



**Bay St Louis, MS
New Marina and Bay Waveland Yacht Club**

14USM02 Data Acquisition and Processing Report

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Product Scale	1:500 1:750 1:5000
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Vertical Datum	MLLW
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ENC Affected	US5MS11M, US4MS10M, US3GC04M, US2GC09M, US1GC09M
Prior Surveys	H11617 (2007), 11USM01 (2011)

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Introduction

The purpose of the survey was to provide the Bay-Waveland Yacht Club (BWYC) as well as the city of Bay St. Louis information about their respective marinas with regards to silting and access to deep water. This was accomplished with a high resolution Multi-Beam Echo-Sounder (MBES) and Side Scan Sonar (SSS) System to check existing chart information as well as historical data, in addition, a phase-differencing bathymetric sonar (PDBS) was used to verify functionality and compare to the MBES for accuracy.

The survey area was divided into three sub-areas denoted 1, 2 and 3. Area 1 is the Bay-Waveland Yacht Club and is principally concerned with silting in and around the immediate area. Area 2 is the Bay St. Louis new marina and they are concerned with boat draft clearance and the effectiveness of dredging. Area 3 is the area and channel between the two marinas, identifying the deep water out to the 2 m contour.

Side-Scan Sonar (SSS) coverage for areas 1, 2, and 3 is shown in figure 1. MBES coverage with the Odom MB1 for both areas 1, 2, and 3 are shown in figure 2 and the coverage with the EdgeTech 4600 can be seen in figure 3.

The survey was conducted to the NOAA 1m object detection survey requirements; however due to a lack of targets a smaller object detection standard was used. If an object was found with a length or width of 1m or greater and/or the object protruded from the bottom by 0.3m or greater, it was also included in the report. The survey was done to International Hydrographic Organization (IHO) Order 1a standards as required.

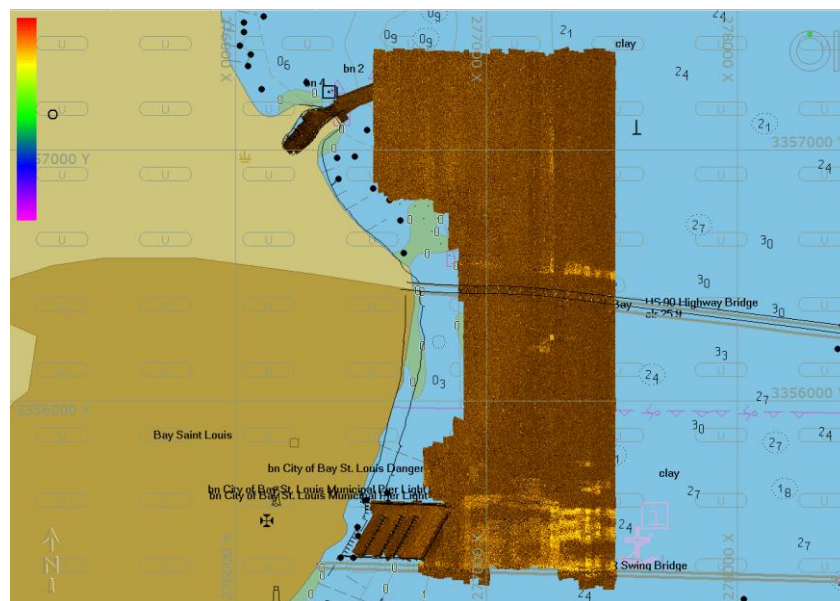


Figure 1 SSS Coverage

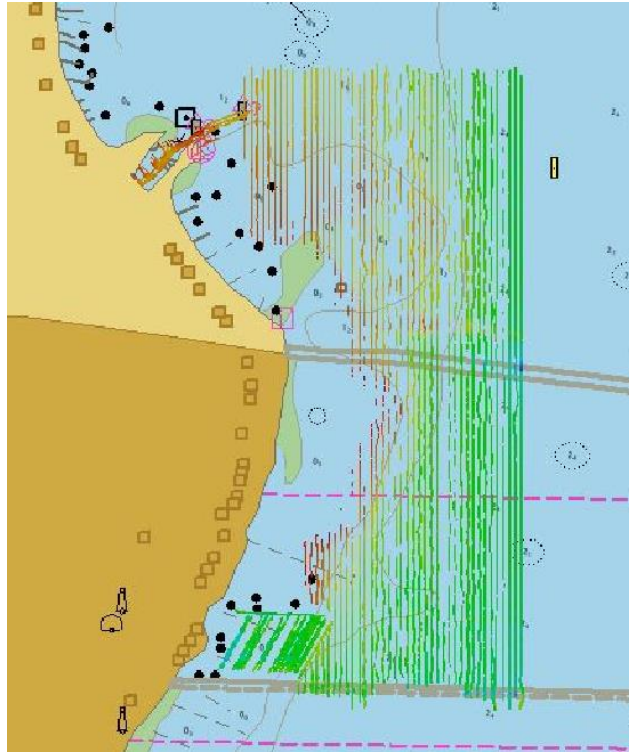


Figure 2 MB1 Coverage

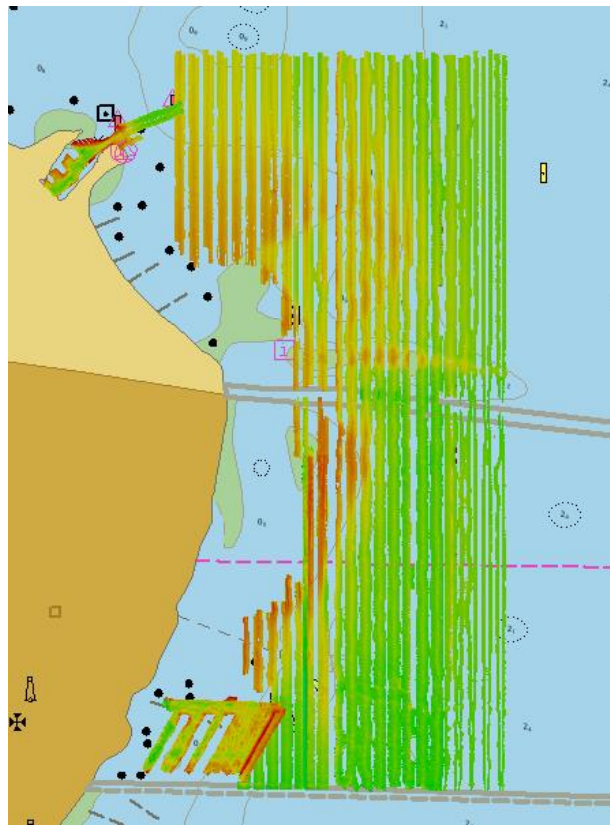


Figure 3 EdgeTech MB Coverage

A Equipment

All the major equipment used during the survey is listed in the table 1

Task	Equipment	Model	Serial Number	Use
Vessel Configuration Survey	Total station	Leica TS02	216915	Angular and distance measurements
	Tripods	Seco Tri-Max	N/A	
	Tribrach	Leica GDF112	180	
	Prisms and rod	GPM111	187	
	Prism	GPR111	185	
	Reflective sheet	N/A	N/A	
	Measuring tape	Fiberglass 60m	N/A	
Shorelining	Topcon GNSS receiver	TopCon GR-3	433-0511	Shoreline positioning
	Rover Rod wheel	TopCon GPS Milimeter	22-050908-01	Shoreline positioning
Leveling Operations	Three wire automatic level	Leica NA 2002	USM 182874	Benchmark leveling
	Leveling rods	Leica NA 2002	N/A	Benchmark leveling
	Topcon GNSS receiver	TopCon GR-3	433-0511	Benchmark positioning
On Water Operations				
Motion Reference	IMU	Applanix	623067054	Heave/pitch/roll measurement
	POS computer system	POS MV V4	2791	Motion processor and interface
	Trimble GNSS antenna	Zephyr model 2	1440912441	Primary POS GNSS antenna
	Trimble GNSS antenna	Zephyr model 2	30939221	Secondary POS GNSS antenna
Positioning	CNAV GNSS antenna	ANT3001R	5906	Primary navigation
	CNAV GNSS receiver	CNAV 3050	12462	Primary navigation
	Trimble GNSS antenna	Zephyr geodetic	12681297	Backup navigation
	Trimble GNSS receiver	Trimble NetRS	4440239259	Backup navigation
Data Acquisition	"Field 2" laptop	Dell Latitude E6510	214471	CNAV logging, MB1 Controller and HYPACK data acquisition
	MB1 multibeam sonar	Teledyne Odom Demo 2	100126	Bathymetry
	MB1 multibeam processor	Teledyne Odom MB1	220047	Bathymetry
	Edgetech 4600 sonar	Edgetech 4600	215070	Phase differencing bathymetry and SSS
	Edgetech 4600 sonar Interface	Edgetech 4600	40282	Controls sonar
	Edgetech 4600 processor	Edgetech 4600	40182	Edgetech 4600 computer, QINSy and POS MV Controller
	Edgetech 4600 casing	Edgetech 4600	40283	
	Sound velocimeter	Odom Digibar Pro 1200 probe and handheld unit	214819	Sound speed determination
	Tide Staff x2			Graduated rod for measuring water level
	Tide Gauge	In-Situ Level Troll 700	144380	Automatic tidal measurement and recording
	Seabed sampler	Wildco Petite Ponar Grab	N/A	Analysis of seabed samples
Miscellaneous	LAN Hub	Netgear	2362155G0222E	Networking
	UPS	ACP	JB0638033009	Uninterrupted power supply
	Monitor	Dell	KR-006HRM-47602-17R-ARXS	display
	Monitor	Dell	MX-07R477-48323-38K-OFD7	display
	External Hard Disk	Lacie	N/A	Backup
	Measuring Tape	Fiberglass 60m	N/A	Measure draft

Table 1 Survey Equipment

A.1 Major Operational Systems

The main hardware used for the survey were the Odom MB1 MBES and the EdgeTech 4600 phase differencing bathymetric and side scan sonar which were supported by the Applanix POSMV for motion sensing. These key systems and equipment as well as the appropriate software, were used in order to achieve the required standard and are described here under.

A.2 Survey Vessel

The new USM skiff, 'A1' was used for data collection during the summer project. This skiff has a flat bottom hull and is constructed of aluminum. It is 6.3 m long, 2.5m width a draft of 0.20m. The vessel is shown in figure 4.



Figure 4 Aluminum Skiff

The skiff was mobilized with over-the-side pole mounts for the MB1 and the EdgeTech 4600 on 11 June 2014. The vessel remained mobilized throughout the survey period.

The offset measurements of the sensors on the vessel, together with their uncertainties, were determined from a vessel configuration survey (VCS) conducted on 04 June 2014. A baseline was established inside the AC Bay, using multiple observations taken via total station to previously selected targets. The VCS was conducted indoors due to rain. The results of the VCS are included in section C.1.1 and appendix I.

Where points could not be completely determined, such as the MB1 and EdgeTech 4600 acoustic center, tape measurements were taken from the reference marks. For further information on how these measurements were used in Caris Hydrographic Information Processing System (HIPS), see section C.1.

Vessel configuration values were validated with a calibration survey (Patch test) conducted on 18 June 2014. For further information on the calibration surveys conducted, see section C.1.2.

A.3 Multibeam Echosounders

A.3.1 MB1

Bathymetric data was collected using the Odom Teledyne MB1 MBES with an integrated sound velocity profiler (SVP), mounted onto a steel maneuverable pole located on the port side of the vessel. The pole was held in place using steel brackets. Figure 5 shows the pole mounted system in the deployed position.



Figure 5 Odom MB1 Multibeam

The MB1 MBES operates between 170-220 kHz, producing a swath of up to 120° with a maximum of 512 beams per ping. The maximum ping rate that can be achieved by this system is 60 Hz.

During the survey, the MBES was operated at 219 kHz using the maximum swath width (120°) due to the shallow nature of the survey area. The number of beams was set to 120.

The actual ping rate achieved was generally 35 pings per second.

A.3.2 EdgeTech 4600

The EdgeTech 4600 swath bathymetry system was used in parallel to the MB1 for bathymetric data collection.

The EdgeTech4600 was also used for feature detection in accordance with NOAA Object Detection [NOAA, 2014] and IHO Order 1a requirements [IHO, 2008] and to assist in bottom topography characterization.

It was mounted onto a steel maneuverable pole located on the starboard side of the vessel and was operated at 540kHz with horizontal binning applied. The maximum swath angle of 170° was used. The EdgeTech's proprietary Discover software was used to control its parameters and QINSy was used to collect bathymetry. Further information regarding the EdgeTech 4600 is present in section B.



Figure 6 EdgeTech 4600 Phase-Differencing Bathymetric Sonar

A.4 Side Scan Sonar

The EdgeTech 4600 operates at frequencies of 540 kHz. The survey was conducted using 540kHz with a range of 25m due to the shallow nature of the areas. The SSS horizontal beam width is 0.5° at 540 kHz. The EdgeTech 4600 consists of two key components. The first is the topside processing unit, which

contains a separate central processing unit (CPU), and the second is the side-mounted transducer. Sonar data was received from the transducer to the CPU in the deck unit.

The transducer was pole mounted to the starboard side of the skiff. The mount has a pivoting capability that allows the transducer to be rotated out of the water for transit purposes. The mount was stable and provided a sufficient surveying position when vertical. It resulted in the transducer being 0.73 m below the surface of the water. Throughout the entire survey, the pole remained vertical, and the coxswain ensured that the vessel did not exceed 6 knots. During transit to and from the survey location the mount was removed from the vessel and placed in the back of the Ford F150 for protection. The sonar and mount are shown in figure 7.



Figure 7 EdgeTech 4600 Sidescan

A.5 Position, Heading, and Motion Reference

Real-time positioning for data collection was obtained from the POSMV system supported by Real-time gypsy (RTG) from the CNAV Global navigation satellite system (GNSS). Moreover, to increase the accuracy of the survey, the raw data from the CNAV and Trimble GNSS receivers were post-processed to generate a Post Processed Kinematic (PPK) solution. For full details on the position accuracy obtained during the survey, see section B.

A.5.1 POSMV

The skiff was equipped with an Applanix POSMV Wavemaster V4 system that was connected to two Trimble Zephyr 2 GNSS Antennas in order to obtain heading. The POSMV also incorporated an Inertial Motion Unit (IMU) used to measure the vessel's attitude and heave.

Time synchronization for the sonar and acquisition systems was obtained from the POSMV by making use of a combination of National Marine Electronics Association (NMEA) "ZDA" timing messages and an analog Pulse Per-Second (PPS) signal.

The POSMV was configured to log all raw Ethernet POSPac packet data at 50Hz which was to be used to apple delayed heave. The POSMV, antenna and IMU are shown in figure 8.



Figure 8 POSMV, Antenna, and IMU

A.6 Sound Velocity Measurement System

A.6.1 Odom Digibar Pro

An Odom Digibar Pro velocimeter was used to collect manual sound velocity casts during the survey. Generally casts were taken at the beginning, middle, and end of the survey and when surveying a new site located away from the previous cast. The Digibar Pro system is shown in figure 9.



Figure 9 The Digibar Pro System

A.7 Geodetic and Tidal Equipment

Benchmark leveling, geodetic observations and tidal observations were conducted using the equipment detailed in table 1. Prior to each use, the Leica NA2002 level was checked for collimation error by performing a collimation or C-check.

The Level TROLL 700 tide gauge was user calibrated in the 1.5m test tank against a graduated staff in building 1029 prior to deployment as well as after removal. The results of the calibration confirmed that the gauge measurement accuracy was within the $\pm 0.001\text{m}$ requirement stipulated in NOAA Specifications and Deliverables.

For further information regarding geodetic/tidal equipment, calibration and associated data processing refer to the Vertical and Horizontal Control Report.

A.8 Seabed Sampler

A Wildco Petite Ponar Grab was used to collect and analyze seabed samples throughout the survey. The grab sampler has a self-releasing pinch-pin which allows samples to be collected upon impact with the seabed. UTC time and GNSS position were noted at the impact of the sampler. Samples were assessed real-time. The sampler is shown in figure 10.



Figure 10 Bottom Sampler

A.9 Acquisition and Processing System

The software suites and the versions used throughout the survey and processing are listed in Table 2.

Task	Software	Version	Use
Data Collection	Win-Situ 5	5.6.21.0	Automatic tidal measurement and recording
	Edgetech Discover Bathymetric	33.0.1.112	Edgetech 4600 side scan logging
	QINSy Console	8.10	Edgetech 4600 bathymetry logging
	HYPACK	13.0 13.0.0.6	MB1 bathymetry logging
	Applanix MV-POS Controller	6.05	Motion control and logging
	C-NAV C-Setup	7.0.5	CNAV control and logging
	Internet Explorer	11.0.960.17107	Trimble NetRS Control and logging
	Image	1.1.13	MB1 bathymetry Controller and real time processing
Data Processing	PC-CDU	7.12	Configuring and downloading TOPCON GNSS data
	RINEX Utility	3.6	Converting CNAV GNSS data to RINEX format
	Convert to RINEX - TBC utility	2.1.4.0	Converting Trimble GNSS data to RINEX format
	GrafNav	8.30.2105	Kinematic and static GNSS post processing
	CARIS HIPS and SIPS	8.1.7 and 8.1.8	Multibeam processing
	SonarWiz 5	5.05.0023	Side Scan Sonar processing
	MATLAB R2013b	8.2.0.701	Data manipulation
	ARCGIS	10.2.2	Chart and ENC production
	NAVOTAS	4.2.5.0	Tide zoning calculation
	Tide Analyst	4.2.0.0	Analysis of tide

Table 2 Software

A.9.1 QINSy

QPS QINSy was used to record bathymetric data from the Edgetech 4600 and was also used to create a sounding grid to monitor coverage gaps. QINSy created 2 line files per survey line due to the dual-head nature of the EdgeTech 4600. When these files were imported to Caris for processing, unresolvable distortion and misalignment problems occurred. In order to process the EdgeTech data, the raw .jsf files were imported into Caris.

Sensor inputs for attitude, GNSS, timing, and sonar were also monitored through the use of visual time-out alarms. This ensured that all sensors could be monitored for correct and consistent output during sounding.

A.9.2 EdgeTech Discover

EdgeTech's Discover software was used for the acquisition of SSS data. It was configured to log data in the JSF format. The Discover software was set up to run on the EdgeTech topside computer, with position and timing information provided from the POSMV. During the SSS acquisition, both the QINSy and Discover displays were monitored simultaneously through the EdgeTech computer via two mounted

monitors. Discover was used for SSS data logging and coverage mapping functions, while QINSy was essentially used to acknowledge overlap and log the bathymetry data from the EdgeTech as .QPD files.

A.9.3 Caris HIPS

Bathymetric survey data was processed using CARIS HIPS version 8.1.8. Processing methodology followed the CARIS HIPS workflow for ellipsoid referenced surveys as outlined in the NOAA Field Procedures Manual [NOAA, 2014]. The workflow is detailed in appendix II.1. Processing methodology and results are described in more detail in section B.

A.9.4 Chesapeake SonarWiz 5

All of the SSS data processing was done via Chesapeake SonarWiz 5. The .jsf files that were recorded in discover, were converted to SonarWiz native format for processing. Further information regarding the SSS data processing conducted with SonarWiz 5 can be found in section B.2.

B Quality Control

B.1 Multibeam Echosounder

B.1.1 Data Acquisition

The EdgeTech 4600 bathymetry was collected using QINSy; while, MB1 data was collected using Hypack 2013. Settings for both systems were checked for proper operation and performance prior to start of daily survey.

Timing was synchronized for both echosounders via PPS signal from the POSMV.

Survey speed was 5 knots for area 3 and 2.5 knots for the marina and yacht club. Speed was restricted in the marina and yacht club as they are no wake zones. The line spacing can be seen in table 5. Due to the shallow depths, 100% multibeam coverage was not attainable and side scan was used to ensure 100% seafloor coverage was met.

EdgeTech

KEY SPECIFICATIONS		
SYSTEM		
Sonar Frequency (choice of one or the other)	230 kHz	540 kHz
Side Scan Sonar Swath Coverage	450 m	250 m
Bathymetric Swath Coverage	10-12 times altitude, 350 m swath	10-12 times altitude, 150 m swath
Side Scan Sonar Range Resolution	3 cm	2 cm
Bathymetric Range Resolution	6 cm	3 cm
Side Scan Sonar Horizontal Beamwidth	0.64 degrees	0.5 degrees
Bathymetric Vertical Resolution	5 cm	3 cm
Pulse Bandwidth	24 kHz	54 kHz
Max Depth Below Transducers	120 m	50m
Pulse Modulation	CW & CHIRP	
Array Elements	1 Transmit and 8 Receive per side	
Ping Repetition Rate	Both channels simultaneously, up to 50 Hz	
Pulse Length	15 μs (CW) to 1.1 ms (CHIRP)	
Port/Starboard Crosstalk	< 60 dB	

Table 3 Manufacturer’s specifications EdgeTech 4600 (Red box indicates the model owned by USM)

MB1

Prior to the data acquisition MB1 settings is modified from its default status in order to meet the survey requirement. Value ranges for key settings used throughout data acquisition are shown in Table 4.

Property	Value
Frequency	219kHz
Transmit Power	4 dB
Range	5m
Pulse width	45.5 μ s
Horizontal Steering	0 °
Coverage Angle	120 °
Auto range scale	3
Maximum Rate	60 p/s
Achieved Rate	35 p/s

Table 4 MBES Controller Value Ranges

Line spacing for different survey areas are shown in Table 5

Area	Planned spacing
BWYC	10 m
New Marina	10 m
Area 3	20 m

Table 5 MBES Main Scheme Coverage

B.1.2 Data Consistency

EdgeTech

The EdgeTech PDBS is considered a dual-headed system. Prior to recording any data, a discrepancy was noticed between the port and starboard sides. This problem was reported to EdgeTech Support, but went unresolved in the time allotted for this survey and may have played a role in the condition of the data.

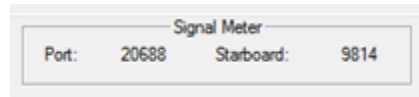


Figure 11 Discover Signal Meter

Data acquired from the EdgeTech required a lot of processing. Larger angles from nadir were extremely inaccurate. A 70 degree angle from nadir filter was used initially to all lines. There was a lot of noise in the yacht club, marina and near the bridges. When entering and exiting the yacht club, the beams closest to nadir indicated depths in excess of 75m as shown in the figure below.

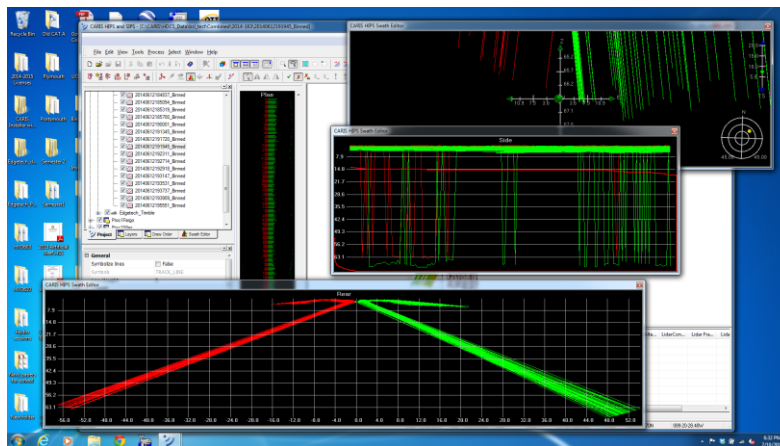


Figure 12 Swath Angle Editor (BWYC)

MB1

The internal consistency of data was generally good up to $\pm 45^\circ$ Port and Starboard. Therefore, the outer beams between $45-60^\circ$ on both side (Port and starboard) were filtered during processing using HIPS & SIPS software. See the section B.1.3 for further details.

B.1.3 Data Processing

CARIS HIPS Vessel File

The vessel file used for processing the EdgeTech data was itemized by Julian day. Two navigation sensors were used throughout the survey one is as primary (CNAV) and another as backup (Trimble). Thus, two separate Caris HIPS vessel files were created to capture both vessel configurations used. It contained Total Propagated Uncertainty (TPU) values for the vessel and equipment. These values were

based upon manufacturer specifications. The sensor layback values, as calculated in the vessel configuration survey, were included as well. Patch test values were entered for each Julian day. The same values were used for each day as the variations between days of survey were minor and did not create any significant benefit.

Sound Velocity

Sound velocity casts were generally conducted 3 times per day and upon starting a different survey area. All sound velocities were compiled into one file and the data was processed with nearest in time. The minimum and maximum sound speed was observed 1507 m/s and 1522 m/s respectively. The maximum sound speed variation observed in the same day at different time was 7m/s. All sound velocity profiles collected are included in appendix IV.

Navigation and Attitude

CNAV 3050 and Trimble GNSS units were used simultaneously to provide navigation and attitude data. The CNAV 3050 was used in real-time to provide data to the POSMV while the Trimble raw data was recorded and stored for use if necessary. The TopCon, CNAV and Trimble GNSS data were processed against the Gulf Coast Geospatial Consortium (GCGC) Continuously Operating Reference Station (CORS), which is stationed at BWYC (Station ID MSWV). This is a 1Hz reference station. All navigation coordinates were generated using the North American Datum of 1983 (NAD83) (2011/PA11/MA11) epoch 2010.0 datum. Data was exported from GrafNav into a text file and imported to replace the real-time navigation in Caris HIPS using the Generic Data Parser tool. Due to system configuration errors, the raw CNAV data was not acquired on the first 3 days of survey and the Trimble data was used for post-processing.

Area 3 survey lines consistently crossed under both the Rt. 90 bridge and CRX train bridge. These crossings created random positions and distorted the lines. The Swath Angle surface, created in Caris HIPS, indicated large height variations in the vicinity of the bridges which required meticulous data cleaning.

