926	-5.85	GPS2	GPS2
1004	2.199	1.5269	-5.51	GPS3	GPS3
1005	-5.6546	3.9893	-0.91	CORSTERN	CORSTERN
1006	-5.7982	1.0005	-0.52	REFA	REFA
1007	-5.8075	-1.9854	-0.9	CORSTERN	CORSTERN
1008	10.8527	-0.6459	-1.21	CORBOW	CORBOW
1009	10.8136	1.0005	-1.19	REFB	REFB
1010	10.8679	2.2918	-1.19	CORBOW	CORBOW

EXHIBIT C
LOCATION OF SPOT ELEVATIONS

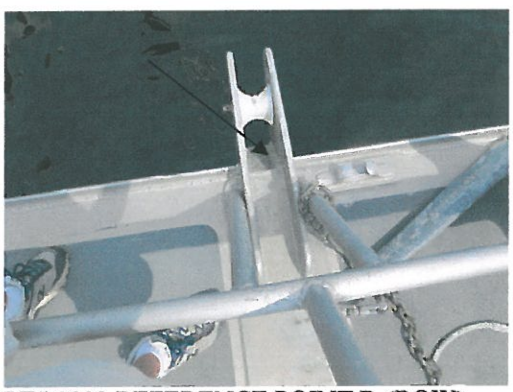
PT # 1008 BOW (PORT)

PT# 1010 BOW (STARBOARD)

PT # 1007 CORNER STERN (PORT)



PT # 1006 REFERENCE POINT A



PT# 1009 REFERENCE POINT B (BOW)

PT# 1001 POLE BASE (PORT)

PTS# 1002, 1003, 1004 GPS UNITS (TYP.)

PT #1005 CORNER STERN (STARBOARD)