Position accuracy details are shown in Table 6:

Date	Julian Day	Source	Horizontal σ (m)	Height σ (m)
11 June 14	162	Trimble PPK	0.0283	0.0452
12 June 14	163	Trimble PPK	0.0218	0.0321
16 June 14	167	Trimble PPK	0.0524	0.0636
17 June 14	168	CNAV PPK	0.0686	0.0858
18 June 14	169	Trimble PPK	0.0297	0.0462
19 June 14	170	CNAV PPK	0.0732	0.0882

Table 6 Highest Observed Position Standard Deviations During MBES Sounding

Quality of GNSS data (CNAV and Trimble)

QC reports were generated after cleaning all the surveyed lines to analyze the quality of the data. In the QC report, it was revealed that on 17 June 14 (Julian day 168) 5-product lines failed to meet the survey specification requirement (Order 1a). Further investigation revealed from Grafnav software (Used to

obtain PPK solution) that though value of HDOP (horizontal Dilution of Precision) met the survey requirement but the PDOP (Position Dilution of Precision) for both Trimble and CNAV exceed the limit thereby failed to meet the required survey standard of IHO order 1a for the period 1347-1444 UTC on (17 Jun 14). Following figure shows the HDOP and PDOP values for the mentioned time:

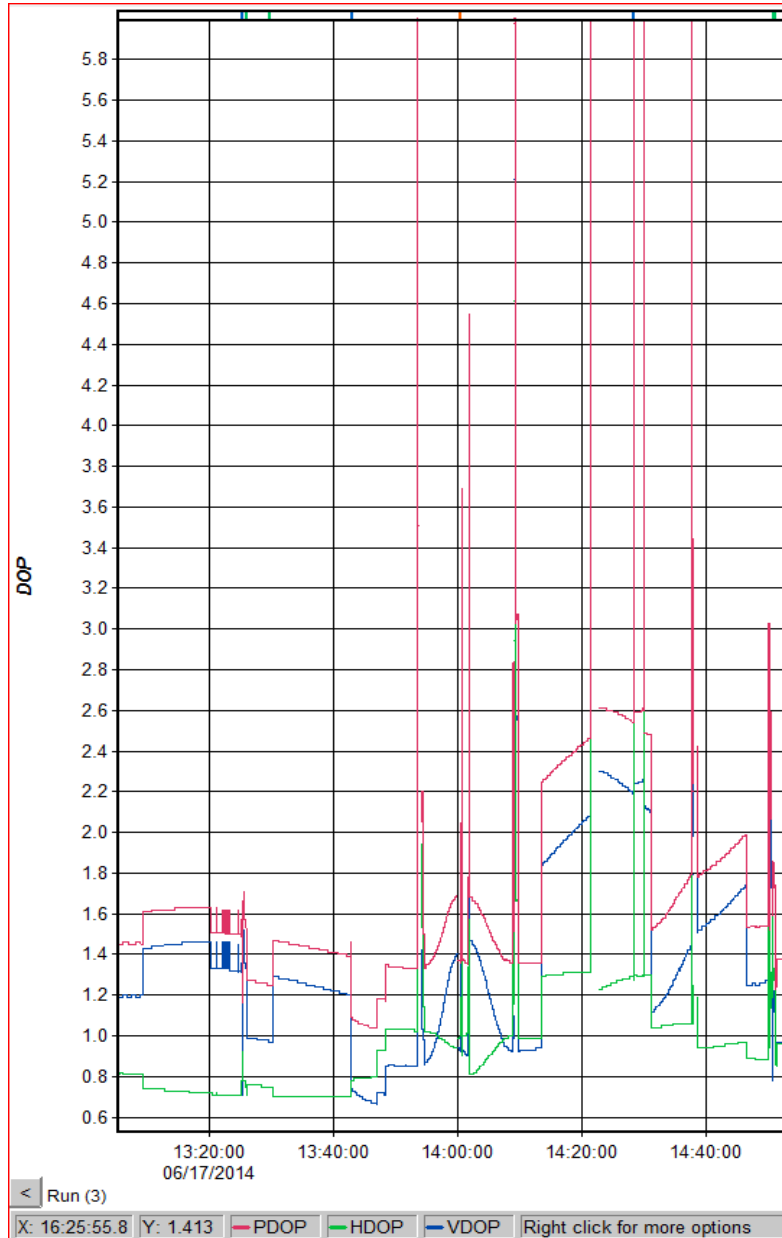


Figure 13 HDOP and VDOP value between the time period 1347-1444 UTC on (17 Jun 14)

Caris Data Processing

EdgeTech

Originally the EdgeTech bathymetry was recorded in QINSy, generating .qpd files. However due to the dual-head nature of the sonar, the software created two files (port, starboard) for each line. When these lines were viewed for processing, the software would overlap the lines vice place them side by side. As a work around, EdgeTech support working with Caris, released an update for HIPS/SIPS allowing the raw .jsf files from the EdgeTech to be converted and imported that were recorded via the Discover software. With the exception of minor adjustments by the processor, the Caris HIPS workflow is listed in appendix II.1. A significant roll error was discovered in the raw data. Numerous lines were used to acquire an acceptable value. On the recommendation of EdgeTech, Hypack's patch test software was initially used. Although the yaw, pitch, and latency values were acceptable, the roll was still producing poor quality lines as viewed from the Caris HIPS subset editor. On the recommendation from Dr. Ian Church, a Caris HIPS roll test was conducted. The value computed significantly improved the data. The Swath Angle surfaces indicated that there was a significant role that did not get corrected by delayed heave. This may be a factor of the small flat bottom boat being affected by sea surface variations. Unfortunately due to extreme time constraints, the data is not as clean as it could have been. Swath Angle surfaces were prepared for all three areas.

The Combined Uncertainty and Bathymetry Estimator (CUBE) surface was not used. According to Lisa Brisson of EdgeTech support, "The CUBE algorithm uses the sonar's range and angle uncertainties to apply filters to the data before creating the surface. You cannot create a CUBE surface because the uncertainty values for the 4600 are not within the imported HIPS/SIPS data files. We are currently working with CARIS to update their importer driver to decipher these uncertainties and correctly populate them into the CUBE algorithm. Fledermaus or Hypack does not read our uncertainties yet either. This is a new feature that we're still trying to get worked in with our third party software companies."

MB1

Multibeam data was processed following the standard Caris HIPS workflow. The normal workflow applied to all data can be seen in Appendix II.1.

Project survey areas were divided into three sections according to the survey priority. For each area one swath angle surfaces were generated from the corrected soundings. For all area swath surfaces were generated at 0.25m resolution to meet IHO order 1a conditions.

All significant bathymetric features identified were inspected to determine the shoalest sounding over the feature in the subset editor.

Crossline Comparisons

Crosslines were run perpendicular to the survey lines with a spacing of 15 times the main lines spacing in area3. Due to the limited space in the yacht club and marina, survey lines were used as cross-check lines. The lines used in the yacht club were perpendicular to each other and the lines chosen at the

marina were no less than 45 degrees of an angle to each other. The comparisons were conducted using the QC Report tool in Caris HIPS by selecting the crosslines and the associated base surface.

EdgeTech

BWYC: IHO Order 1a was accomplished

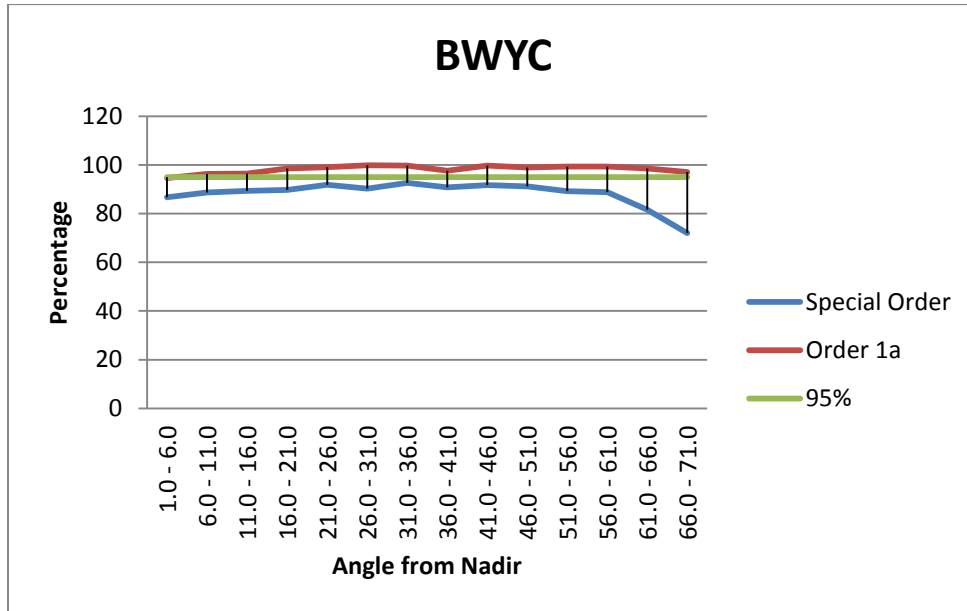


Figure 14 BWYC QC Report

Marina: IHO Order 1a was accomplished after applying a 45 degree filter from nadir

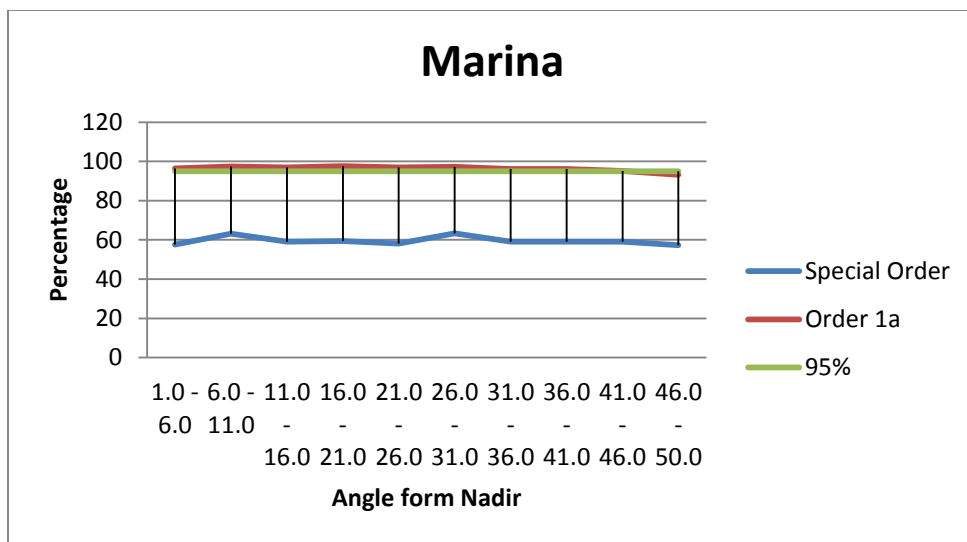


Figure 15 Marina QC Report

Area3: IHO Order 1a was accomplished after applying a 40 degree filter from nadir

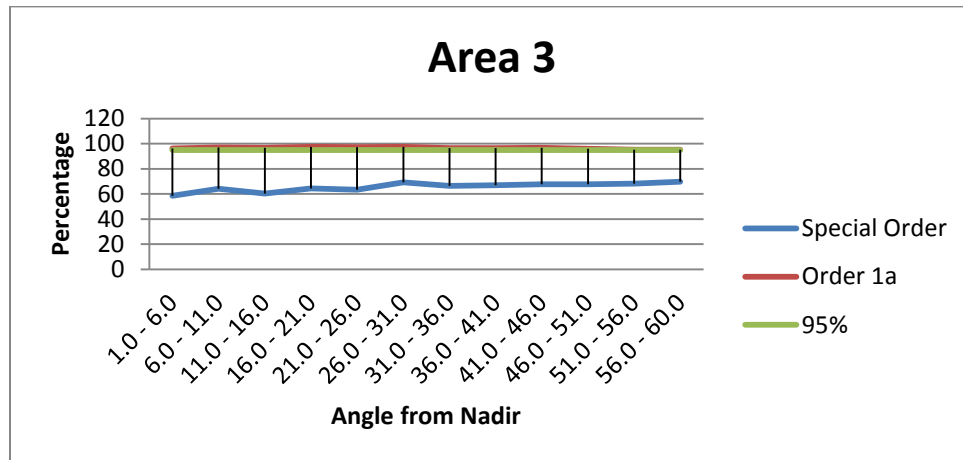


Figure 16 Area 3 QC Report

MB1

Area	No. Beams	No. Beams	Order 1a	Special Order	Highest Mean Difference (m)
	Order 1a	Special Order	Met?	Met?	(Included beams only)
BWYC	120 (100%)	120(99.97%)	Yes	Yes	0.058
New Marina	120 (100%)	120 (99.3%)	Yes	Yes	0.071
Area 3	120 (100%)	120(96.40%)	Yes	Yes	0.105

Table 7 Crossline Comparison Results

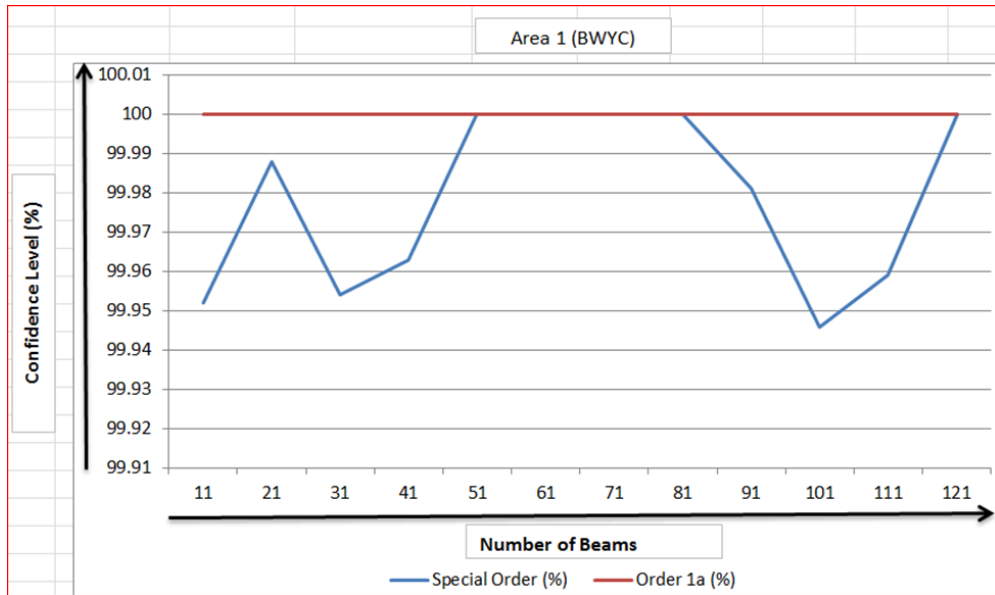


Figure 17 Crossline Comparison Results - Area 1

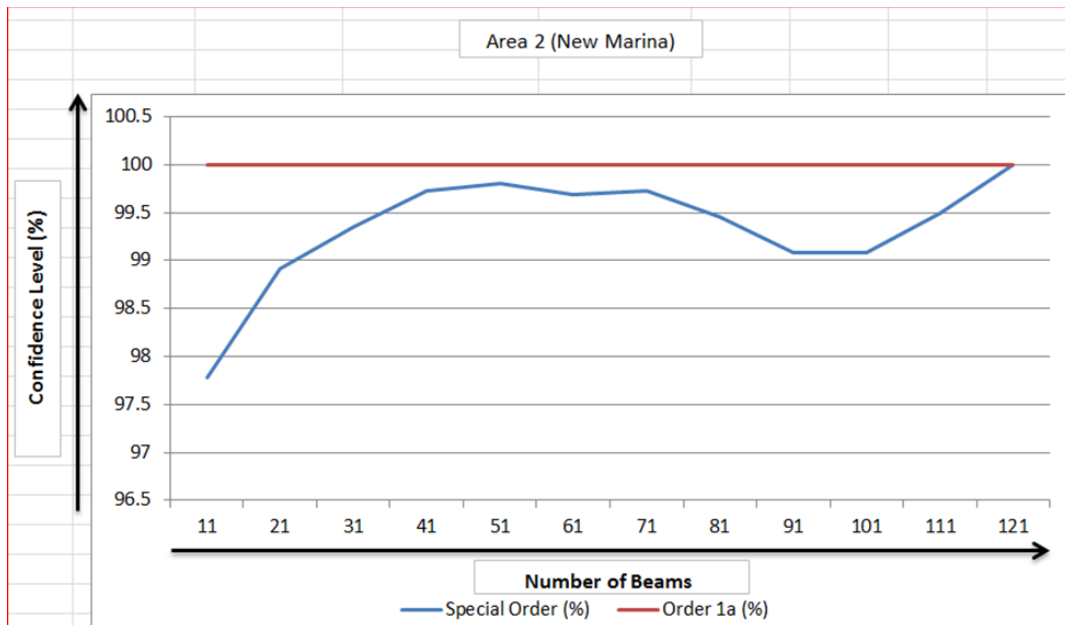


Figure 18 Crossline Comparison Results - Area 2

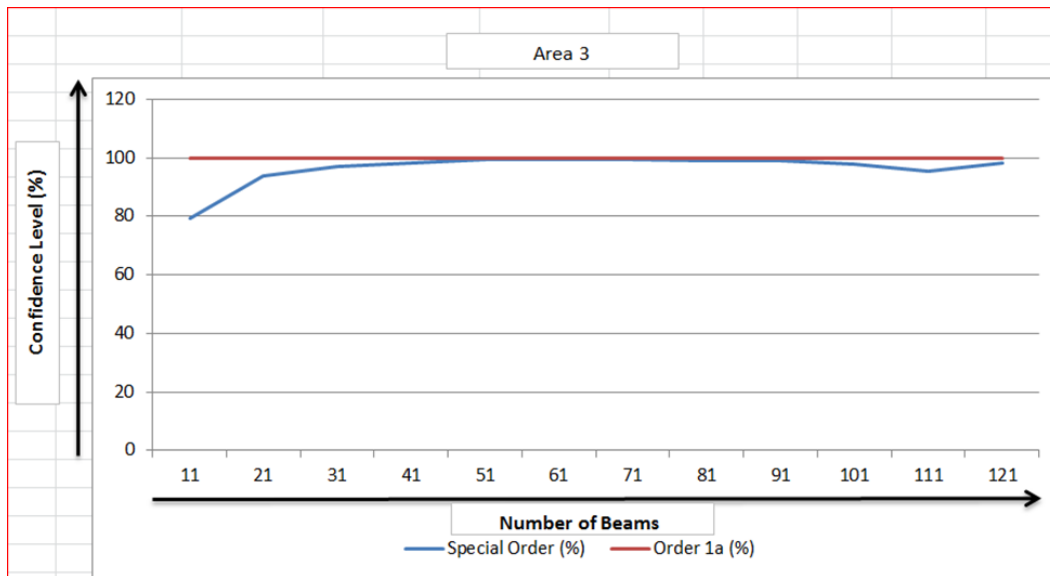


Figure 19 Crossline Comparison Results - Area 3

B.1.4 Coverage and Junctions

EdgeTech

The multibeam coverage did not cover 100% of the sea floor. However, the side scan sea floor coverage is 186%. IHO order 1a requires 100% sea floor coverage.

Area	Total Area (m ²)	Coverage Area (m ²)	Percentage
BWYC	35207	20184	57
Marina	70669	51464	73
Area 3	1584927	1044699	66

Table 8 EdgeTech Coverage

Two junctions were identified using the EdgeTech data. The first is between the marina and area 3 and the second is between the yacht club and area 3. A differencing surface was created between two depth surfaces, either the yacht club or marina and area 3.

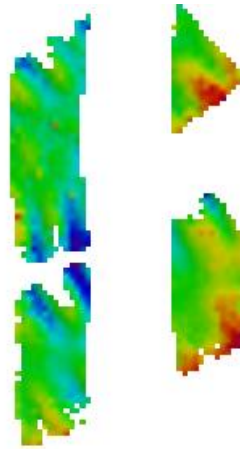


Figure 20 Difference Surface Between BWYC and Area 3

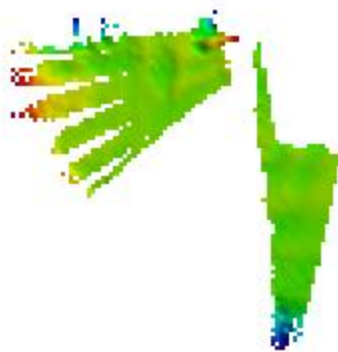


Figure 21 Difference Surface Between Marina and Area 3

	Max Diff	Min Diff	Mean Diff	Std Dev	Total Counts
BWYC Junction	-0.01m	-0.63m	-0.31m	0.09m	1625
Marina Junction	0.15m	-0.86m	-0.35	0.14	1504

Table 9 Junction Differences (EdgeTech)

The mean vertical difference at each location was most likely caused by processing with different navigation sources. Each area was surveyed on different days. Due to configuration errors the yacht club and marina data were processed using navigation data from different GNSS units. The Trimble GNSS was the primary source of navigation data for the yacht club and marina, while the CNAV was the primary source of navigation data for area 3.

MB1

	Total Area (m ²)	Coverage Area (m ²)	Percentage
BWYC	35207	9311	26
Marina	70669	24048	34
Area 3	1584927	412976	26

Table 10 MB1 Coverage by Area

All features identified by the SSS were investigated. Not all features were located in MBES or PDBS to verify the least depths. Due to time constraints and issues with processing the PDBS data, no features were found. The MBES surfaces did verify the least depth of two features in area three.

Two junctions exist within the survey area. The two areas can be seen in table 10.

	Max Diff	Min Diff	Mean Diff	Std Dev	Total Counts
BWYC Junction	0.24 m	-0.30 m	0.02 m	0.07 m	1175
Marina Junction	0.45 m	-0.23 m	0.04 m	0.10 m	235

Table 11 Junction Differences (MB1)

B.1.5 5 EdgeTech 4600 vs. MB1

The two sonars were used simultaneously in each area of the survey. Unfortunately due to delays in processing the EdgeTech data, the marina and area 3 data was not cleaned to the extent of the yacht club. The below comparison is the difference surface between EdgeTech BWYC and MB1 BWYC.

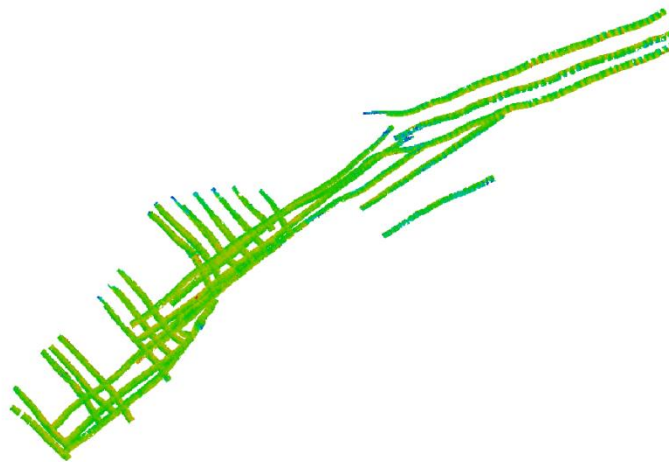


Figure 22 EdgeTech vs MB1 BWYC Difference

The surface was created with bin sizes of 1m. The green color indicates the area around the mean depth difference, -0.37m, at standard deviation of 0.07m. The bias between the two surfaces is theorized to be caused by the configuration settings of the PDBS. According to QC reports, crossline and surface, generated by the QC report feature in Caris HIPS both surfaces met both IHO order 1a and Special Order surveys. The actual difference is less than 0.2% as indicated in the reports. The PDBS may be more susceptible to human error in configuration, but it offered a 70 degree swath from nadir, where MB1 MBES was limited to 45 degrees from nadir.

B.2 Side Scan Sonar

B.2.1 Data Acquisition and Confidence Checks

SSS data acquisition occurred simultaneously with the MBES. The range scale used for all SSS data collection was 25 m. This value was calculated from 10-12 times the max water depth (in meters). Since our water depth range was fairly consistent in all 3 areas, our range scale remained the same. As this was a “skunk stripe” survey, the line spacing was 20 meters, which resulted 100% SSS coverage for the entire survey, and 200% SSS coverage for 86% of the entire survey. However, in order to acquire more multibeam coverage in the marina and yacht club, 10m line spacing was used in those areas.

	Total Area (m ²)	200% Coverage Area (m ²)	Percentage
BWYC	35207	27900	79.2
Marina	70669	61010	86.3
Area 3	849247	783005	92.2

Table 12 SSS Coverage by Area

The SSS was used to ensure a full seafloor search in accordance with IHO S-44 Order 1a, and was used for object/target detection. It operated so that it was capable of detecting an object on the seafloor that measures 1 m³ (although many smaller objects were detected). The boat coxswain operated the boat at approximately 5 knots (~2.6 m/s) to ensure that a 1 m³ object would be able to receive at least 3 pings for proper detection. The pulse repetition rate determines the speed that a vessel can travel along the track and still maintain the required coverage of the seafloor. The maximum allowable survey speed that can be used to satisfy the target detection requirements is given by the following equation:

$$\text{Max Speed} = \text{target size} \times \frac{\text{prf}}{3}$$

The max speed is measured in m/s, the target size in meters, and pulse repetition rate in sec⁻¹. For a 1 m target and a pulse repetition rate of 20 Hz, the equation yields a max speed of 6.7 m/s (12.9 knots). However, the IHO suggests collection of SSS no faster than 6 knots for practical purposes. This means that our average vessel speed was well within the allowable speed.

The SSS performance was checked on multiple occasions during the survey. Checks were conducted using objects including crab traps and other objects with less than a 0.5 m diameter, at or near the full 25 m range scale. These confidence checks proved that the EdgeTech 4600 was capable of resolving objects much smaller than the 1 m requirement at the edge of the range scale. This allowed detection and classification of targets that were much smaller than the required size.

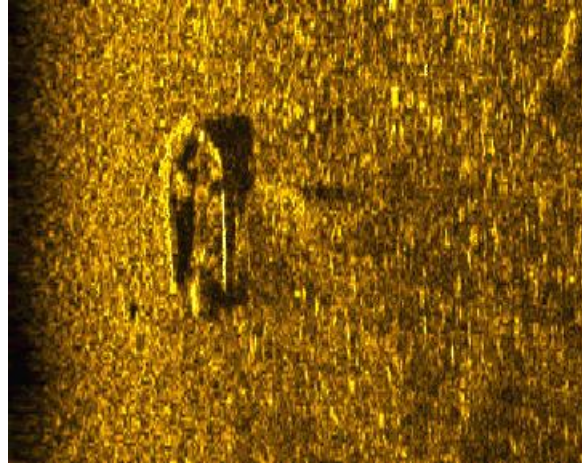


Figure 23 SSS Sunken Vessel at 25m Range

B.2.2 Imaging Processing

The data from the SSS was constantly under supervision during the collection. Any significant features, surface effects, and even water column disturbances were noted in a survey log and recorded in the SSS data.

The JSF files were imported into SonarWiz 5 using a value of 60 dB for the time variable gain (TVG). Auto JSF Scalar and ADC Gain from the JSF sonar packet were also applied upon import. The position source NMEA Coords was selected, as well as the NMEA heading source. There was no layback applied to the data as the system was mounted, instead of towed. A sensor depth of 0.73m was applied under “File Manager”. User gain control (UGC), Automatic Gain Control (AGC), and Beam Angle Correction (BAC) settings were applied to each line in an attempt to create three consistent mosaics (one for each of the three survey areas).

All lines were examined thoroughly with the Digitizer Tool. This tool was used for target identification and capture as each line was reviewed. As the survey area was very shallow and consisted of entrances to marinas and other critical areas of navigation, All targets greater than 0.3m were considered significant. There were only a few targets that had heights greater than 0.5 m, and there were no targets that reached an entire meter. Each targets was classified and put into reports that were generated using the SonarWiz automated reporting tools. Target reports for each area are included in appendix V.

B.2.3 Review Process and Proof of Coverage

Both clarity and intensity of the SSS data were reviewed and monitored throughout the collection period. Coverage was monitored using a Sounding Grid in QINSy to ensure that no data gaps had occurred during collection. Coverage is also visible in SonarWiz, which was reviewed throughout survey collection as well. Line data and mosaics were independently processed; however, they were checked by multiple team members to ensure that all targets were classified properly and no gaps in the data existed.

B.2.4 Target Selection

Before the survey, the intended target detection size limit was 1 m³. However, the SSS often produced higher resolution data, and allowed much smaller contacts to be classified. Any contact that showed a significant shadow or reflection at or below 1m in any dimension was included in the target report. Because of the extremely shallow depths in the area, and the importance of safe navigation in this area, targets from 0.3m and above were accepted. The feature selection process complied with the requirements stipulated in the NOAA Specifications and Deliverables (NOAA 2013).

All of the targets found in the data were digitized with an image and position. The target's shadow length, a width, and a length were used in order to obtain an estimate of its height. Targets were also classified whenever possible.

B.2.5 Seabed Samples

The seabed sampling of all three areas was conducted on 18 June 2014. A Petite Ponar Grab was used to sample four different locations in the three areas. The sediment grab obtained samples from the top ~10 cm of the seabed sediment. The locations that were sampled were selected by assessing possible texture boundaries from return intensity variation that had been observed in the gain correct SSS mosaics. The team also made sure to grab at least one sample from each survey area. The full list of samples is shown in table 12. The location on chart 11371 was verified correct.

Time (UTC)	Latitude	Longitude	NATSUR	NATQUA	Color
21:06	30° 19' 45.6" N	89° 18' 49.4" E	Clay (2)	Sticky, Fine (5,1)	Grey (7)
15:31	30° 18' 41.3" N	89° 18' 41.6" E	Clay (2)	Fine (1)	Grey (7)
19:55	30° 18' 38.8" N	89° 19' 17.5" E	Clay, Sand (2,4)	Sticky, Medium (5,2)	Grey, Grey (7,7)
21:20	30° 19' 30.9" N	89° 19' 34.7" E	Clay (2)	Fine (1)	Grey (7)

Table 13 Seabed Samples Collected 18 June 2014 with S-57 Encoding Values






B.2.6 Seabed Texture

Beam averaged backscatter data was not recorded during this survey. Thus, SSS mosaics were processed in place of multibeam backscatter to gather the seabed texture distribution. The general intensity variation that was used across all mosaics was minimal, except in Area 3. This suggests little variation in the seabed texture across the first two areas. In Area 3, the most prominent variation occurred at the southern end where the sediment seemed to contain more sand than clay (which was most common in the other two areas and most of Area 3). This area is at the junction between the Gulf Of Mexico and Bay St. Louis. It is also the area leading up to the Bay St. Louis Marina & Pier. Seabed sample data is recorded in the S57 Final Feature File that is submitted with this dataset.

B.3 Aids to Navigation

While there were only a few aids to navigation (ATONs) in the vicinity of the survey area, there were many that were not of use anymore. The older ATONs were in more shallow water than most of the survey area. In order to verify these, the transducers were removed after the survey portion was complete.

All of the ATONs that were within the survey area were positioned using PPK GNSS data from the TopCon GR3. CNAV and Trimble data was recorded as a backup.

Timestamp & Imagery	Area	Name	Feature No.	Verified Position	Charted Position	Distance off station (m)	Bearing from station (°)	Light Characteristics
1725 	1	NOAA Bay Waveland Tide Monitoring Platform Light	10270	30° 19' 34.76" N 89° 19' 32.92" W	30° 19' 34.51" N 89° 19' 33.39" W	14.59	240	Flashing Yellow at 3 Seconds
2129 	1	Bay Waveland Yacht Club Entrance Light	-	30° 19' 32.30" N 89° 19' 31.11" W	-	-	-	Flashing Green at 5 Seconds
1746 	1	Bay Waveland Yacht Club Entrance Marker	-	30° 19' 32.46" N 89° 19' 30.57" W	-	-	-	-
1711 	1	Bay Waveland Yacht Club Entrance Marker	-	30° 19' 33.38" N 89° 19' 29.25" W	-	-	-	-
1715 	1	Saint Louis Bay Beacon 4	-	30° 19' 33.18" N 89° 19' 31.98" W	30° 19' 33.48" N 89° 19' 32.12" W	8.62	335	Flashing Red at 5 Seconds

1917		1	Saint Louis Bay Beacon 2	-	30° 19' 37.85" N 89° 19' 25.12" W	30° 19' 35.39" N 89° 19' 26.41" W	82.94	206	Flashing Red at 5 Seconds
1803		2	City of Bay St. Louis Municipal Pier Light 1	10357.01	30° 18' 40.39" N 89° 19' 14.04" W	30° 18' 40.37" N 89° 19' 14.36" W	7.73	268	N/A
1805		2	City of Bay St. Louis Municipal Pier Light 2	10357.02	30° 18' 41.26" N 89° 19' 14.05" W	30° 18' 41.15" N 89° 19' 14.61" W	15.68	259	Flashing Red at 1 Second
1819		3	City of Bay St. Louis Danger Lights	10357	30° 18' 43.90" N 89° 19' 11.24" W	30° 18' 43.9" N 89° 19' 11.20" W	0.98	90	Flashing White at 1 Second
1821		3	City of Bay St. Louis Danger Lights	-	30° 18' 44.98" N 89° 19' 10.41" W	-	-	-	Flashing White at 2 Seconds
1811		3	City of Bay St.	-	30° 18' 45.73" N	-	-	-	N/A

		Louis Danger Lights		89° 19' 16.94" W				
1814 	3	City of Bay St. Louis Danger Lights	-	30° 18' 46.66" N 89° 19' 16.59" W	-	-	-	Flashing White at 1s
1426 	3	Old Channel Marker	-	30° 19' 13.73" N 89° 19' 14.98" W	-	-	-	-
1428 	3	Old Channel Marker	-	30° 19' 13.78" N 89° 19' 12.88" W	-	-	-	-
1430 	3	Old Channel Marker	-	30° 19' 15.398" N 89° 19' 14.21" W	-	-	-	-
1432 	3	Old Channel Marker	-	30° 19' 15.21" N 89° 19' 16.27" W	-	-	-	-
1434 	3	Old Channel Marker	-	30° 19' 16.86" N 89° 19' 15.27" W	-	-	-	-
1436 	3	Old Channel Marker	-	30° 19' 16.81" N 89° 19' 17.598" W	-	-	-	-
1438	3	Old Channel Marker	-	30° 19' 18.48" N 89° 19' 16.88" W	-	-	-	-










								
1440	3	Old Channel Marker	-	30° 19' 18.397" N 89° 19' 18.95" W	-	-	-	-
								
1442	3	Old Channel Marker	-	30° 19' 20.08" N 89° 19' 18.23" W	-	-	-	-
								
1444-	3	Old Channel Marker	-	30° 19' 20" N 89° 19' 20.27" W	-	-	-	-
								
1446	3	Old Channel Marker	-	30° 19' 21.66" N 89° 19' 19.55" W	-	-	-	-
								
1448	3	Old Channel Marker	-	30° 19' 21.61" N 89° 19' 21.65" W	-	-	-	-
								
1450	3	Old Channel Marker	-	30° 19' 23.22" N 89° 19' 20.87" W	-	-	-	-
								
1452	3	Old Channel Marker	-	30° 19' 23.196" N 89° 19' 22.98" W	-	-	-	-
								
1454	3	Old Channel Marker	-	30° 19' 24.82" N 89° 19' 22.22" W	-	-	-	-
								
1458	3	Old Channel Marker	-	30° 19' 28.46" N 89° 19' 25.78" W	-	-	-	-

Table 14 Aids to Navigation Positioned on 18-19 June 2014

C Corrections to Echo Soundings

C.1 Caris HIPS Vessel File

Each multibeam sensor had a different Caris HIPS vessel file and due to the varying of the GNSS units based on day, the file contained separate date-stamped sections to account for changes in the navigation source (CNAV and Trimble). The coordinates for the vessel configuration were determined from the vessel configuration survey described in section C.1.1. Calibration parameters were generated from calibration surveys as described in section C.1.2. Total propagated uncertainty (TPU) parameters were sourced from manufacturer specifications, and propagation of observed measurement uncertainties.

C.1.1 Vessel Offsets

Vessel Configuration Parameters and Laybacks

On June 4, 2014 a vessel configuration survey was completed for the aluminum skiff using a Leica TS02 TotalStation, standard Leica prisms, and Leica reflective tapes. Due to time constraints and poor weather the pre-installed bolt network was unavailable. The aluminum skiff was positioned in between two set benchmarks inside building 1020. Using the TotalStation, the horizontal distance, horizontal angles and vertical angles between each benchmark, and each prism were measured.

The GNSS and IMU positions were all observed from multiple stations, when possible, additional points on the vessel were observed to aid in the building of the vessel file as well as for the crude (tape) measurements.

Forward and reverse measurements were taken for each point and the measurements were adjusted using a least-squares 3 dimensional adjustment. The adjusted observation points were plotted in AutoCAD Civil 3D. All of the vessel observations were moved in the AutoCAD program so that the reference point (RP), which is also the IMU, becomes (0, 0, 0). The vessel was then rotated so that the X and Y axis are orientated properly in the X, Y, and Z directions.

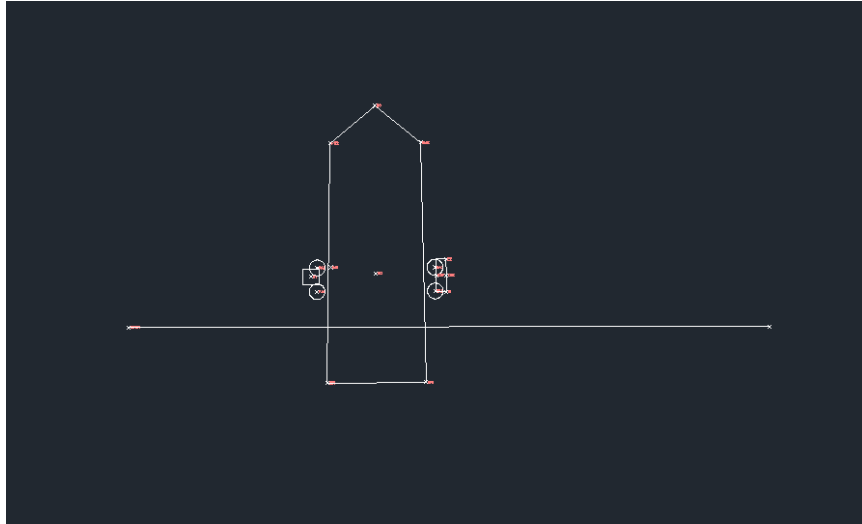


Figure 24 AutoCad VCS

The position of the SSS points and MBES acoustic center were determined using the schematic of the systems and using taped offsets in AutoCAD Civil 3D.

Full results of the calibration survey are included in appendix I.2.



Figure 25 Survey Vessel

Principle Systems

The principle system positions derived from the vessel configuration file are shown in table 14.

		X (m)	Y (m)	Z (m)
PA1	Port Antenna Bow	-0.0153	-0.3020	-1.129
PA2	Port Antenna Stern	-0.5496	-0.3073	-1.114
SA2	Starboard Antenna Bow	-0.0002	2.3423	-1.102
SA1	Starboard Antenna Stern	-0.5322	2.3492	-1.096
OC	Odom Center	-0.2152	-0.4424	1.152
ECP	Edgetech Center Port	-0.1829	2.3753	1.416
ECS	Edgetech Center Starboard	-0.1829	2.5953	1.416
DC	Deck Center	-0.1367	1.0157	0.201
BC	Bow Center	3.6309	0.9943	0.004
EP1	Edgetech Pole Top	-0.2684	2.4857	-0.933
EP2	Edgetech Pole Bottom	-0.1959	2.5097	0.638
OP1	Odom Pole Top	-0.2731	-0.4488	-0.729
OP2	Odom Pole Bottom	-0.2032	-0.4618	0.630

Table 15 Vessel Configuration (X=bow+, Y=starboard+, Z=down+)

The offset of the primary antenna to the IMU (RP) was entered into the POSMV unit so as to ensure real-time translation of heave, pitch, roll and azimuth data to the vessel. Offsets were also entered into QINSy to ensure accurate positioning of vessel position during real-time collection of data. The uncertainties of the sensors, as determined by the manufacturer, were entered into the Caris HIPS vessel file. The vessel report is included in appendix I.

C.1.2 Multibeam Calibration

Initial Calibration

Multiple patch test calibrations line sets were conducted but because of non-ideal conditions and lack of targets, the one conducted on June 18, 2014, (JD 169) in front of Pass Christian was used. This set of lines was determined to be the best because of a slope in the area however, actual targets on the sea floor were lacking. Calibration values were obtained via the Caris calibration tool. The calibration values were applied to the Caris HIPS vessel file for data collected on June 8-19, 2014 (Julian days 159-170). Roll lines from JD 163 were used. Patch test lines and descriptions can be seen in table 12 and calibration values are shown in table 13.

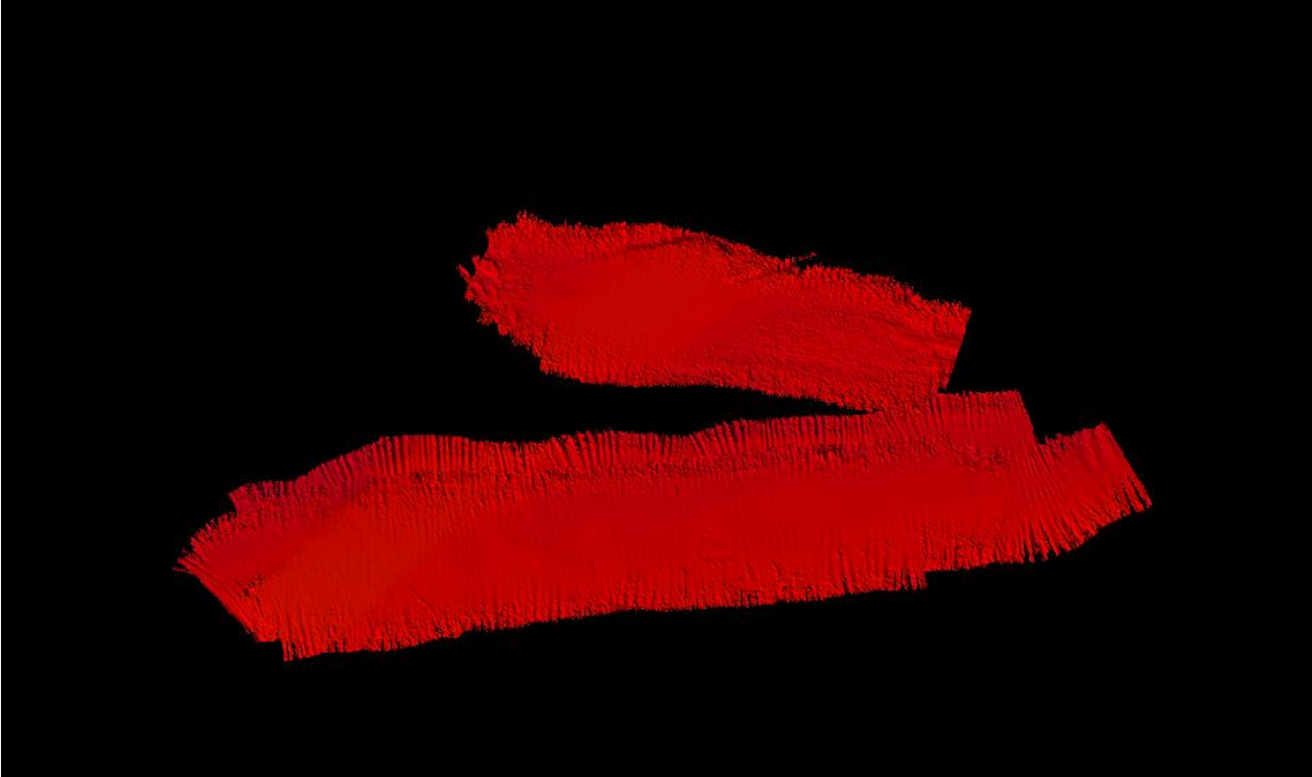


Figure 26 EdgeTech Patch Test Lines

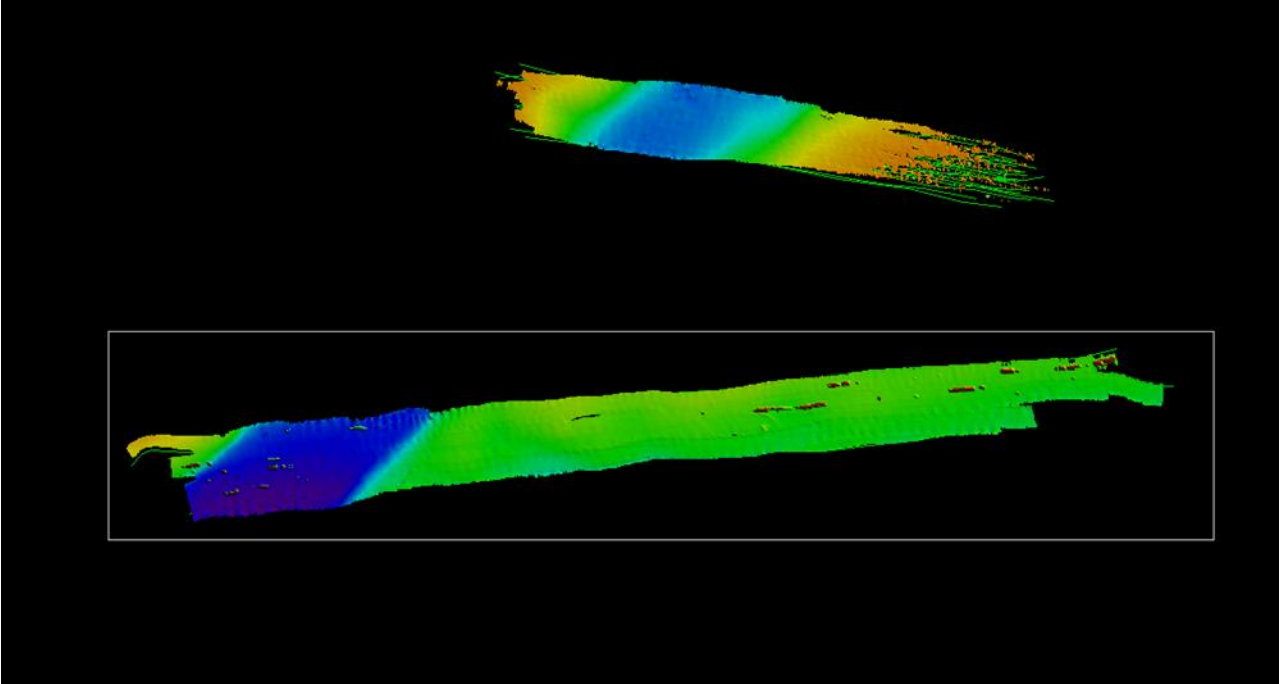


Figure 27 MB1 Patch Test Lines

Test	Criteria	Lines Used	Speed (knots)	Course (deg)
Latency	2 lines running in same direction and having 2 different speeds on a sloppy bottom (ideally 10-20 deg)	003_1649	3	96
		003_1723	6	95
Pitch	2 lines running in opposite directions and having the same speed on a sloppy bottom (ideally 10-20 deg)	008_1831	1.8	264
		007_1826	1.7	84
Yaw	2 separate lines running in the same direction and with same speed having a target ideally centered between the 2 lines.	008_1833	1.9	84
		007_1826	1.7	84
Roll	2 lines with same speed but in opposite directions on a flat bottom.	003_1840	3.8	84
		007_1837	3.8	264

Table 16 Patch Test Lines

System	Side	Date	Roll (°)	Pitch (°)	Yaw (°)	Timing (s)
Edgetech	Port	June 8-19, 2014	-2.713	0.5	1.5	0
Edgetech	Starboard	June 8-19, 2015	-3.9	0.5	1.5	0
MB1		June 8-19, 2014	1.6	-2	-1.5	0

Table 17 Vessel Calibration Data

C.2 Attitude and Position Data

The POSMV data was logged at 50 Hz, this data included raw dual frequency positioning data from both GNSS antennas and heave data. This data was applied for heave to all lines in all three of the areas using the Caris HIPS delayed heave function.

GNSS data was logged with both CNAV 3050 and Trimble, data was logged at once a second and processed in GrafNav using a PPK solution.

C.3 Tide and Water Level Corrections

The majority of the data was reduced to MLLW NTDE 1983-2001 using Ellipsoid Reference Survey (ERS) techniques. A single separation value between ellipsoid and MLLW was derived using several components including: tidal data collected from a gauge established before the survey, a tidal datum transfer linking the new gauge to a nearby established NOAA gauge (station ID: 8747437), dual frequency static GNSS survey, as well as three-wire level runs connecting the tide gauge to a primary bench mark. ERS could not be used for the entire survey. Tides published by NOAA from station 8747437 were applied to approximately one hour of bathymetry data. For more details please see the *Horizontal and Vertical Control Report*.

BM1	
Latitude	30° 18' 42.1" N
Longitude	089° 19' 27.3" W
MLLW at BM 1	2.6786
NAD 83	-24.984
SEP	-27.6626

Table 18 Separation Summary

NOAA's Geoid 12A model was used to justify using one separation value within the survey area. Five points within the survey area shows very little difference. The difference between the extremes was only 0.047 m, please see Table 18 for the model's values.

Geoid 12A		
Point 1	30 19 30.99 N 089 19 26.76 W	-27.477
Point 2	30 19 16.39 N 089 19 12.72 W	-27.469
Point 3	30 18 56.70 N 089 19 6.82 W	-27.453
Point 4	30 18 45.22 N 089 19 9.4 W	-27.441
BM 1	30 18 42.14 N 089 19 27.29 W	-27.43
Differences		0.047

Table 19 Geoid 12A Model Values Within the Survey Areas

The Tide Zoning section proved insignificant tidal variation between the top and bottom of the survey area, and GEOID12a shows miniscule changes along the ellipsoid within the survey area. All of these statistics verify the need for only one separation value within the survey area.

C.4 Sound Velocity Correction

Sound velocity casts were conducted at multiple times each day, generally at the beginning, middle, and end of the day and whenever areas were changed. These SVP files were compiled into a single Caris HIPS SVP file. When a cast was taken the collection time, date and position were recorded. The nearest in time technique was used because the survey area was small and the sound velocity would be most accurate based on time not distance.

C.5 TPU Calculation

The uncertainty management strategy (adapted from Dr. Well's lecture note) at appendix VI has been used to assess the accuracy achieved.

C.5.1 The Standard

The minimum accuracy requirement for the survey is IHO Order 1a (at 95% Confidence). Based on the depth of our area, the maximum allowable TVU and THU is detailed in the table below.

Component	Requirement	Maximum Budget WRT Depth (m)		
Total Horizontal Uncertainty (THU)	5 m + 5% depth	Shallowest	0.3	5.02
		Mean	2.26	5.11
		Deepest	4.21	5.21
Total Vertical Uncertainty (TVU)	$\sqrt{a^2 + (b \times d)^2}$ a = 0.5 m b=0.013	Shallowest	0.3	0.50
		Mean	2.26	0.50
		Deepest	4.21	0.50

Table 20 IHO Standard

C.5.2 Strategic Designing

The different measurement / computational strategies used to limit uncertainty to the standard were to:

- Use PPK for all GNSS processing with base station only a few Km from site.
- Use Motion Sensor to correct for attitude of vessel
- Clean GNSS and Multibeam data to remove spikes.
- Carry a Vessel calibration survey using total station.
- Effect patch test.

Furthermore, Hypack TPU Editor was used as a planning tool to assess the error budget. Figure 26 shows that by using the different measurement / computational methods mentioned above, the required accuracy can be easily achieved.

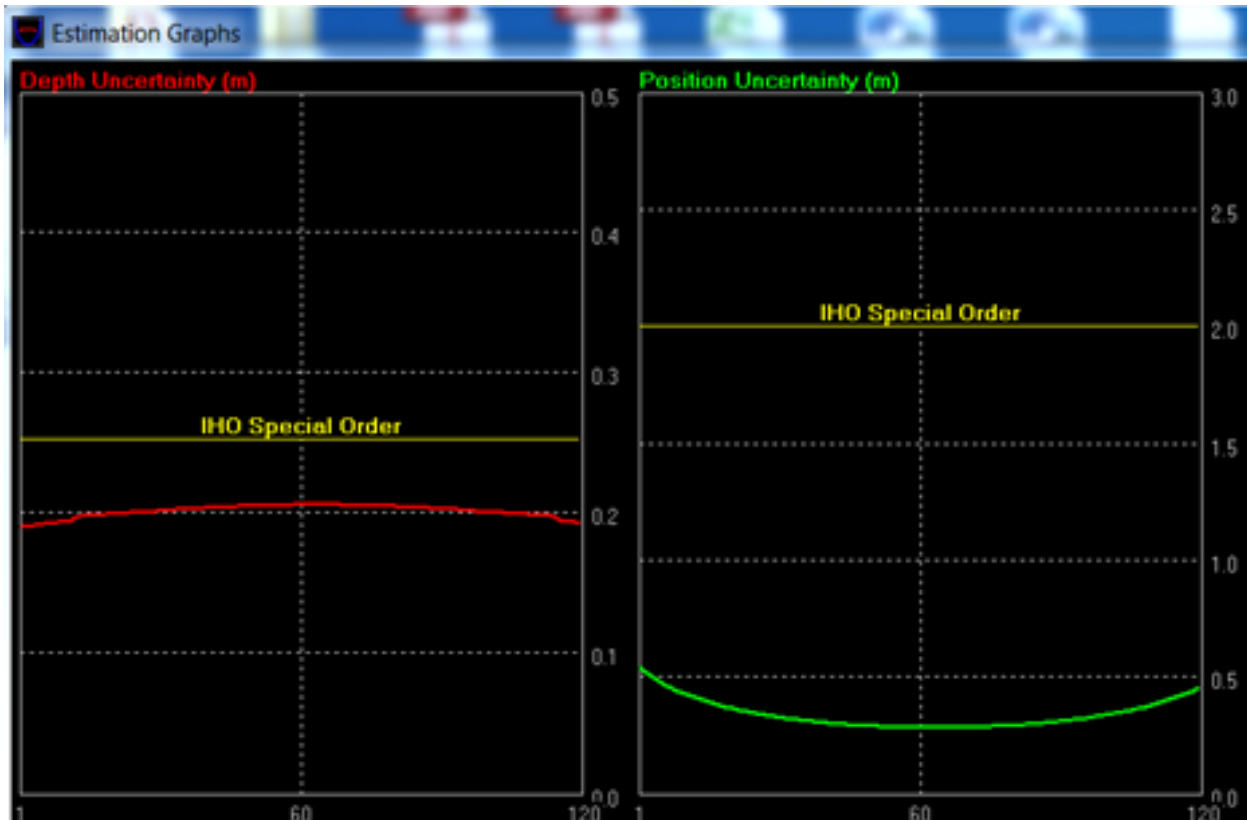


Figure 28 Hypack TPU Editor

C.5.3 Monitoring

In order to assess the uncertainties actually obtained,

- Cross Check lines were ran at every 15* line spacing distance and analyzed in CARIS
- CARIS was used for TPU calculation with :
 - Observed Standard deviations entered in vessel file where available.
 - Sound Velocity and Tides uncertainties entered in TPU controller window.

C.5.4 Evaluation

The actual uncertainties obtained during the project have been compared to the standard.

C.5.4.1 SEP uncertainties

Table 21 gives the uncertainties associated with the determination of the ellipsoid to chart datum separation. See the Horizontal and Vertical Control report for more details.

SEP Uncertainty	1 σ value (m)
Tide Gauge Clock Drift	0.001
Instrument Uncertainty	0.001
Tidal Datum Transfer	0.055
Leveling Error	0.001
GPS Error	0.004
Tide Gauge Calibration	0.001
$\sum \sqrt{\sigma^2}$	0.055
$1.96 * \sum \sqrt{\sigma^2}$ 95% Confidence	0.108

(Value from NOAA's Computational Techniques for Tidal Datum Handbook, 2003, Pg. 26)

Table 21 SEP uncertainty

C.5.4.2 Sounding uncertainty for ellipsoidal reference survey

The major contributions to the sounding uncertainty are outlined in table 22 below. The vessel GNSS standard deviation was determined from PPK solution in Grafnav software while the standard deviation in the measurement of the Z- offset value was determined from the vessel configuration survey. The Uncertainty in the acoustic measurement that includes sound velocity, refraction, reflectivity uncertainties etc., for depth less than 15 feet were derived from the USACE, 2013.

Factors	1 σ value (m)
Vessel GNSS	0.06
Vessel Configuration	0.002
Acoustic depth measurement	0.016
$\sum \sqrt{\sigma^2}$	0.062
$1.96 * \sum \sqrt{\sigma^2}$ 95% Confidence	0.122

(Value from USACE, 2013 pg D-12 and includes sound velocity, refraction, reflectivity uncertainties, etc. for depth < 15 ft)

Table 22 Sounding Uncertainty

C.5.4.3 GNSS Horizontal Uncertainties

The standard deviations (at 1σ) of the horizontal observations of the GNSS receivers on the boat was obtained while processing the PPK solution in Grafnav and are given in the table below

Date	Julian Day	Source	Horizontal σ (m)	95% CI (2.45* σ) (m)
11-Jun-14	162	Trimble PPK	0.028	0.069
12-Jun-14	163	Trimble PPK	0.022	0.053
16-Jun-14	167	Trimble PPK	0.052	0.128
17-Jun-14	168	CNAV PPK	0.069	0.168
18-Jun-14	169	Trimble PPK	0.030	0.073
19-Jun-14	170	CNAV PPK	0.073	0.179

Table 23 Horizontal standard deviation

C 5.4.4 Determining TPU and TVU in CARIS

The uncertainty values (at 1 σ) as determined in sec C 5.4.1 to 5.4.3 as well as those from known uncertainties, as reported by the manufacturers and/or obtained in guidance with other agencies (such as CARIS web site) were entered into the CARIS.

C.5.4.4.1 CARIS vessel file

Table 24 gives values that were entered in CARIS vessel file and their origin.

Entry	Edgetech		MB1		Manual Tides
	162-167,169	168, 170	162-167,169	168, 170	168(% Lines)
Motion Gyro (°)	0.02	0.02	0.02	0.02	0.02
Heave % Amplitude	5	5	5	5	5
Heave (m)	0.05	0.05	0.05	0.05	0.05
Roll (°)	0.02	0.02	0.02	0.02	0.02
Pitch (°)	0.02	0.02	0.02	0.02	0.02
Position Navigation (m)	0.033	0.071	0.033	0.071	0.071
Timing Transducer (s)	0.005	0.005	0.001	0.001	0.001
Navigation Timing (s)	0.005	0.005	0.001	0.001	0.001
Gyro Timing (s)	0.005	0.005	0.001	0.001	0.001
Heave Timing (s)	0.005	0.005	0.001	0.001	0.001
Pitch Timing (s)	0.005	0.005	0.001	0.001	0.001
Roll Timing (s)	0.005	0.005	0.001	0.001	0.001
Offset X (m)	0.002	0.002	0.002	0.002	0.002
Offset Y (m)	0.002	0.002	0.002	0.002	0.002
Offset Z (m)	0.002	0.002	0.002	0.002	0.002
Vessel Speed (m/s)	0.03	0.03	0.03	0.03	0.03
Loading (m)	0	0	0	0	0.044
Draft (m)	0	0	0	0	0.044
MRU Gyro Alignment	0.05	0.05	0.05	0.05	0.05
MRU Roll/Pitch Alignment	0.02	0.02	0.02	0.02	0.02

Table 24 Standard deviations in vessel files

C.5.4.4.2 CARIS TPU controller

Figure 27 shows the values that were entered in the TPU Controller for ERS and their origin.

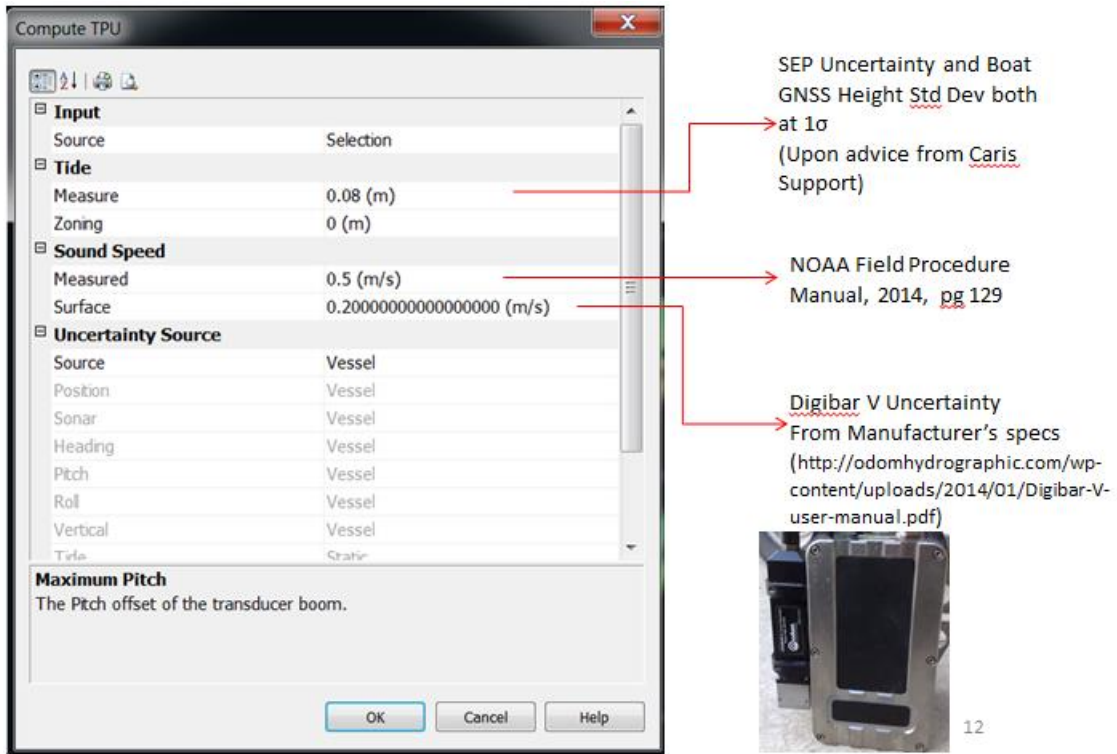


Figure 29 TPU controller

C.5.4.4.3 Cross Check analysis in CARIS

Cross check analysis revealed that 5 survey lines in area 3 (288_1347, 289_1401, 290_1415, 291_1429, 292_1444) did not meet order 1a, see table 28. This was due to bad GNSS.

Beam Nu..	Count	Max (+)	Min (-)	Mean	Std Dev	Special Order (%)	Order 1a (%)	Order 1b (%)	Order 2 (%)
1 - 11	150	0.852	1.089	0.144	0.492	25.333	56.667	56.667	95.333
11 - 21	4,308	0.944	1.204	-0.133	0.477	36.769	68.709	68.709	92.874
21 - 31	16,024	1.055	1.293	-0.148	0.419	44.652	78.152	78.152	94.415
31 - 41	18,846	1.041	1.270	-0.101	0.407	48.907	80.181	80.181	96.413
41 - 51	19,122	1.025	1.154	-0.078	0.402	48.975	79.626	79.626	97.584
51 - 61	19,062	0.890	1.122	-0.066	0.399	49.397	79.042	79.042	98.190
61 - 71	18,988	0.971	1.129	-0.045	0.406	50.427	78.360	78.360	98.399
71 - 81	18,848	1.129	1.078	-0.018	0.408	50.568	78.539	78.539	98.764
81 - 91	16,856	1.120	1.098	-0.033	0.380	54.675	83.045	83.045	99.075
91 - 101	12,846	1.009	1.032	-0.079	0.337	64.113	87.249	87.249	99.642
101 - 111	2,848	0.471	1.012	-0.119	0.254	78.301	90.871	90.871	99.930
111 - 121	3	0.000	0.035	-0.019	0.014	100.000	100.000	100.000	100.000

Table 25 Cross Check analysis of Bad GPS lines

C.5.5 Modify

Changes were needed in order to meet the required standard and it was proposed to use traditional tide values from BWYC Tide station (NOAA 8474347).

C.5.5.1 Assessing Tide station Uncertainty

It was determined from NOAA website (<http://tidesandcurrents.noaa.gov/inundation/userguide?a=1>) that the measurement error and datum error combined in the tide values obtained from NOAA tide stations are less than 0.01m at 95% CI.

C.5.5.2 Additional Vertical uncertainty on Boat using Traditional Tides

Since traditional tides were proposed to be used, such factors as Heave, Draft and Loading needed to be included in the CARIS vessel file for a proper assessment of the uncertainty involved. Table 26 gives an assessment of the additional uncertainty involved. A new boat file was created for this purpose.

Factors	1 σ value (m)
Delta Draft	0.05
Draft	0.044
Loading	0.044
$\sum \sqrt{\sigma^2}$	0.080
$1.96 * \sum \sqrt{\sigma^2}$	
95% Confidence	0.156

} From Caris

Table 26 Boat uncertainty

C.5.5.3 Horizontal Uncertainty

Figure 28 Shows the Standard deviation obtained from the PPK solution for that particular time (13:47:34 to 14:44:24 on Jd 168_14)

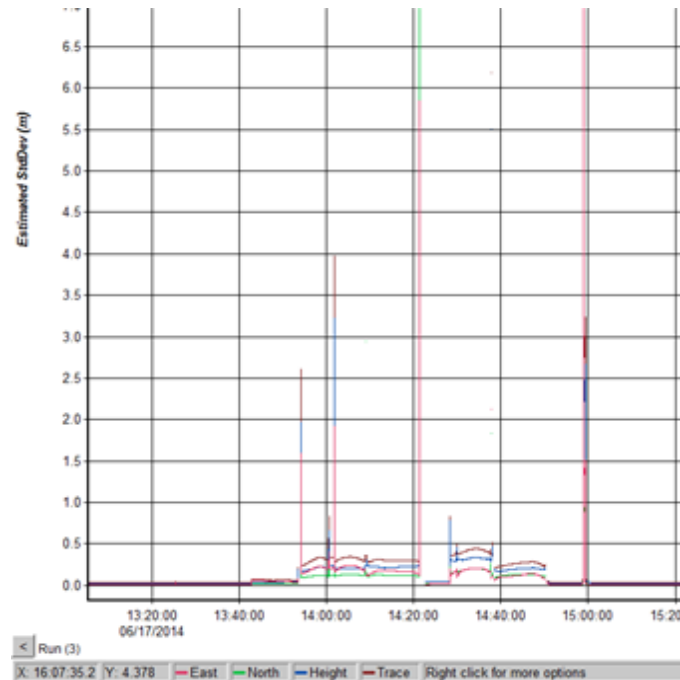


Figure 30 Standard deviation during bad gps period

This figure shows that the horizontal standard deviation for that particular time was generally lower than 0.5m. Since the THU requirement for the survey ranged from 5.02 to 5.21 m, it was decided to use the horizontal GNSS data after cleaning “spikes” in the Navigation Editor of CARIS. The horizontal standard deviation was 0.194m before cleaning of the data.

C.5.6 Results

C.5.6.1 Application of Traditional Tides

After applying the Traditional tides together with the relevant uncertainties to the 5 lines mentioned above, it was found that these lines now net the IHO Order 1a specifications, see table30 below.

Beam Nu...	Count	Max (+)	Min (-)	Mean	Std Dev	Special Order (%)	Order 1a (%)	Order 1b (%)	Order 2 (%)
1 - 11	164	0.368	0.290	-0.060	0.110	96.341	100.000	100.000	100.000
11 - 21	3,655	0.406	0.303	-0.011	0.094	98.988	100.000	100.000	100.000
21 - 31	12,941	0.394	0.268	0.002	0.082	99.838	100.000	100.000	100.000
31 - 41	15,280	0.429	0.268	0.010	0.085	99.777	100.000	100.000	100.000
41 - 51	15,172	0.399	0.240	0.032	0.084	99.690	100.000	100.000	100.000
51 - 61	15,154	0.528	0.223	0.047	0.081	99.479	99.987	99.987	100.000
61 - 71	15,105	0.519	0.217	0.070	0.080	98.974	99.987	99.987	100.000
71 - 81	14,832	0.488	0.186	0.092	0.076	97.984	100.000	100.000	100.000
81 - 91	13,267	0.406	0.162	0.099	0.076	97.920	100.000	100.000	100.000
91 - 101	10,251	0.365	0.102	0.117	0.072	97.298	100.000	100.000	100.000
101 - 111	2,328	0.323	0.112	0.151	0.066	94.674	100.000	100.000	100.000
111 - 121	8	0.181	0.000	0.121	0.058	100.000	100.000	100.000	100.000

Table 27 Cross check result after applying Traditional tides

C.5.6.2 Cross Check Lines Results.

The results of the cross check lines within the 3 areas are shown below.

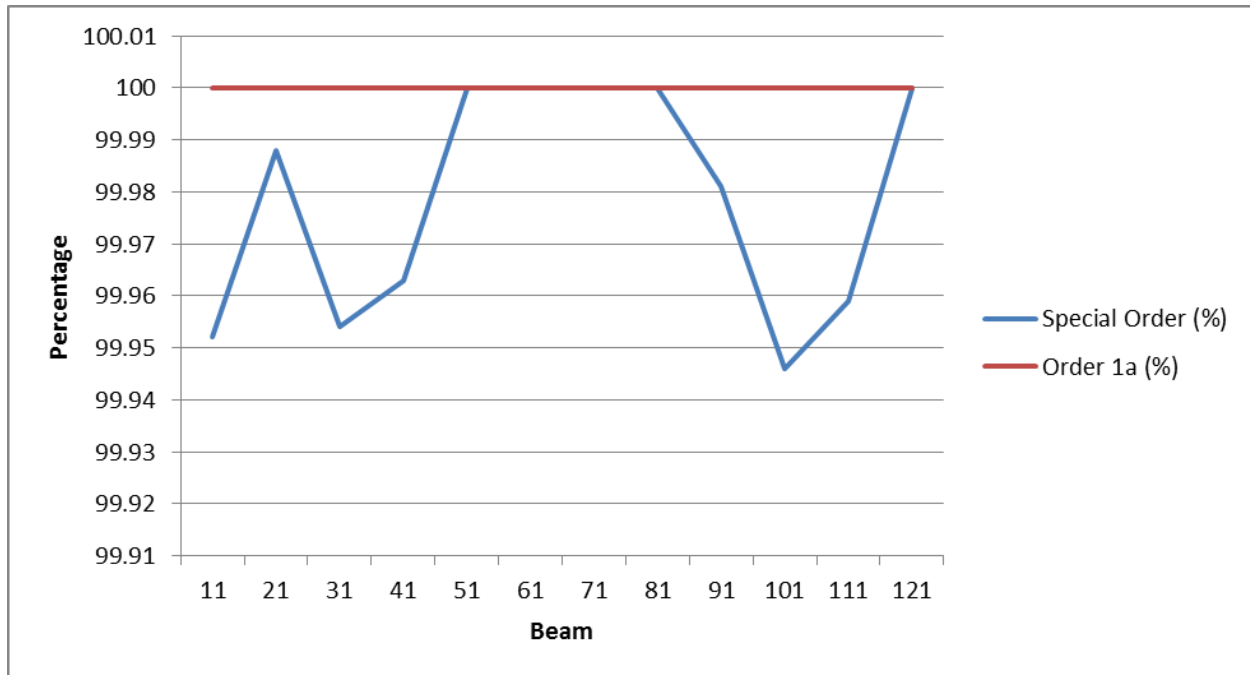


Figure 31 Site 1 (BWYC)

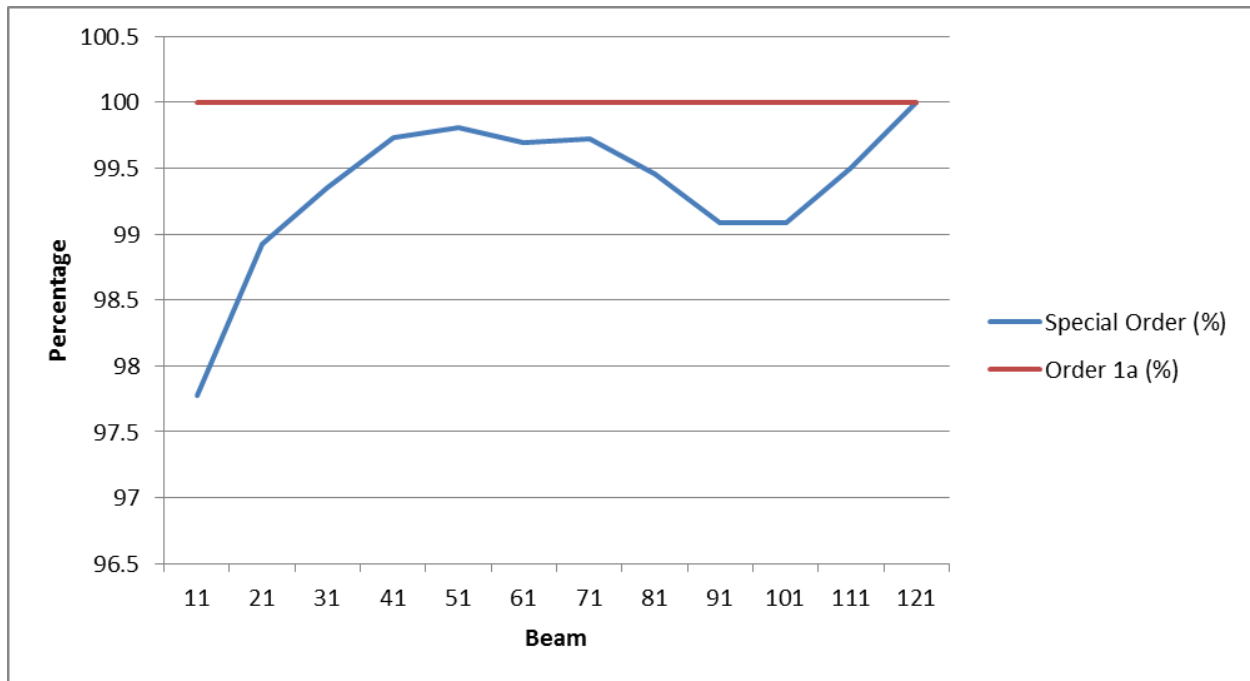


Figure 32 Site 2 (New Marina)

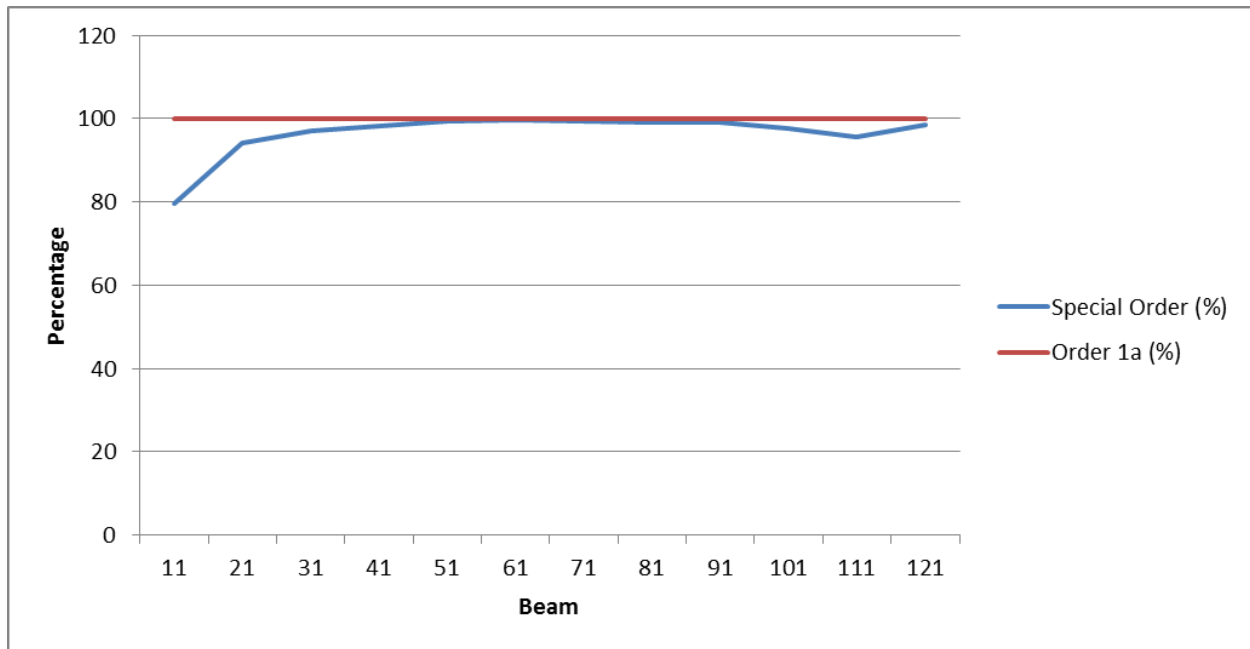


Figure 33 Site 3

It can be seen that all the lines in the 3 areas meet IHO Order 1A. Table 31 Gives a summary of the result.

Area	No. Beams	No. Beams	Order 1a	Special Order
	Order 1a	Special Order	Met?	Met?
Area 1	120 (100%)	120(99.97%)	Yes	Yes
Area 2	120 (100%)	120 (99.3%)	Yes	Yes
Area 3	120 (100%)	120(96.40%)	Yes	Yes

Table 28 Summary of Cross line Results

C.5.6.3 TVU and TPU obtained from CARIS

Using CARIS Subset Editor, different parts of the surveyed area was queried and the results are shown in the table below.

Area	THU (m)	TVU (m)	Order 1a Met?	Special Order Met?
Area 1	0.07	0.18	Yes	Yes
Area 2	0.14	0.18	Yes	Yes
Area 3	0.14	0.18	Yes	Yes

Table 29 THU and TPU values

D Approval Sheet

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Appendices

I Vessel Reports

I.1 Caris HIPS Vessel Report

EdgeTech (Trimble and CNAV by Julian Day)

Vessel Name: Combined

Vessel created: July 21, 2014

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2014-162 00:00

Comments:
Time Correction(s) 0.000

Transducer #1:

Pitch Offset: 0.500
Roll Offset: -2.713
Azimuth Offset: 1.500

DeltaX: 2.485
DeltaY: -0.183
DeltaZ: 1.416

Manufacturer: EdgeTech
Model: Unknown
Serial Number:

Transducer #2:

Pitch Offset: 0.500
Roll Offset: -3.900
Azimuth Offset: 1.500

DeltaX: 2.485
DeltaY: -0.183
DeltaZ: 1.416

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2014-163 00:00

Comments:

Time Correction(s) 0.000

Transducer #1:

Pitch Offset: 0.500
Roll Offset: -2.713
Azimuth Offset: 1.500

DeltaX: 2.485
DeltaY: -0.183
DeltaZ: 1.416

Manufacturer: Unknown

Model: Unknown

Serial Number:

Transducer #2:

Pitch Offset: 0.500

Roll Offset: -3.900

Azimuth Offset: 1.500

DeltaX: 2.485

DeltaY: -0.183

DeltaZ: 1.416

Depth Sensor:

Sensor Class: Swath

Time Stamp: 2014-167 00:00

Comments:

Time Correction(s) 0.000

Transducer #1:

Pitch Offset: 0.500

Roll Offset: -2.713

Azimuth Offset: 1.500

DeltaX: 2.485

DeltaY: -0.183

DeltaZ: 1.416

Manufacturer:

Model: Unknown

Serial Number:

Transducer #2:

Pitch Offset: 0.500

Roll Offset: -3.900

Azimuth Offset: 1.500

DeltaX: 2.485

DeltaY: -0.183

DeltaZ: 1.416

Depth Sensor:

Sensor Class: Swath

Time Stamp: 2014-168 00:00

Comments:

Time Correction(s) 0.000

Transducer #1:

Pitch Offset: 0.500

Roll Offset: -2.713

Azimuth Offset: 1.500

DeltaX: 2.485
DeltaY: -0.183
DeltaZ: 1.416

Manufacturer:

Model: Unknown

Serial Number:

Transducer #2:

Pitch Offset: 0.500
Roll Offset: -3.900
Azimuth Offset: 1.500

DeltaX: 2.485
DeltaY: -0.183
DeltaZ: 1.416

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2014-169 00:00

Comments:

Time Correction(s) 0.000

Transducer #1:

Pitch Offset: 0.500
Roll Offset: -2.713
Azimuth Offset: 1.500

DeltaX: 2.485
DeltaY: -0.183
DeltaZ: 1.416

Manufacturer:

Model: Unknown

Serial Number:

Transducer #2:

Pitch Offset: 0.500
Roll Offset: -3.900
Azimuth Offset: 1.500

DeltaX: 2.485
DeltaY: -0.183
DeltaZ: 1.416

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2014-170 00:00

Comments:

Time Correction(s) 0.000

Transducer #1:

Pitch Offset: 0.500
Roll Offset: -2.713
Azimuth Offset: 1.500

DeltaX: 2.485
DeltaY: -0.183
DeltaZ: 1.416

Manufacturer:

Model: Unknown

Serial Number:

Transducer #2:

Pitch Offset: 0.500
Roll Offset: -3.900
Azimuth Offset: 1.500

DeltaX: 2.485
DeltaY: -0.183
DeltaZ: 1.416

Depth Sensor:

Sensor Class: Swath

Time Stamp: 2014-162 00:00

Comments:

Time Correction(s) 0.000

Transducer #1:

Pitch Offset: 0.500

Roll Offset: -2.713

Azimuth Offset: 1.500

DeltaX: 2.485

DeltaY: -0.183

DeltaZ: 1.416

Manufacturer: EdgeTech

Model: Unknown

Serial Number:

Transducer #2:

Pitch Offset: 0.500

Roll Offset: -3.900

Azimuth Offset: 1.500

DeltaX: 2.485

DeltaY: -0.183

DeltaZ: 1.416

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2014-163 00:00

Comments:
Time Correction(s) 0.000

Transducer #1:

Pitch Offset: 0.500
Roll Offset: -2.713
Azimuth Offset: 1.500

DeltaX: 2.485
DeltaY: -0.183
DeltaZ: 1.416

Manufacturer: Unknown
Model: Unknown
Serial Number:

Transducer #2:

Pitch Offset: 0.500
Roll Offset: -3.900
Azimuth Offset: 1.500

DeltaX: 2.485

DeltaY: -0.183

DeltaZ: 1.416

Depth Sensor:

Sensor Class: Swath

Time Stamp: 2014-167 00:00

Comments:

Time Correction(s) 0.000

Transducer #1:

Pitch Offset: 0.500

Roll Offset: -2.713

Azimuth Offset: 1.500

DeltaX: 2.485

DeltaY: -0.183

DeltaZ: 1.416

Manufacturer:

Model: Unknown

Serial Number:

Transducer #2:

Pitch Offset: 0.500

Roll Offset: -3.900

Azimuth Offset: 1.500

DeltaX: 2.485

DeltaY: -0.183

DeltaZ: 1.416

Depth Sensor:

Sensor Class: Swath

Time Stamp: 2014-168 00:00

Comments:

Time Correction(s) 0.000

Transducer #1:

Pitch Offset: 0.500

Roll Offset: -2.713

Azimuth Offset: 1.500

DeltaX: 2.485

DeltaY: -0.183

DeltaZ: 1.416

Manufacturer:

Model: Unknown

Serial Number:

Transducer #2:

Pitch Offset: 0.500
Roll Offset: -3.900
Azimuth Offset: 1.500

DeltaX: 2.485
DeltaY: -0.183
DeltaZ: 1.416

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2014-169 00:00

Comments:
Time Correction(s) 0.000

Transducer #1:

Pitch Offset: 0.500
Roll Offset: -2.713
Azimuth Offset: 1.500

DeltaX: 2.485
DeltaY: -0.183
DeltaZ: 1.416

Manufacturer:
Model: Unknown

Serial Number:

Transducer #2:

Pitch Offset: 0.500
Roll Offset: -3.900
Azimuth Offset: 1.500

DeltaX: 2.485
DeltaY: -0.183
DeltaZ: 1.416

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2014-170 00:00

Comments:

Time Correction(s) 0.000

Transducer #1:

Pitch Offset: 0.500
Roll Offset: -2.713
Azimuth Offset: 1.500

DeltaX: 2.485
DeltaY: -0.183
DeltaZ: 1.416

Manufacturer:

Model: Unknown

Serial Number:

Transducer #2:

Pitch Offset: 0.500

Roll Offset: -3.900

Azimuth Offset: 1.500

DeltaX: 2.485

DeltaY: -0.183

DeltaZ: 1.416

Navigation Sensor:

Time Stamp: 2014-162 00:00

Comments: (null)

Time Correction(s) 0.000

DeltaX: -0.307

DeltaY: -0.550

DeltaZ: -1.114

Manufacturer: (null)

Model: (null)

Serial Number: (null)

Time Stamp: 2014-163 00:00

Comments:

Time Correction(s) 0.000

DeltaX: -0.307

DeltaY: -0.550

DeltaZ: -1.114

Manufacturer:

Model:

Serial Number:

Time Stamp: 2014-167 00:00

Comments:

Time Correction(s) 0.000

DeltaX: -0.307

DeltaY: -0.550

DeltaZ: -1.114

Manufacturer:

Model:

Serial Number:

Time Stamp: 2014-168 00:00

Comments:

Time Correction(s) 0.000

DeltaX: 2.349

DeltaY: -0.532

DeltaZ: -1.096

Manufacturer:

Model:

Serial Number:

Time Stamp: 2014-169 00:00

Comments:

Time Correction(s) 0.000

DeltaX: -0.307

DeltaY: -0.550

DeltaZ: -1.114

Manufacturer:

Model:

Serial Number:

Time Stamp: 2014-170 00:00

Comments:

Time Correction(s) 0.000

DeltaX: 2.349
DeltaY: -0.532
DeltaZ: -1.096

Manufacturer:
Model:
Serial Number:

Gyro Sensor:

Time Stamp: 2014-162 00:00

Comments: (null)

Time Correction(s) 0.000

Entry 0) Draft: 0.000 Speed: 0.000

Time Stamp: 2014-163 00:00

Comments:

Time Correction(s) 0.000

Time Stamp: 2014-167 00:00

Comments:

Time Correction(s) 0.000

Time Stamp: 2014-168 00:00

Comments:

Time Correction(s) 0.000

Time Stamp: 2014-169 00:00

Comments:

Time Correction(s) 0.000

Time Stamp: 2014-170 00:00

Comments:

Time Correction(s) 0.000

Heave Sensor:

Time Stamp: 2014-162 00:00

Comments: (null)

Apply No

Time Correction(s) 0.000

DeltaX: 0.000

DeltaY: 0.000

DeltaZ: 0.000

Offset: 0.000

Manufacturer: (null)

Model: (null)

Serial Number: (null)

Time Stamp: 2014-163 00:00

Comments:

Apply No

Time Correction(s) 0.000

DeltaX: 0.000

DeltaY: 0.000

DeltaZ: 0.000

Offset: 0.000

Manufacturer:

Model:

Serial Number:

Time Stamp: 2014-167 00:00

Comments:

Apply No

Time Correction(s) 0.000

DeltaX: 0.000

DeltaY: 0.000

DeltaZ: 0.000

Offset: 0.000

Manufacturer:

Model:

Serial Number:

Time Stamp: 2014-168 00:00

Comments:

Apply No

Time Correction(s) 0.000

DeltaX: 0.000

DeltaY: 0.000

DeltaZ: 0.000

Offset: 0.000

Manufacturer:

Model:

Serial Number:

Time Stamp: 2014-169 00:00

Comments:

Apply No

Time Correction(s) 0.000

DeltaX: 0.000

DeltaY: 0.000
DeltaZ: 0.000
Offset: 0.000

Manufacturer:
Model:
Serial Number:

Time Stamp: 2014-170 00:00

Comments:
Apply No
Time Correction(s) 0.000
DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000
Offset: 0.000

Manufacturer:
Model:
Serial Number:

Pitch Sensor:

Time Stamp: 2014-162 00:00

Comments: (null)

Apply No

Time Correction(s) 0.000

Pitch offset: 0.000

Manufacturer: (null)

Model: (null)

Serial Number: (null)

Time Stamp: 2014-163 00:00

Comments:

Apply No

Time Correction(s) 0.000

Pitch offset: 0.000

Manufacturer:

Model:

Serial Number:

Time Stamp: 2014-167 00:00

Comments:

Apply No

Time Correction(s) 0.000

Pitch offset: 0.000

Manufacturer:

Model:

Serial Number:

Time Stamp: 2014-168 00:00

Comments:

Apply No

Time Correction(s) 0.000

Pitch offset: 0.000

Manufacturer:

Model:

Serial Number:

Time Stamp: 2014-169 00:00

Comments:

Apply No

Time Correction(s) 0.000

Pitch offset: 0.000

Manufacturer:

Model:

Serial Number:

Time Stamp: 2014-170 00:00

Comments:

Apply No

Time Correction(s) 0.000

Pitch offset: 0.000

Manufacturer:

Model:

Serial Number:

Roll Sensor:

Time Stamp: 2014-162 00:00

Comments: (null)

Apply No

Time Correction(s) 0.000

Roll offset: 0.000

Manufacturer: (null)

Model: (null)

Serial Number: (null)

Time Stamp: 2014-163 00:00

Comments:

Apply No

Time Correction(s) 0.000

Roll offset: 0.000

Manufacturer:

Model:

Serial Number:

Time Stamp: 2014-167 00:00

Comments:

Apply No

Time Correction(s) 0.000

Roll offset: 0.000

Manufacturer:

Model:

Serial Number:

Time Stamp: 2014-168 00:00

Comments:

Apply No

Time Correction(s) 0.000

Roll offset: 0.000

Manufacturer:

Model:

Serial Number:

Time Stamp: 2014-169 00:00

Comments:

Apply No

Time Correction(s) 0.000

Roll offset: 0.000

Manufacturer:

Model:

Serial Number:

Time Stamp: 2014-170 00:00

Comments:

Apply No

Time Correction(s) 0.000

Roll offset: 0.000

Manufacturer:

Model:

Serial Number:

TPU

Time Stamp: 2014-162 00:00

Comments:

Offsets

Motion sensing unit to the transducer 1

X Head 1 2.485

Y Head 1 -0.183

Z Head 1 1.416

Motion sensing unit to the transducer 2

X Head 2 2.485

Y Head 2 -0.183

Z Head 2 1.416

Navigation antenna to the transducer 1

X Head 1 2.793

Y Head 1 0.367

Z Head 1 2.530

Navigation antenna to the transducer 2

X Head 2 2.793

Y Head 2 0.367

Z Head 2 2.530

Roll offset of transducer number 1 0.000

Roll offset of transducer number 2 0.000

Heave Error: 0.050 or 5.000'' of heave amplitude.

Measurement errors: 0.002

Motion sensing unit alignment errors

Gyro:0.050 Pitch:0.020 Roll:0.020

Gyro measurement error: 0.020
Roll measurement error: 0.020
Pitch measurement error: 0.020
Navigation measurement error: 0.033
Transducer timing error: 0.005
Navigation timing error: 0.005
Gyro timing error: 0.005
Heave timing error: 0.005
PitchTimingStdDev: 0.005
Roll timing error: 0.005
Sound Velocity speed measurement error: 0.000
Surface sound speed measurement error: 0.000
Tide measurement error: 0.000
Tide zoning error: 0.000
Speed over ground measurement error: 0.030
Dynamic loading measurement error: 0.000
Static draft measurement error: 0.000
Delta draft measurement error: 0.000
StDev Comment: (null)

Time Stamp: 2014-163 00:00

Comments:

Offsets

Motion sensing unit to the transducer 1

X Head 1 2.485

Y Head 1 -0.183

Z Head 1 1.416

Motion sensing unit to the transducer 2

X Head 2 2.485

Y Head 2 -0.183

Z Head 2 1.416

Navigation antenna to the transducer 1

X Head 1 2.793

Y Head 1 0.367

Z Head 1 2.530

Navigation antenna to the transducer 2

X Head 2 2.793

Y Head 2 0.367

Z Head 2 2.530

Roll offset of transducer number 1 0.000

Roll offset of transducer number 2 0.000

Heave Error: 0.050 or 5.000'' of heave amplitude.

Measurement errors: 0.002

Motion sensing unit alignment errors

Gyro:0.050 Pitch:0.020 Roll:0.020

Gyro measurement error: 0.020

Roll measurement error: 0.020

Pitch measurement error: 0.020

Navigation measurement error: 0.033

Transducer timing error: 0.005

Navigation timing error: 0.005

Gyro timing error: 0.005

Heave timing error: 0.005

PitchTimingStdDev: 0.005

Roll timing error: 0.005
Sound Velocity speed measurement error: 0.000
Surface sound speed measurement error: 0.000
Tide measurement error: 0.000
Tide zoning error: 0.000
Speed over ground measurement error: 0.030
Dynamic loading measurement error: 0.000
Static draft measurement error: 0.000
Delta draft measurement error: 0.000
StDev Comment: (null)

Time Stamp: 2014-167 00:00

Comments:

Offsets

Motion sensing unit to the transducer 1

X Head 1 2.485

Y Head 1 -0.183

Z Head 1 1.416

Motion sensing unit to the transducer 2

X Head 2 2.485

Y Head 2 -0.183

Z Head 2 1.416

Navigation antenna to the transducer 1

X Head 1 2.793

Y Head 1 0.367

Z Head 1 2.530

Navigation antenna to the transducer 2

X Head 2 2.793

Y Head 2 0.367

Z Head 2 2.530

Roll offset of transducer number 1 0.000

Roll offset of transducer number 2 0.000

Heave Error: 0.050 or 5.000'' of heave amplitude.

Measurement errors: 0.002

Motion sensing unit alignment errors

Gyro:0.050 Pitch:0.020 Roll:0.020

Gyro measurement error: 0.020

Roll measurement error: 0.020

Pitch measurement error: 0.020

Navigation measurement error: 0.033

Transducer timing error: 0.005

Navigation timing error: 0.005

Gyro timing error: 0.005

Heave timing error: 0.005

PitchTimingStdDev: 0.005

Roll timing error: 0.005

Sound Velocity speed measurement error: 0.000

Surface sound speed measurement error: 0.000

Tide measurement error: 0.000

Tide zoning error: 0.000

Speed over ground measurement error: 0.030

Dynamic loading measurement error: 0.000

Static draft measurement error: 0.000

Delta draft measurement error: 0.000

StDev Comment: (null)

Time Stamp: 2014-168 00:00

Comments:

Offsets

Motion sensing unit to the transducer 1

X Head 1 2.485

Y Head 1 -0.183

Z Head 1 1.416

Motion sensing unit to the transducer 2

X Head 2 2.485

Y Head 2 -0.183

Z Head 2 1.416

Navigation antenna to the transducer 1

X Head 1 0.136

Y Head 1 0.349

Z Head 1 2.512

Navigation antenna to the transducer 2

X Head 2 0.136

Y Head 2 0.349

Z Head 2 2.512

Roll offset of transducer number 1 0.000

Roll offset of transducer number 2 0.000

Heave Error: 0.050 or 5.000'' of heave amplitude.

Measurement errors: 0.002

Motion sensing unit alignment errors
Gyro:0.050 Pitch:0.020 Roll:0.020
Gyro measurement error: 0.020
Roll measurement error: 0.020
Pitch measurement error: 0.020
Navigation measurement error: 0.071
Transducer timing error: 0.005
Navigation timing error: 0.005
Gyro timing error: 0.005
Heave timing error: 0.005
PitchTimingStdDev: 0.005
Roll timing error: 0.005
Sound Velocity speed measurement error: 0.000
Surface sound speed measurement error: 0.000
Tide measurement error: 0.000
Tide zoning error: 0.000
Speed over ground measurement error: 0.030
Dynamic loading measurement error: 0.000
Static draft measurement error: 0.000
Delta draft measurement error: 0.000
StDev Comment: (null)

Time Stamp: 2014-169 00:00

Comments:

Offsets

Motion sensing unit to the transducer 1

X Head 1 2.485

Y Head 1 -0.183

Z Head 1 1.416

Motion sensing unit to the transducer 2

X Head 2 2.485

Y Head 2 -0.183

Z Head 2 1.416

Navigation antenna to the transducer 1

X Head 1 2.793

Y Head 1 0.367

Z Head 1 2.530

Navigation antenna to the transducer 2

X Head 2 2.793

Y Head 2 0.367

Z Head 2 2.530

Roll offset of transducer number 1 0.000

Roll offset of transducer number 2 0.000

Heave Error: 0.050 or 5.000'' of heave amplitude.

Measurement errors: 0.002

Motion sensing unit alignment errors

Gyro:0.050 Pitch:0.020 Roll:0.020

Gyro measurement error: 0.020

Roll measurement error: 0.020

Pitch measurement error: 0.020

Navigation measurement error: 0.033

Transducer timing error: 0.005

Navigation timing error: 0.005

Gyro timing error: 0.005

Heave timing error: 0.005
PitchTimingStdDev: 0.005
Roll timing error: 0.005
Sound Velocity speed measurement error: 0.000
Surface sound speed measurement error: 0.000
Tide measurement error: 0.000
Tide zoning error: 0.000
Speed over ground measurement error: 0.030
Dynamic loading measurement error: 0.000
Static draft measurement error: 0.000
Delta draft measurement error: 0.000
StDev Comment: (null)

Time Stamp: 2014-170 00:00

Comments:

Offsets

Motion sensing unit to the transducer 1

X Head 1 2.485

Y Head 1 -0.183

Z Head 1 1.416

Motion sensing unit to the transducer 2

X Head 2 2.485

Y Head 2 -0.183

Z Head 2 1.416

Navigation antenna to the transducer 1

X Head 1 0.136

Y Head 1 0.349

Z Head 1 2.512

Navigation antenna to the transducer 2

X Head 2 0.136

Y Head 2 0.349

Z Head 2 2.512

Roll offset of transducer number 1 0.000

Roll offset of transducer number 2 0.000

Heave Error: 0.050 or 5.000'' of heave amplitude.

Measurement errors: 0.002

Motion sensing unit alignment errors

Gyro:0.050 Pitch:0.020 Roll:0.020

Gyro measurement error: 0.020

Roll measurement error: 0.020

Pitch measurement error: 0.020

Navigation measurement error: 0.071

Transducer timing error: 0.005

Navigation timing error: 0.005

Gyro timing error: 0.005

Heave timing error: 0.005

PitchTimingStdDev: 0.005

Roll timing error: 0.005

Sound Velocity speed measurement error: 0.000

Surface sound speed measurement error: 0.000

Tide measurement error: 0.000

Tide zoning error: 0.000

Speed over ground measurement error: 0.030

Dynamic loading measurement error: 0.000

Static draft measurement error: 0.000

Delta draft measurement error: 0.000

StDev Comment: (null)

Svp Sensor:

Time Stamp: 2014-162 00:00

Comments:

Time Correction(s) 0.000

Svp #1:

Pitch Offset: 0.000

Roll Offset: 0.000

Azimuth Offset: 0.000

DeltaX: 2.485

DeltaY: -0.183

DeltaZ: 1.416

SVP #2:

Pitch Offset: 0.000

Roll Offset: 0.000

Azimuth Offset: 0.000

DeltaX: 2.485

DeltaY: -0.183

DeltaZ: 1.416

Time Stamp: 2014-163 00:00

Comments:

Time Correction(s) 0.000

Svp #1:

Pitch Offset: 0.000

Roll Offset: 0.000

Azimuth Offset: 0.000

DeltaX: 2.485

DeltaY: -0.183

DeltaZ: 1.416

SVP #2:

Pitch Offset: 0.000

Roll Offset: 0.000

Azimuth Offset: 0.000

DeltaX: 2.485

DeltaY: -0.183

DeltaZ: 1.416

Time Stamp: 2014-167 00:00

Comments:

Time Correction(s) 0.000

Svp #1:

Pitch Offset: 0.000

Roll Offset: 0.000

Azimuth Offset: 0.000

DeltaX: 2.485

DeltaY: -0.183

DeltaZ: 1.416

SVP #2:

Pitch Offset: 0.000

Roll Offset: 0.000

Azimuth Offset: 0.000

DeltaX: 2.485

DeltaY: -0.183

DeltaZ: 1.416

Time Stamp: 2014-168 00:00

Comments:

Time Correction(s) 0.000

Svp #1:

Pitch Offset: 0.000

Roll Offset: 0.000

Azimuth Offset: 0.000

DeltaX: 2.485

DeltaY: -0.183

DeltaZ: 1.416

SVP #2:

Pitch Offset: 0.000

Roll Offset: 0.000

Azimuth Offset: 0.000

DeltaX: 2.485

DeltaY: -0.183

DeltaZ: 1.416

Time Stamp: 2014-169 00:00

Comments:

Time Correction(s) 0.000

Svp #1:

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

DeltaX: 2.485
DeltaY: -0.183
DeltaZ: 1.416

SVP #2:

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

DeltaX: 2.485
DeltaY: -0.183
DeltaZ: 1.416

Time Stamp: 2014-170 00:00

Comments:

Time Correction(s) 0.000

Svp #1:

Pitch Offset: 0.000
Roll Offset: 0.000

Azimuth Offset: 0.000

DeltaX: 2.485

DeltaY: -0.183

DeltaZ: 1.416

SVP #2:

Pitch Offset: 0.000

Roll Offset: 0.000

Azimuth Offset: 0.000

DeltaX: 2.485

DeltaY: -0.183

DeltaZ: 1.416

MB1 (Trimble)

Vessel Name: MB1_Primary

Vessel created: July 21, 2014

Depth Sensor:

Sensor Class: Swath

Time Stamp: 2014-159 00:00

Comments:

Time Correction(s) 0.000

Transducer #1:

Pitch Offset: -2.000

Roll Offset: 1.600

Azimuth Offset: -1.500

DeltaX: -0.442

DeltaY: -0.215

DeltaZ: 1.152

Manufacturer: ODOM

Model: Unknown

Serial Number: 100126

Depth Sensor:

Sensor Class: Swath

Time Stamp: 2014-159 00:00

Comments:

Time Correction(s) 0.000

Transducer #1:

Pitch Offset: -2.000

Roll Offset: 1.600

Azimuth Offset: -1.500

DeltaX: -0.442

DeltaY: -0.215

DeltaZ: 1.152

Manufacturer: ODOM

Model: Unknown

Serial Number: 100126

Navigation Sensor:

Time Stamp: 2014-159 00:00

Comments: Trimble

Time Correction(s) 0.000

DeltaX: -0.307

DeltaY: -0.550

DeltaZ: -1.114

Manufacturer: Trimble

Model: zephyr Geodetic

Serial Number: 12682197

Gyro Sensor:

Time Stamp: 2014-159 00:00

Comments: (null)

Time Correction(s) 0.000

Entry 0) Draft: 0.000 Speed: 0.000

Heave Sensor:

Time Stamp: 2014-159 00:00

Comments:

Apply No

Time Correction(s) 0.000

DeltaX: 0.000

DeltaY: 0.000

DeltaZ: 0.000

Offset: 0.000

Manufacturer:

Model:

Serial Number:

Pitch Sensor:

Time Stamp: 2014-159 00:00

Comments:

Apply No

Time Correction(s) 0.000

Pitch offset: 0.000

Manufacturer:

Model:

Serial Number:

Roll Sensor:

Time Stamp: 2014-159 00:00

Comments:

Apply No

Time Correction(s) 0.000

Roll offset: 0.000

Manufacturer:

Model:

Serial Number:

TPU

Time Stamp: 2014-159 00:00

Comments: Trimble

Offsets

Motion sensing unit to the transducer 1

X Head 1 -0.442

Y Head 1 -0.215

Z Head 1 1.152

Motion sensing unit to the transducer 2

X Head 2 0.000

Y Head 2 0.000

Z Head 2 0.000

Navigation antenna to the transducer 1

X Head 1 -0.135

Y Head 1 0.334

Z Head 1 2.266

Navigation antenna to the transducer 2

X Head 2 0.000

Y Head 2 0.000

Z Head 2 0.000

Roll offset of transducer number 1 0.000

Roll offset of transducer number 2 0.000

Heave Error: 0.050 or 5.000'' of heave amplitude.

Measurement errors: 0.002

Motion sensing unit alignment errors

Gyro:0.050 Pitch:0.020 Roll:0.020

Gyro measurement error: 0.020

Roll measurement error: 0.020

Pitch measurement error: 0.020

Navigation measurement error: 0.033

Transducer timing error: 0.001

Navigation timing error: 0.001

Gyro timing error: 0.001

Heave timing error: 0.001

PitchTimingStdDev: 0.001

Roll timing error: 0.001

Sound Velocity speed measurement error: 0.000

Surface sound speed measurement error: 0.000

Tide measurement error: 0.000

Tide zoning error: 0.000

Speed over ground measurement error: 0.030

Dynamic loading measurement error: 0.000

Static draft measurement error: 0.000

Delta draft measurement error: 0.000

StDev Comment: (null)

Svp Sensor:

Time Stamp: 2014-159 00:00

Comments:

Time Correction(s) 0.000

Svp #1:

Pitch Offset: 0.000

Roll Offset: 0.000

Azimuth Offset: 0.000

DeltaX: -0.442

DeltaY: -0.215

DeltaZ: 1.152

SVP #2:

Pitch Offset: 0.000

Roll Offset: 0.000

Azimuth Offset: 0.000

DeltaX: 0.000

DeltaY: 0.000

DeltaZ: 0.000

WaterLine:

Time Stamp: 2014-159 00:00

Comments:

Apply Yes

WaterLine 0.650

MB1 (CNAV)

Vessel Name: MB1_CNAV_PT_Final

Vessel created: July 21, 2014

Depth Sensor:

Sensor Class: Swath

Time Stamp: 2014-159 00:00

Comments:

Time Correction(s) 0.000

Transducer #1:

Pitch Offset: -2.000

Roll Offset: 2.700

Azimuth Offset: -0.500

DeltaX: -0.442

DeltaY: -0.215

DeltaZ: 1.152

Manufacturer: ODOM

Model: Unknown

Serial Number: 100126

Depth Sensor:

Sensor Class: Swath

Time Stamp: 2014-159 00:00

Comments:

Time Correction(s) 0.000

Transducer #1:

Pitch Offset: -2.000

Roll Offset: 2.700

Azimuth Offset: -0.500

DeltaX: -0.442

DeltaY: -0.215

DeltaZ: 1.152

Manufacturer: ODOM

Model: Unknown

Serial Number: 100126

Navigation Sensor:

Time Stamp: 2014-159 00:00

Comments: CNAV

Time Correction(s) 0.000

DeltaX: 2.349

DeltaY: -0.532

DeltaZ: -1.096

Manufacturer: CNAV

Model: ANT3001R

Serial Number: 5906

Gyro Sensor:

Time Stamp: 2014-159 00:00

Comments: (null)

Time Correction(s) 0.000

Entry 0) Draft: 0.000 Speed: 0.000

Heave Sensor:

Time Stamp: 2014-159 00:00

Comments:

Apply No

Time Correction(s) 0.000

DeltaX: 0.000

DeltaY: 0.000

DeltaZ: 0.000

Offset: 0.000

Manufacturer:

Model:

Serial Number:

Pitch Sensor:

Time Stamp: 2014-159 00:00

Comments:

Apply No

Time Correction(s) 0.000

Pitch offset: 0.000

Manufacturer:

Model:

Serial Number:

Roll Sensor:

Time Stamp: 2014-159 00:00

Comments:

Apply No

Time Correction(s) 0.000

Roll offset: 0.000

Manufacturer:

Model:

Serial Number:

TPU

Time Stamp: 2014-159 00:00

Comments: CNAV

Offsets

Motion sensing unit to the transducer 1

X Head 1 -0.442

Y Head 1 -0.215

Z Head 1 1.152

Motion sensing unit to the transducer 2

X Head 2 0.000

Y Head 2 0.000

Z Head 2 0.000

Navigation antenna to the transducer 1

X Head 1 -2.792

Y Head 1 0.317

Z Head 1 2.248

Navigation antenna to the transducer 2

X Head 2 0.000

Y Head 2 0.000

Z Head 2 0.000

Roll offset of transducer number 1 0.000

Roll offset of transducer number 2 0.000

Heave Error: 0.050 or 5.000'' of heave amplitude.

Measurement errors: 0.002

Motion sensing unit alignment errors

Gyro:0.050 Pitch:0.020 Roll:0.020

Gyro measurement error: 0.020

Roll measurement error: 0.020

Pitch measurement error: 0.020

Navigation measurement error: 0.071

Transducer timing error: 0.001

Navigation timing error: 0.001
Gyro timing error: 0.001
Heave timing error: 0.001
PitchTimingStdDev: 0.001
Roll timing error: 0.001
Sound Velocity speed measurement error: 0.000
Surface sound speed measurement error: 0.000
Tide measurement error: 0.000
Tide zoning error: 0.000
Speed over ground measurement error: 0.030
Dynamic loading measurement error: 0.000
Static draft measurement error: 0.000
Delta draft measurement error: 0.000
StDev Comment: (null)

Svp Sensor:

Time Stamp: 2014-159 00:00

Comments:

Time Correction(s) 0.000

Svp #1:

Pitch Offset: 0.000

Roll Offset: 0.000

Azimuth Offset: 0.000

DeltaX: -0.442

DeltaY: -0.215

DeltaZ: 1.152

SVP #2:

Pitch Offset: 0.000

Roll Offset: 0.000

Azimuth Offset: 0.000

DeltaX: 0.000

DeltaY: 0.000

DeltaZ: 0.000

WaterLine:

Time Stamp: 2014-159 00:00

Comments:

Apply Yes

WaterLine 0.650

MB1 (Traditional Tides)

Vessel Name: MB1_CNAV_Manual_Tide

Vessel created: July 21, 2014

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2014-159 00:00

Comments:

Time Correction(s) 0.000

Transducer #1:

Pitch Offset: -2.000
Roll Offset: 2.700
Azimuth Offset: -0.500

DeltaX: -0.442
DeltaY: -0.215
DeltaZ: 1.152

Manufacturer: ODOM
Model: Unknown
Serial Number: 100126

Depth Sensor:

Sensor Class: Swath

Time Stamp: 2014-159 00:00

Comments:

Time Correction(s) 0.000

Transducer #1:

Pitch Offset: -2.000

Roll Offset: 2.700

Azimuth Offset: -0.500

DeltaX: -0.442

DeltaY: -0.215

DeltaZ: 1.152

Manufacturer: ODOM

Model: Unknown

Serial Number: 100126

Navigation Sensor:

Time Stamp: 2014-159 00:00

Comments: CNAV

Time Correction(s) 0.000

DeltaX: 2.349

DeltaY: -0.532

DeltaZ: -1.096

Manufacturer: CNAV

Model: ANT3001R

Serial Number: 5906

Gyro Sensor:

Time Stamp: 2014-159 00:00

Comments: (null)

Time Correction(s) 0.000

Entry 0) Draft: 0.000 Speed: 0.000

Heave Sensor:

Time Stamp: 2014-159 00:00

Comments:

Apply No

Time Correction(s) 0.000

DeltaX: 0.000

DeltaY: 0.000

DeltaZ: 0.000

Offset: 0.000

Manufacturer:

Model:

Serial Number:

Pitch Sensor:

Time Stamp: 2014-159 00:00

Comments:

Apply No

Time Correction(s) 0.000

Pitch offset: 0.000

Manufacturer:

Model:

Serial Number:

Roll Sensor:

Time Stamp: 2014-159 00:00

Comments:

Apply No

Time Correction(s) 0.000

Roll offset: 0.000

Manufacturer:

Model:

Serial Number:

TPU

Time Stamp: 2014-159 00:00

Comments: CNAV

Offsets

Motion sensing unit to the transducer 1

X Head 1 -0.442

Y Head 1 -0.215

Z Head 1 1.152

Motion sensing unit to the transducer 2

X Head 2 0.000

Y Head 2 0.000

Z Head 2 0.000

Navigation antenna to the transducer 1

X Head 1 -2.792

Y Head 1 0.317

Z Head 1 2.248

Navigation antenna to the transducer 2

X Head 2 0.000

Y Head 2 0.000

Z Head 2 0.000

Roll offset of transducer number 1 0.000

Roll offset of transducer number 2 0.000

Heave Error: 0.050 or 5.000'' of heave amplitude.

Measurement errors: 0.002

Motion sensing unit alignment errors

Gyro:0.050 Pitch:0.020 Roll:0.020

Gyro measurement error: 0.020

Roll measurement error: 0.020

Pitch measurement error: 0.020

Navigation measurement error: 0.071

Transducer timing error: 0.001

Navigation timing error: 0.001

Gyro timing error: 0.001

Heave timing error: 0.001

PitchTimingStdDev: 0.001

Roll timing error: 0.001

Sound Velocity speed measurement error: 0.000

Surface sound speed measurement error: 0.000

Tide measurement error: 0.000

Tide zoning error: 0.000

Speed over ground measurement error: 0.030

Dynamic loading measurement error: 0.044

Static draft measurement error: 0.044

Delta draft measurement error: 0.050

StDev Comment: (null)

Svp Sensor:

Time Stamp: 2014-159 00:00

Comments:

Time Correction(s) 0.000

Svp #1:

Pitch Offset: 0.000

Roll Offset: 0.000

Azimuth Offset: 0.000

DeltaX: -0.442

DeltaY: -0.215

DeltaZ: 1.152

SVP #2:

Pitch Offset: 0.000

Roll Offset: 0.000

Azimuth Offset: 0.000

DeltaX: 0.000

DeltaY: 0.000

DeltaZ: 0.000

WaterLine:

Time Stamp: 2014-159 00:00

Comments:

Apply Yes

WaterLine 0.650

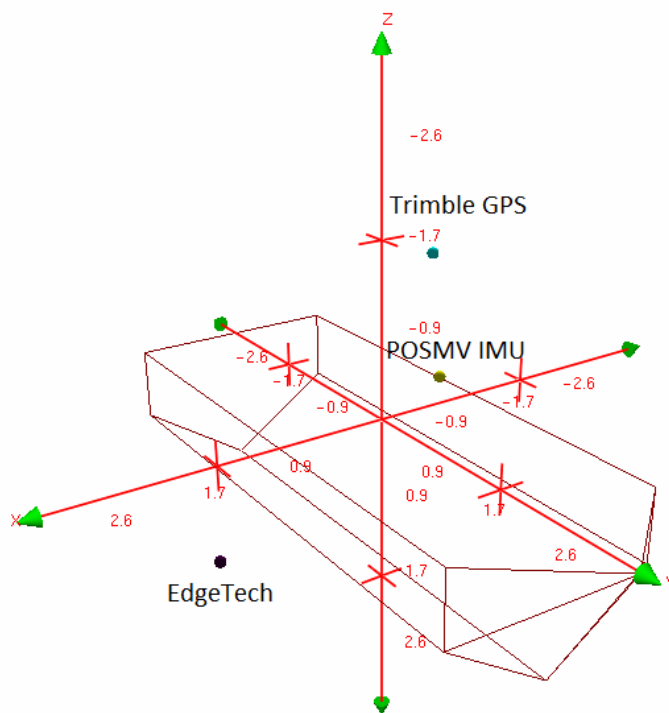


Figure 34 Caris HIPS EdgeTech (Trimble)

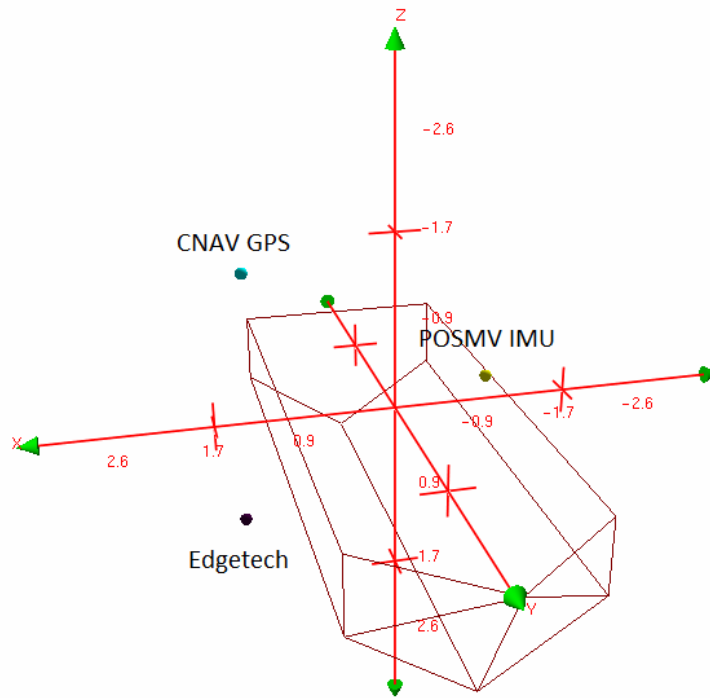


Figure 35 Caris HIPS EdgeTech (CNAV)

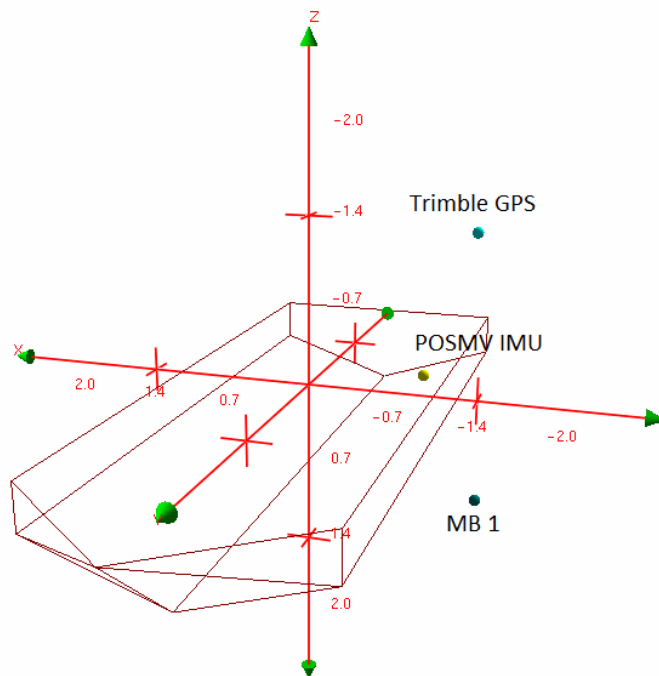


Figure 36 Caris HIPS MB1 (Trimble)

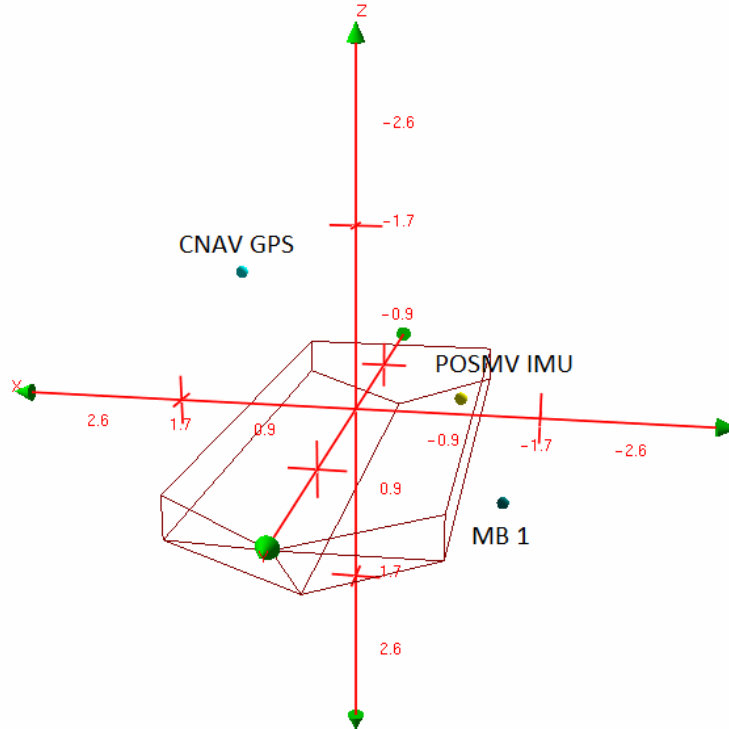


Figure 37 Caris HIPS MB1 (CNAV)

I.2 Vessel Configuration Survey Data

The benchmark positions, relative to benchmark 1, used in the vessel configuration survey are shown in table I.1

Control Points				
	X	Y	Z	
1	0.000	0.000	0.000	
2	0.000	14.421	0.015	

Table 30 Relative Benchmark Positions

Positions for relevant sensors and reference points obtained through adjustment in Leica GeoOffice and rotated to the local POSMV coordinate system are shown in table 16. An image of the adjusted points and baselines is shown in figure 26.

(NOTE: All distances are in meters and defined in the POSMV coordinate system: X is the centerline and positive forward, Y is positive to starboard, Z is positive down.)

		X	Y	Z
PA1	Port Antenna Bow	-0.0153	-0.3020	-1.129
PA2	Port Antenna Stern	-0.5496	-0.3073	-1.114
SA2	Starboard Antenna Bow	-0.0002	2.3423	-1.102
SA1	Starboard Antenna Stern	-0.5322	2.3492	-1.096
OC	Odom Center	-0.2152	-0.4424	1.152
ECP	Edgetech Center Port	-0.1829	2.3753	1.416
ECS	Edgetech Center Starboard	-0.1829	2.5953	1.416
DC	Deck Center	-0.1367	1.0157	0.201
BC	Bow Center	3.6309	0.9943	0.004
EP1	Edgetech Pole Top	-0.2684	2.4857	-0.933
EP2	Edgetech Pole Bottom	-0.1959	2.5097	0.638
OP1	Odom Pole Top	-0.2731	-0.4488	-0.729
OP2	Odom Pole Bottom	-0.2032	-0.4618	0.630

Table 31 Sensor/Reference Positions Relative to IMU (Reference Point)

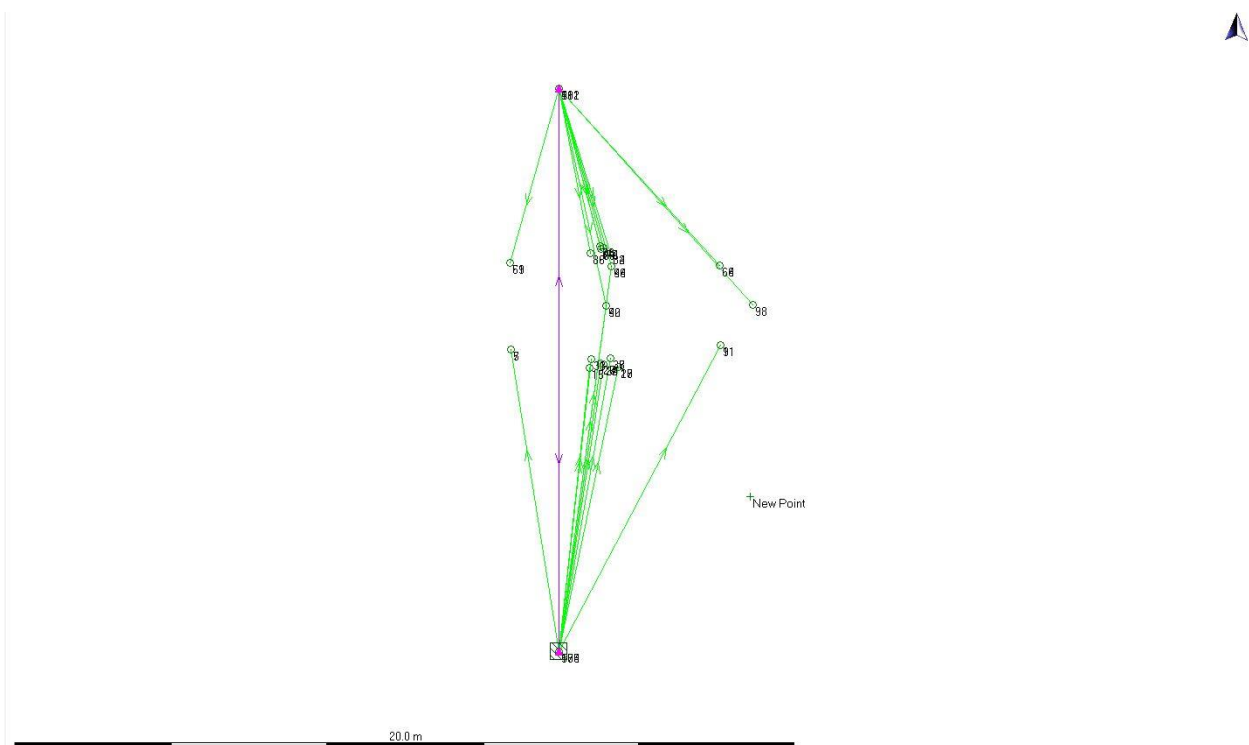
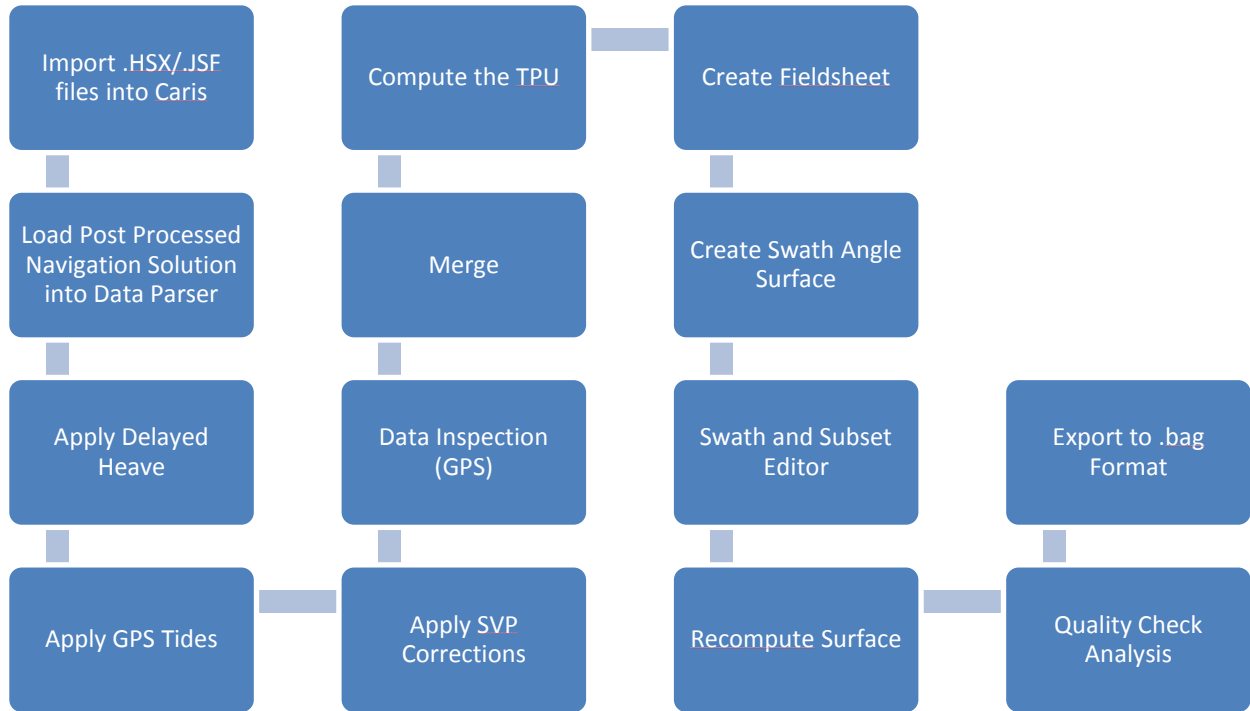


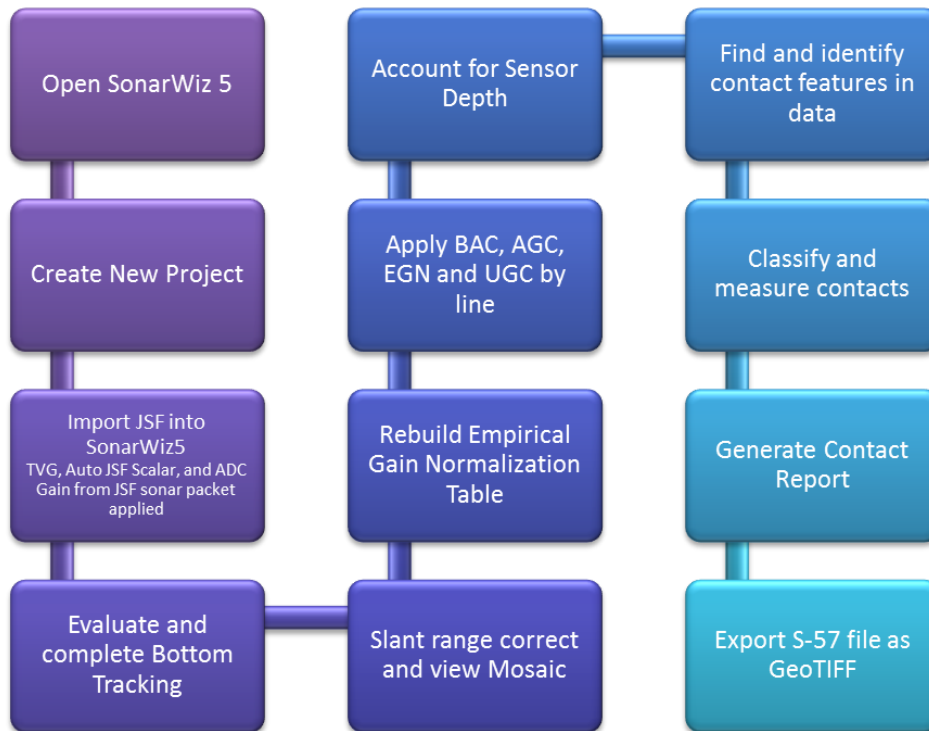
Figure 38 Leica GeoOffice Vessel Configuration Adjustment

II Data Processing Workflow Diagrams

II.1 Caris HIPS Workflow



II.2 SonarWiz Workflow



III Systems and Sensors

III.1 Wiring Diagram

Teledyne/Odom MB1

Heading I/O and GNSS I/O to POSMV COM 2 via null modem and RS-232 serial cable

HPR I/O to POSMV COM 3 via null modem and RS-232 serial cable

LAN 1 to HUB via Ethernet cable

1PPS In to POSMV 1PPS via RG-59/U coaxial cable

Sonar 1 to transducer

Power to UPS

EdgeTech 4600

COM 1 to POSMV COM 4 via RS-232 serial cable

COM 2 to POSMV COM 5 via null modem and RS-232 serial cable

LAN to HUB via Ethernet cable

Monitor 1 to Monitor via DVI-D cable

Monitor 2 to Monitor via DVI-D cable

1PPS to POSMV 1PPS via RG-59/U coaxial cable

SEA CABLE to transducer

Power to UPS

Applanix POSMV

ANT1 to Primary Antenna via RG-303/U coaxial cable

ANT2 to Secondary Antenna via RG-303/U coaxial cable

COM1 to CNAV COM2 USB via RS-232 serial cable

COM2 to null modem split to MB1 Heading I/O and GNSS I/O via RS-232 serial cable

COM3 to null modem to MB1 HPR I/O via RS-232 serial cable

COM4 to EdgeTech via RS-232 serial cable

COM5 to null modem to EdgeTech via RS-232 serial cable

PPS OUT split to MB1 1PPS and EdgeTech 1PPS via RG-59/U coaxial cable

LAN to HUB via Ethernet cable

IMU to IMU via RS-422 serial cable

PWR to UPS

CNAV 3050

ANT to Antenna via RG-303/U coaxial cable

COM2 USB to POSMV COM1 and Laptop via split cable RS-232 and USB

POWER to UPS

TRIMBLE

GNSS to Antenna via RG-303/U coaxial cable

POWER/ETHERNET via special adaptor to Laptop via Ethernet cable and UPS

NOTE: Only connected to Laptop to start/stop logging and download data, during acquisition, the unit is stand alone.

Laptop (Field 2)

USB to CNAV COM2 USB via split cable RS-232 and USB

LAN to HUB via Ethernet cable

Monitor port to coxswain's monitor via DE-15 monitor cable

Power to UPS

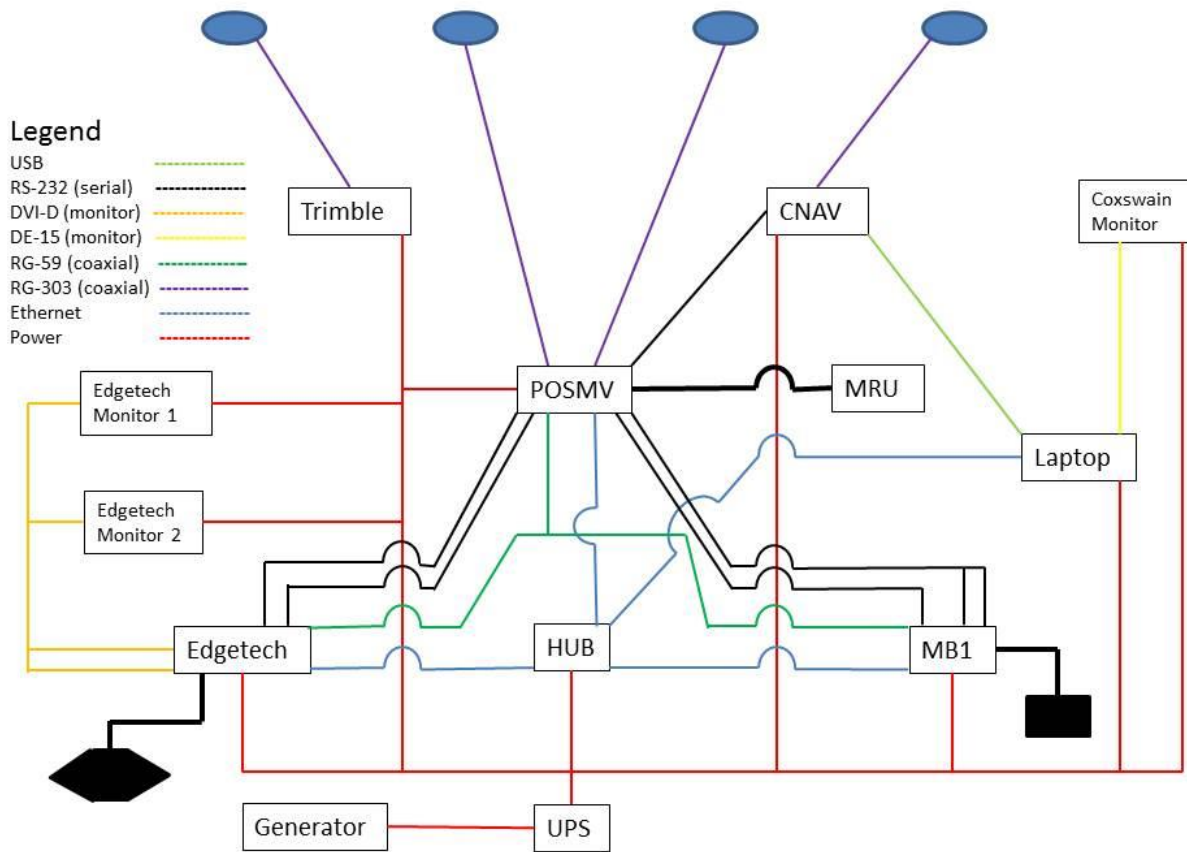


Figure 39 Wiring Diagram

III.2 MBES Coverage Calculation

Area	Total Area (m ²)	Coverage Area (m ²)	Percentage
BWYC	35207	20184	57
Marina	70669	51464	73
Area 3	1584927	1044699	66

Table 32 EdgeTech Coverage by Area

	Total Area (m ²)	Coverage Area (m ²)	Percentage
BWYC	35207	9311	26
Marina	70669	24048	34
Area 3	1584927	412976	26

Table 33 MB1 Coverage by Area

IV. Sound Velocity Profiles

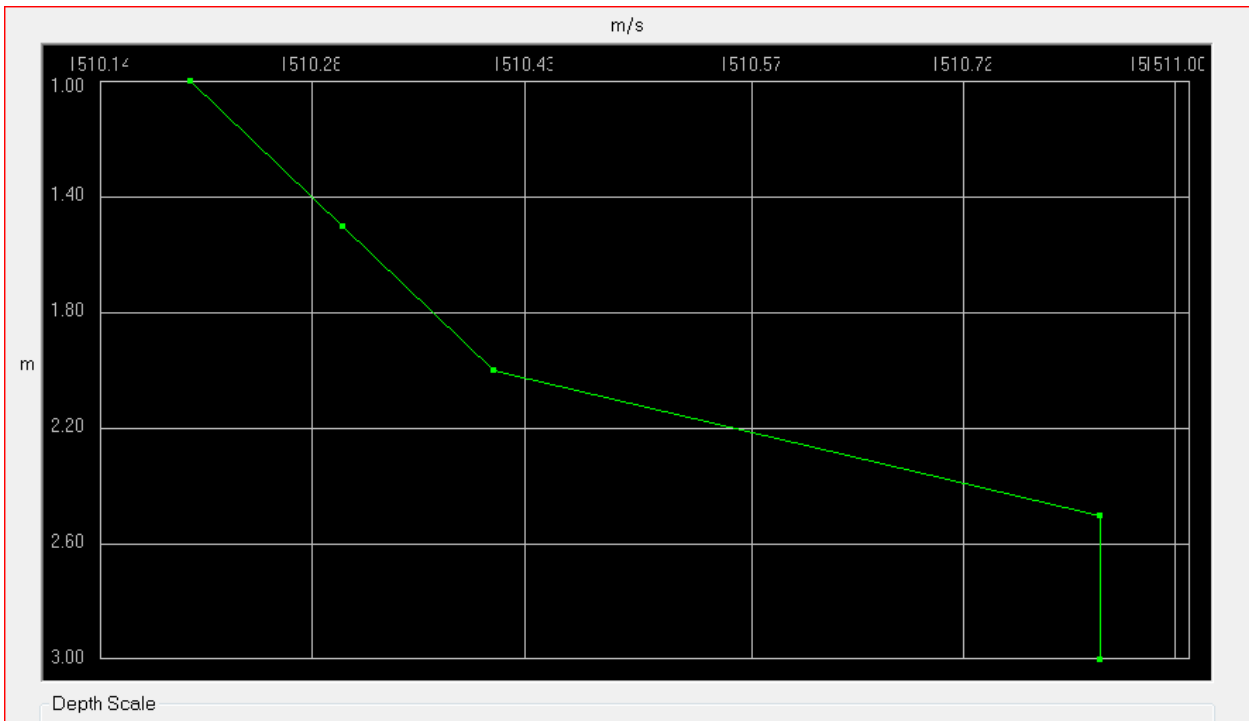


Figure 40 SVP Cast 2014-162 18:25:00 30°18'48"N 089°14'32"W

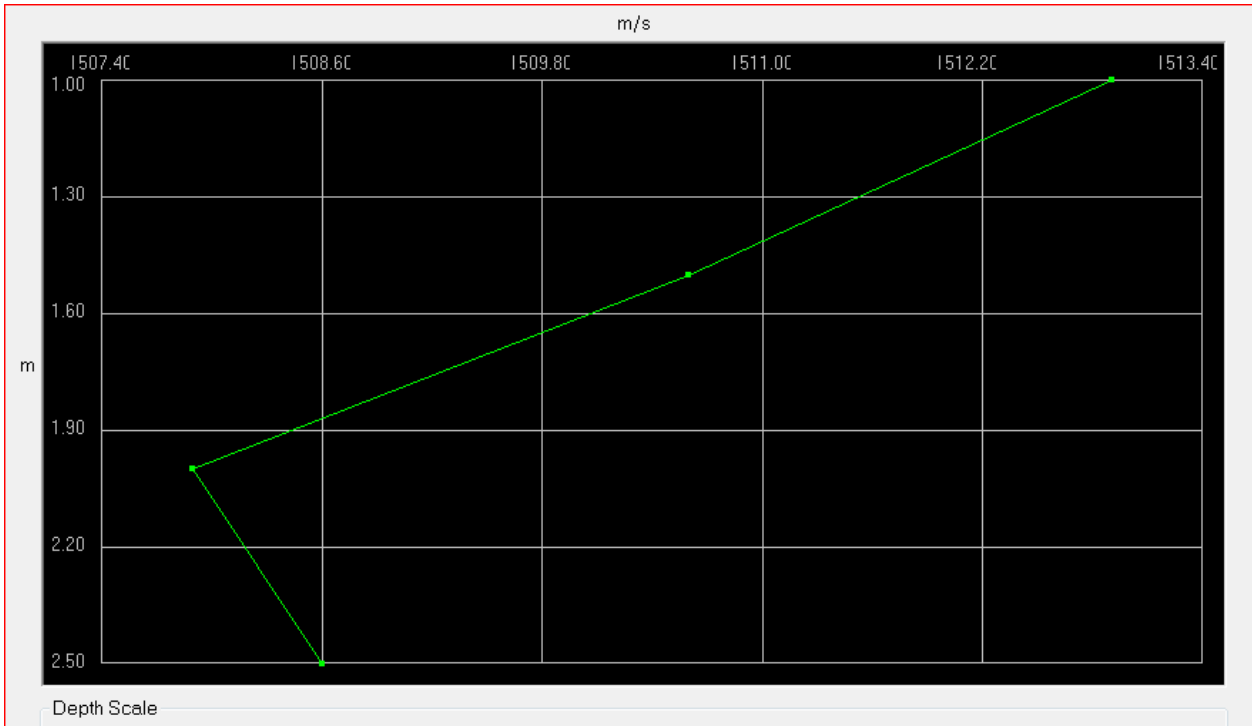


Figure 41 SVP Cast 2014-162 20:15:00 30°18'43"N 089°19'18"W

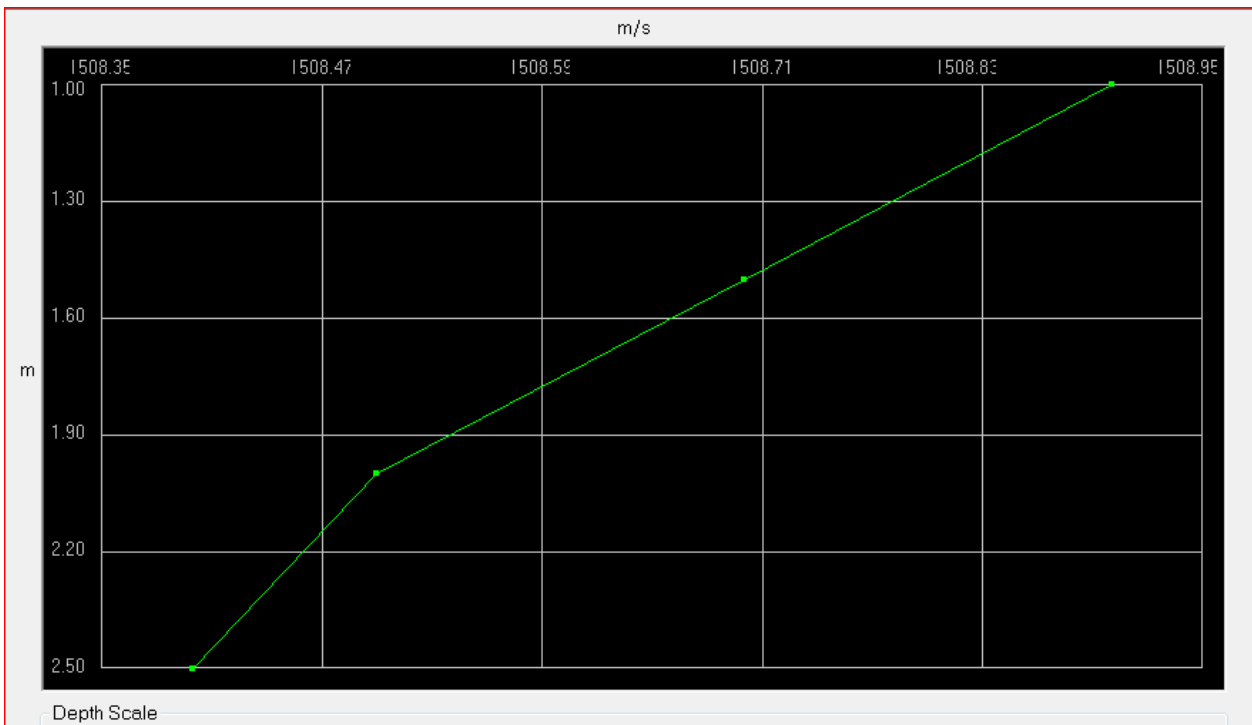


Figure 42 SVP Cast 2014-162 21:01:00 30°18'43"N 089°19'18"W

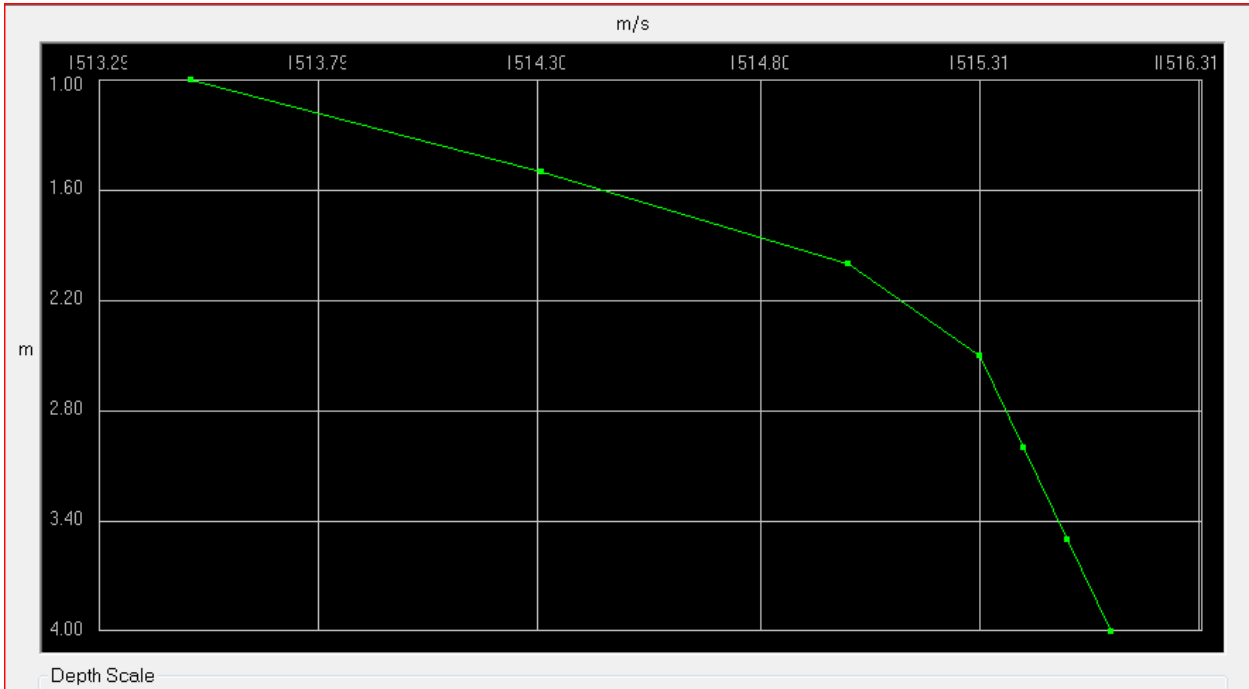


Figure 43 SVP Cast 2014-163 14:31:00 30°18'35"N 089°14'43"W

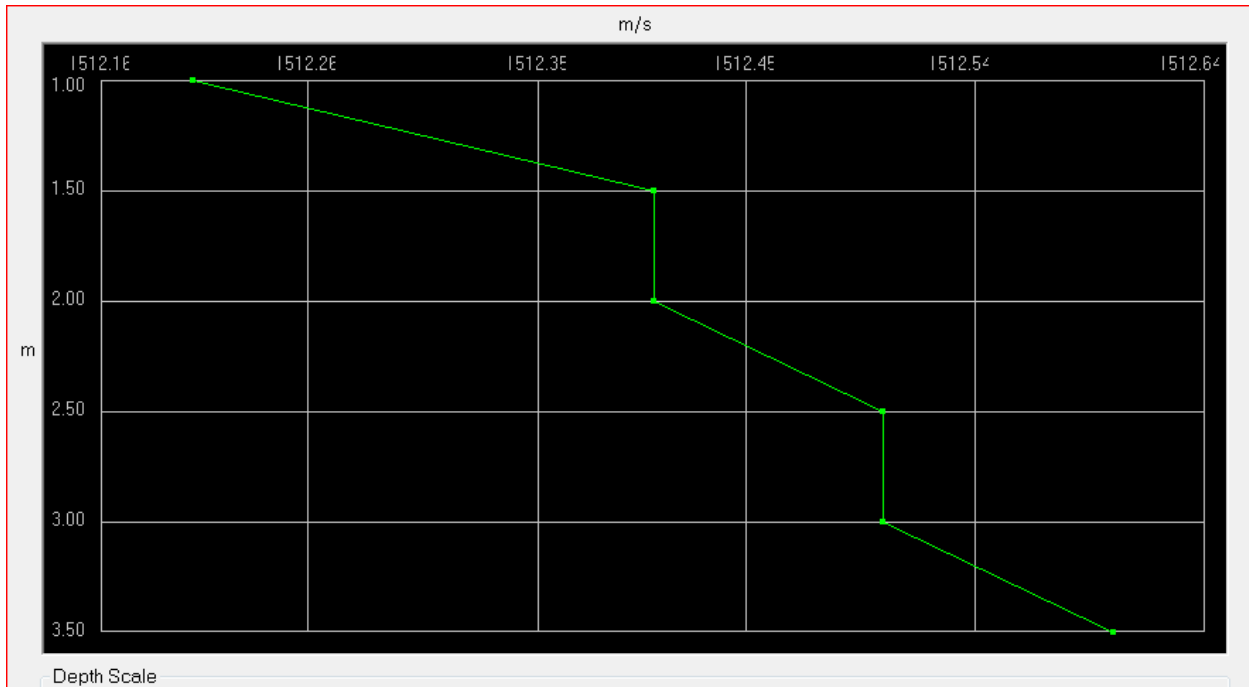


Figure 44 SVP Cast 2014-163 15:34:00 30°18'35"N 089°18'23"W

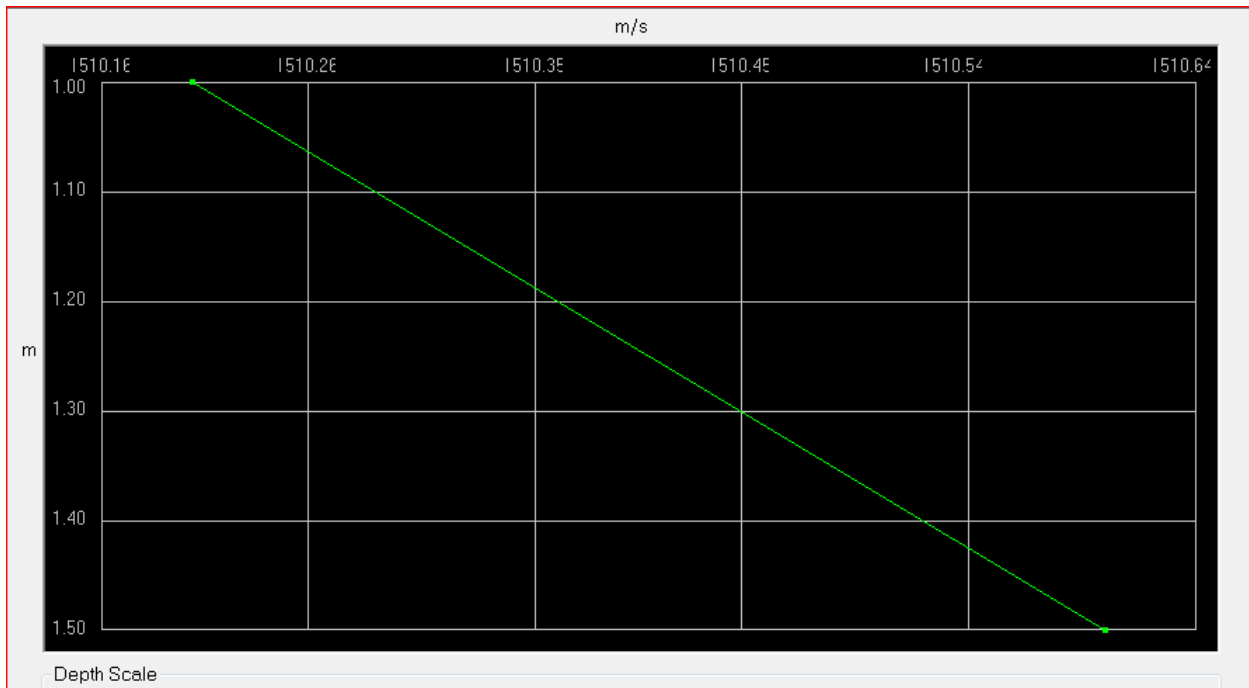


Figure 45 SVP Cast 2014-163 18:11:00 30°19'29"N 089°19'08"W

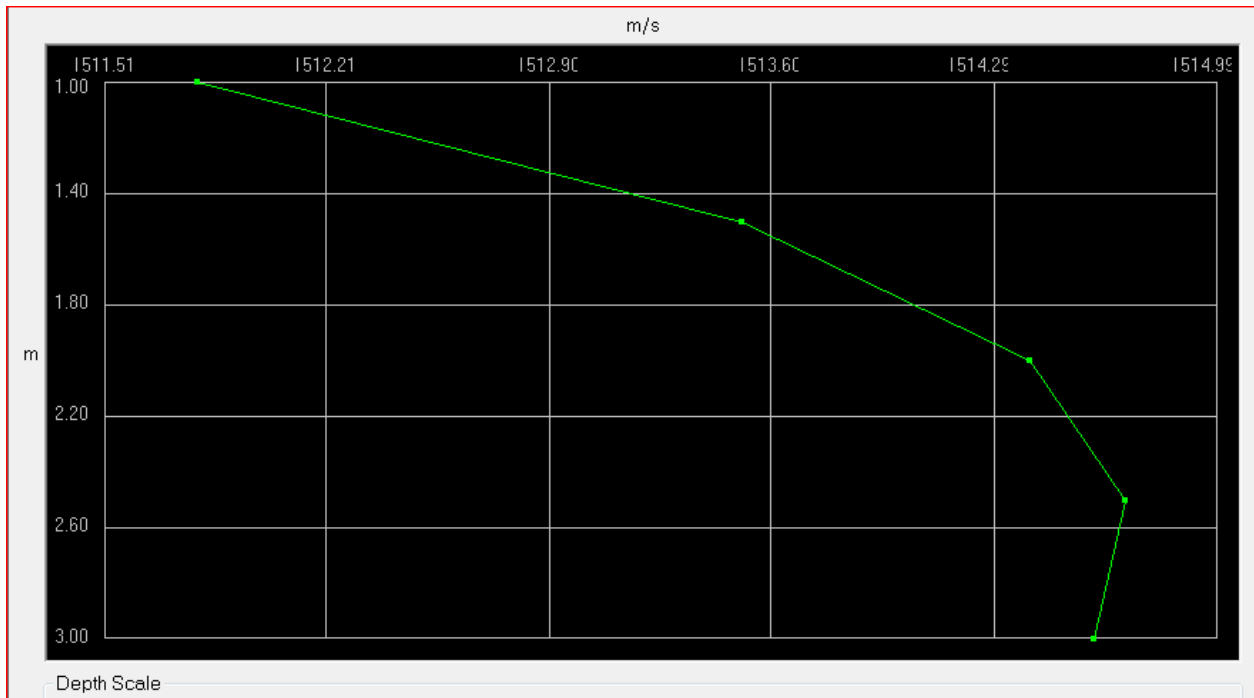


Figure 46 SVP Cast 2014-167 14:55:53 30°19'40"N 089°19'00"W

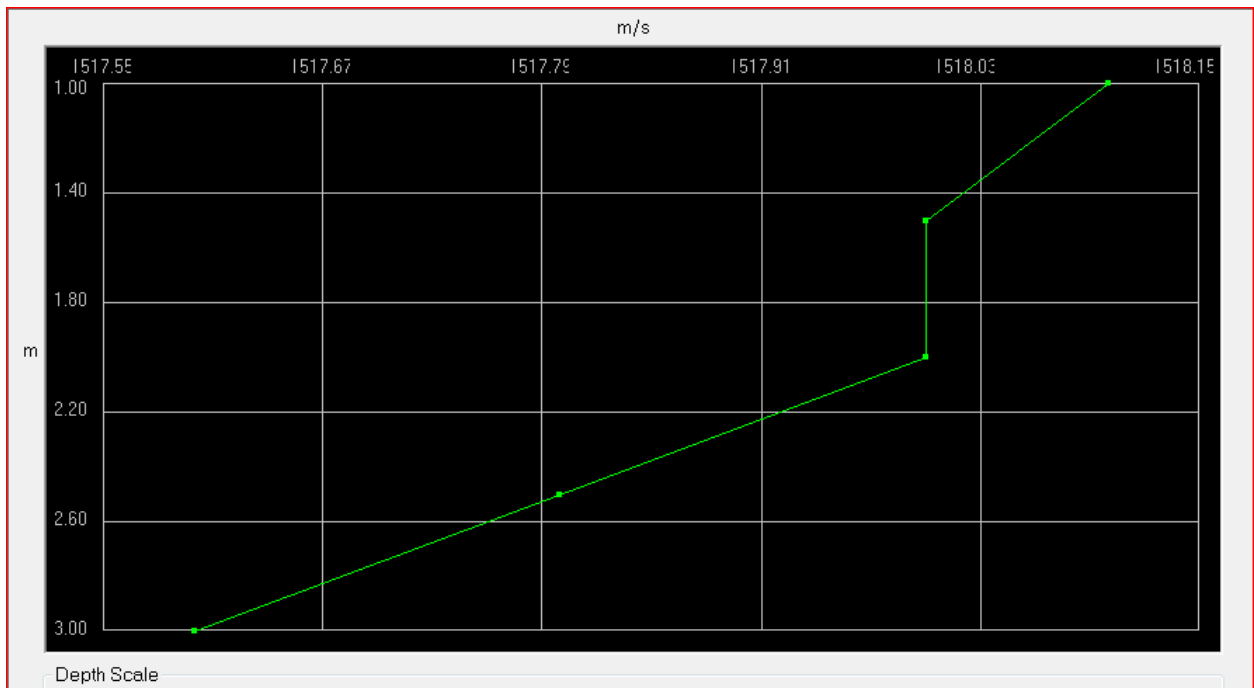


Figure 47 SVP Cast 2014-167 20:08:49 30°18'37"N 089°19'07"W

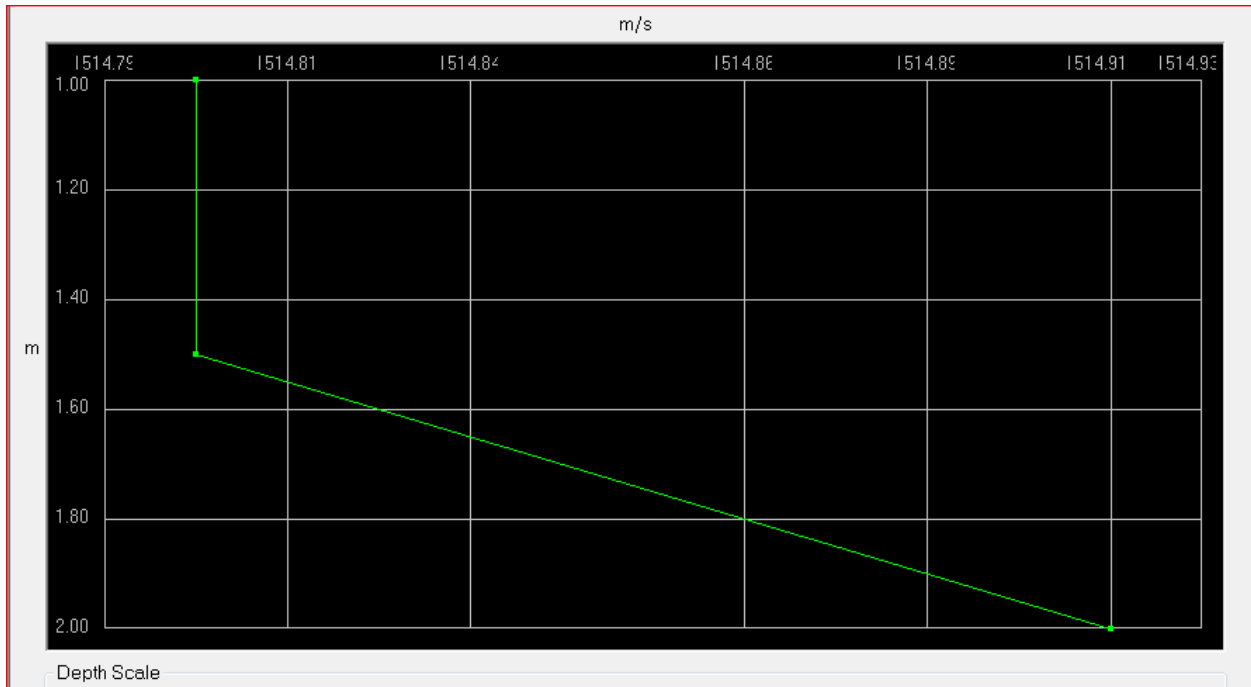


Figure 48 SVP Cast 2014-168 13:24:00 30°19'44"N 089°19'10"W

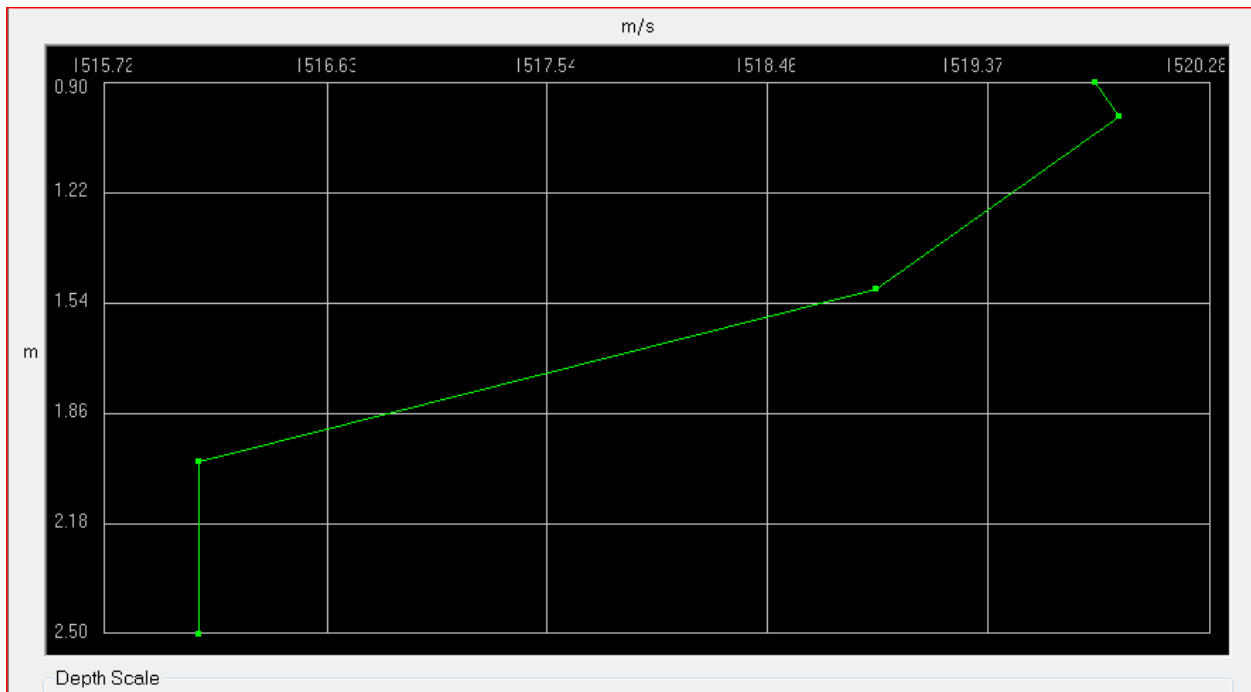


Figure 49 SVP Cast 2014-168 17:07:00 30°18'30"N 089°19'11"W

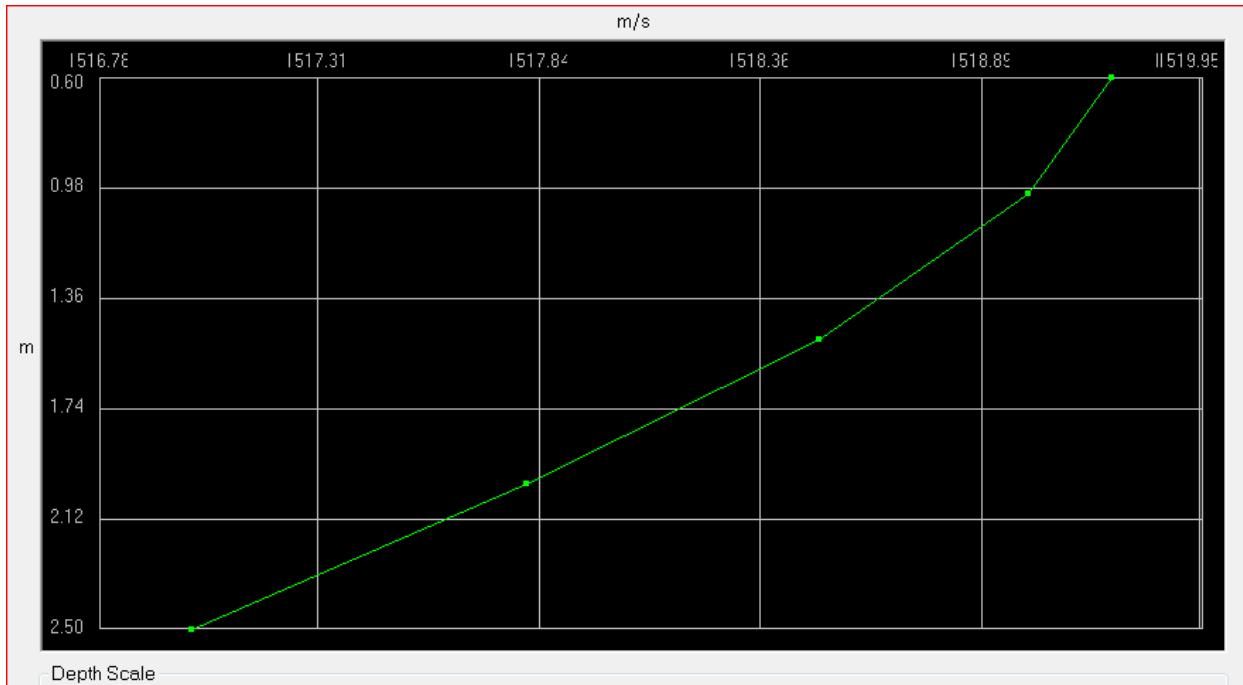


Figure 50 SVP Cast 2014-168 19:25:00 30°19'30"N 089°18'48"W

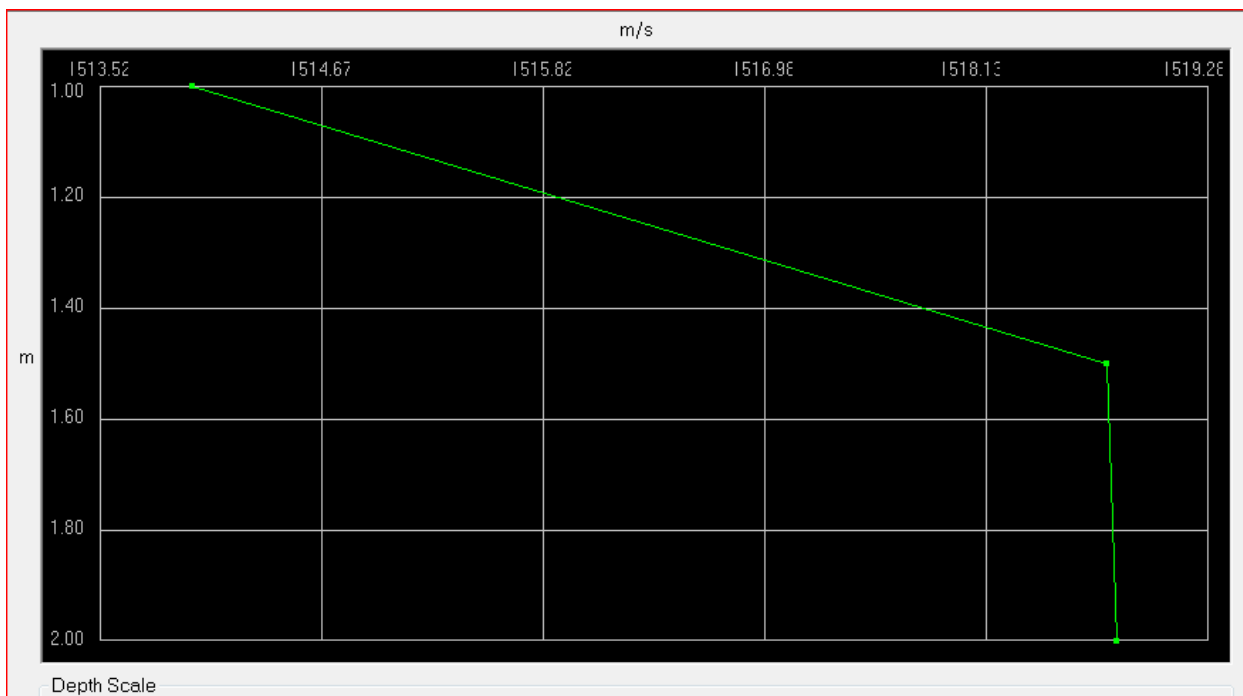


Figure 51 SVP Cast 2014-169 13:27:26 30°19'20"N 089°18'57"W

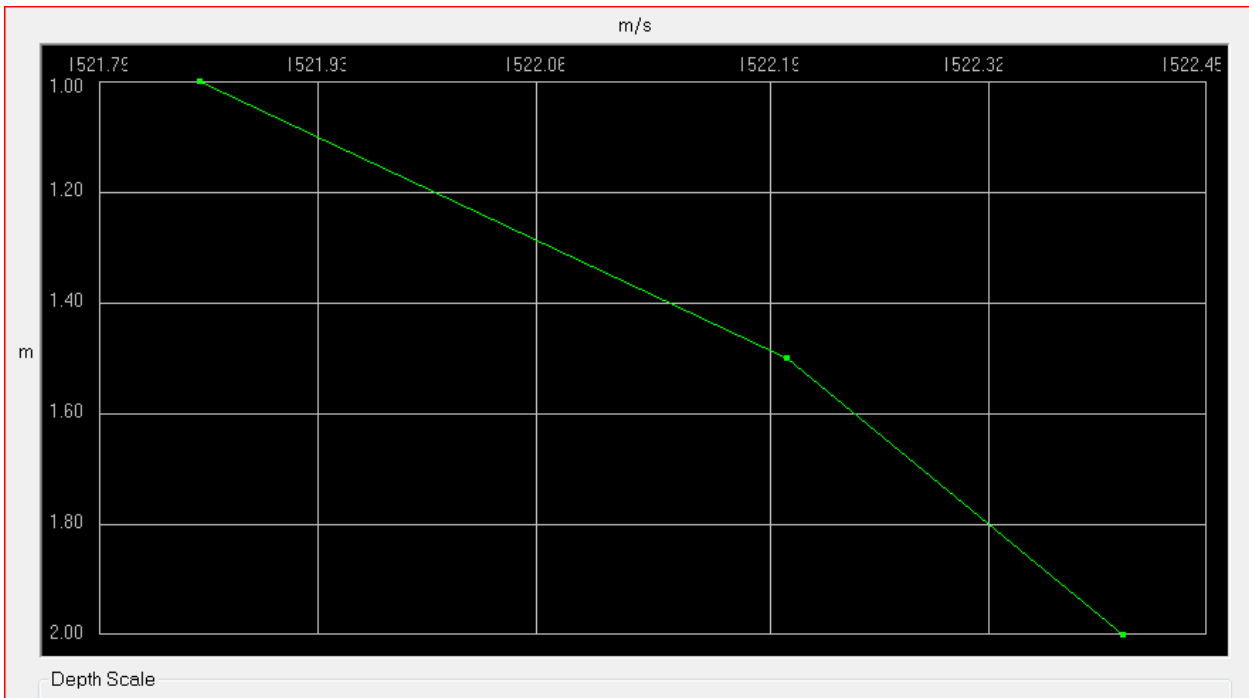


Figure 52 SVP Cast 2014-169 17:34:21 30°18'42"N 089°14'34"W

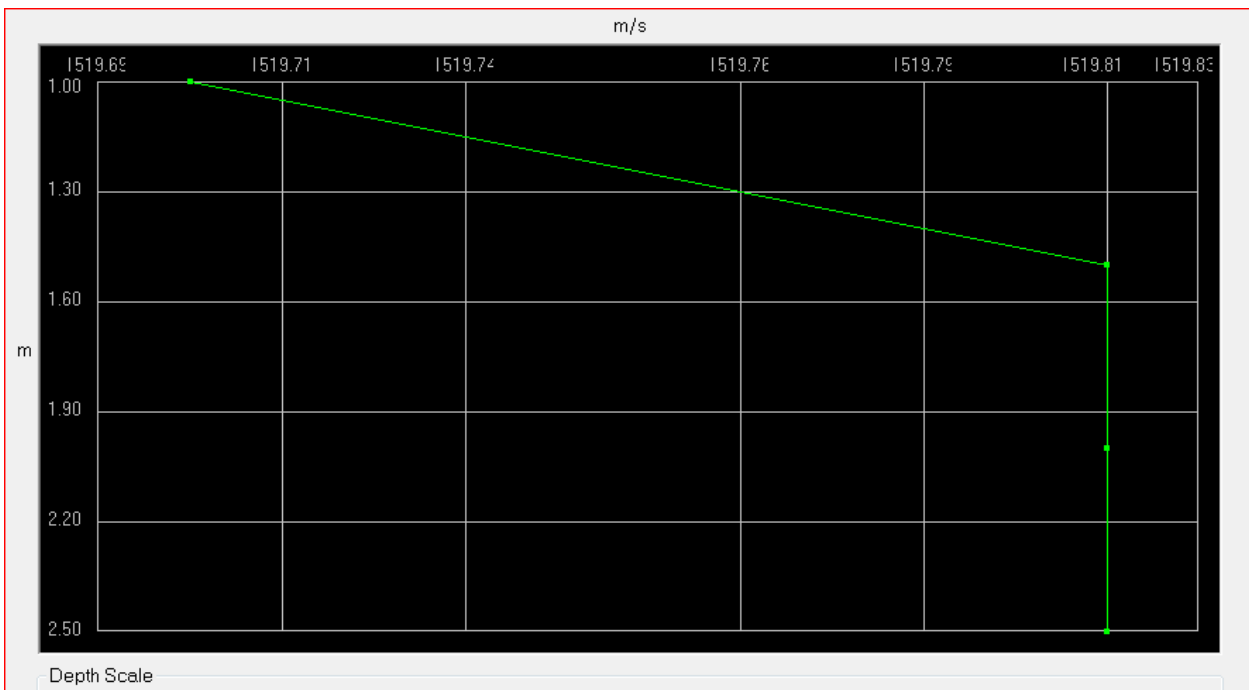
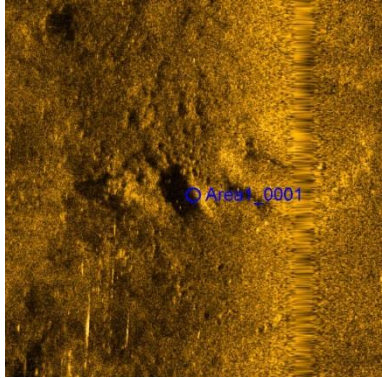
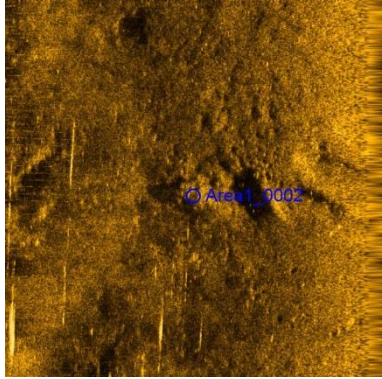


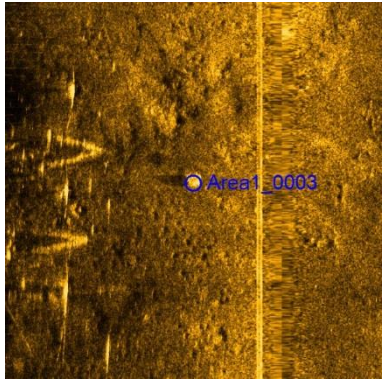
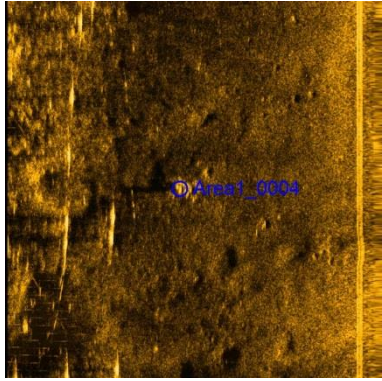
Figure 53 SVP Cast 2014-170 14:39:00 30°18'42"N 089°19'06"W

V. SSS Contact Reports

Report 14USM02_Area_1_Targets

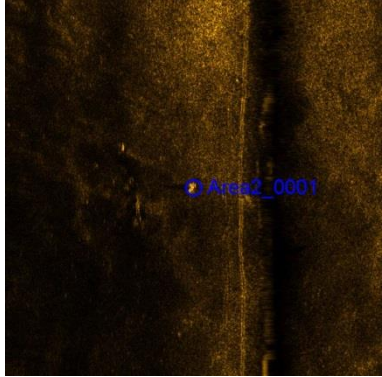
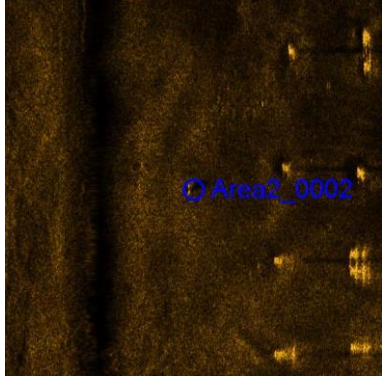
Generated on 7/2/2014 2:52:14 PM by SonarWiz

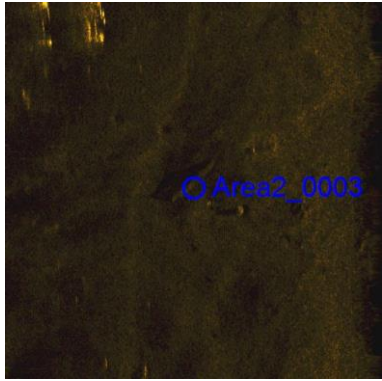
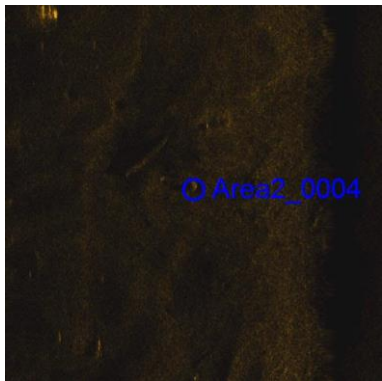
Target Image	Target Info	User Entered Info
 <p>A sonar image showing a dark, irregularly shaped target on a lighter, textured seabed. A blue circle with the text 'Area1_0001' is overlaid on the target.</p>	<p>Area1_0001</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/12/2014 6:20:49 PM • Click Position 30.3253354987 -89.3263674089 (WGS84) 30.3251392298 -89.3263211613 (NAD27LL) 30.3253354987 -89.3263674089 (LocalLL) (X) 276332.38 (Y) 3357129.52 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: U:\HydroData\Team_BayStLouis\SSS\jd163\20140612182034_Binned.jsf • Ping Number: 449498 • Range to target: 6.53 Meters • Fish Height: 2.94 Meters • Heading: 316.800 Degrees • Event Number: 0 • Line Name: 20140612182034_Binned • Water Depth: 1.28 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.42 Meters • Target Height: 0.61 Meters • Target Length: 3.23 Meters • Target Shadow: 1.87 Meters • Mag Anomaly: • Avoidance Area: • Classification1: soft mud • Classification2: • Area: • Block: • Description: Mound
 <p>A sonar image showing a dark, irregularly shaped target on a lighter, textured seabed. A blue circle with the text 'Area1_0002' is overlaid on the target.</p>	<p>Area1_0002</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/12/2014 6:20:49 PM • Click Position 30.3253083053 -89.3264003493 (WGS84) 30.3251120362 -89.3263541008 (NAD27LL) 30.3253083053 -89.3264003493 (LocalLL) (X) 276329.15 (Y) 3357126.57 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: U:\HydroData\Team_BayStLouis\SSS\jd163\20140612182034_Binned.jsf • Ping Number: 449495 • Range to target: 10.90 Meters • Fish Height: 2.94 Meters • Heading: 316.800 Degrees • Event Number: 0 • Line Name: 20140612182034_Binned • Water Depth: 1.44 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 1.76 Meters • Target Height: 0.47 Meters • Target Length: 1.95 Meters • Target Shadow: 2.14 Meters • Mag Anomaly: • Avoidance Area: • Classification1: soft mud • Classification2: • Area: • Block: • Description: Mound

	<p>Area1_0003</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/12/2014 6:28:36 PM • Click Position <ul style="list-style-type: none"> 30.3252516652 -89.3266672688 (WGS84) 30.3250553972 -89.3266210107 (NAD27LL) 30.3252516652 -89.3266672688 (LocalLL) (X) 276303.35 (Y) 3357120.82 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: U:\HydroData\Team_BayStLouis\SSS\jd163\20140612182819_Binned.jsf • Ping Number: 462023 • Range to target: 5.29 Meters • Fish Height: 2.48 Meters • Heading: 315.100 Degrees • Event Number: 0 • Line Name: 20140612182819_Binned • Water Depth: 1.05 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 1.13 Meters • Target Height: 0.62 Meters • Target Length: 1.01 Meters • Target Shadow: 1.92 Meters • Mag Anomaly: • Avoidance Area: • Classification1: large rocks • Classification2: • Area: • Block: • Description:
	<p>Area1_0004</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/12/2014 7:00:51 PM • Click Position <ul style="list-style-type: none"> 30.3244315196 -89.3269542571 (WGS84) 30.3242352390 -89.3269080012 (NAD27LL) 30.3244315196 -89.3269542571 (LocalLL) (X) 276273.88 (Y) 3357030.47 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: U:\HydroData\Team_BayStLouis\SSS\jd163\20140612190001_Binned.jsf • Ping Number: 513960 • Range to target: 12.05 Meters • Fish Height: 2.48 Meters • Heading: 231.800 Degrees • Event Number: 0 • Line Name: 20140612190001_Binned • Water Depth: 0.98 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 1.48 Meters • Target Height: 0.46 Meters • Target Length: 1.21 Meters • Target Shadow: 2.77 Meters • Mag Anomaly: • Avoidance Area: • Classification1: debris • Classification2: • Area: • Block: • Description:

Report 14USM02_Area_2_Targets

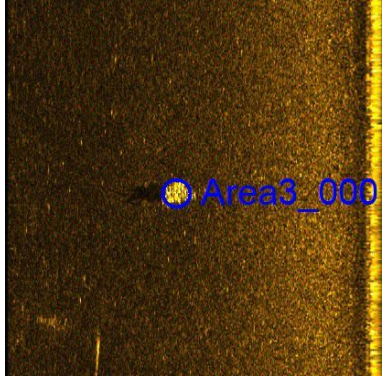
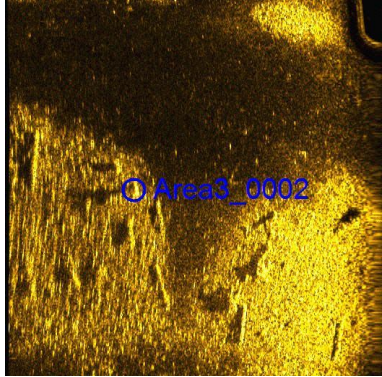
Generated on 7/2/2014 2:50:12 PM by SonarWiz

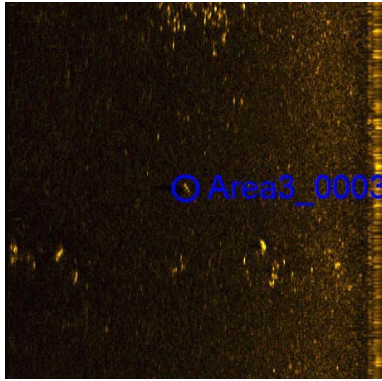
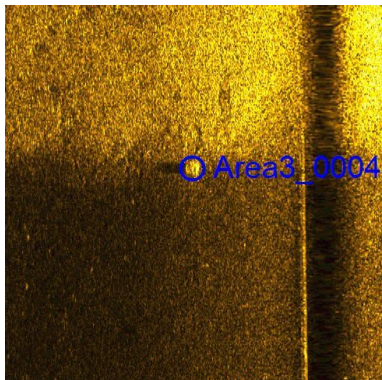
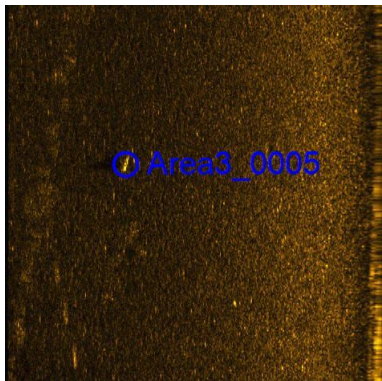
Target Image	Target Info	User Entered Info
 <p>A sonar image showing a dark, textured seabed with a vertical line of data. A blue circle with the text 'Area2_0001' is overlaid on the image.</p>	<p>Area2_0001</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/11/2014 9:18:42 PM • Click Position 30.3105661153 -89.3215706666 (WGS84) 30.3103695394 -89.3215248535 (NAD27LL) 30.3105661153 -89.3215706666 (LocalLL) (X) 276760.17 (Y) 3355482.76 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: U:\HydroData\Team_BayStLouis\SSS\jd162\20140611211736_Binned.jsf • Ping Number: 79701 • Range to target: 4.70 Meters • Fish Height: 2.04 Meters • Heading: 217.800 Degrees • Event Number: 0 • Line Name: 20140611211736_Binned • Water Depth: 2.43 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.47 Meters • Target Height: 0.45 Meters • Target Length: 0.83 Meters • Target Shadow: 1.45 Meters • Mag Anomaly: • Avoidance Area: • Classification1: debris • Classification2: • Area: Mississippi Sound (AL) • Block: • Description:
 <p>A sonar image showing a dark, textured seabed with several bright, vertical streaks. A blue circle with the text 'Area2_0002' is overlaid on the image.</p>	<p>Area2_0002</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/11/2014 9:29:51 PM • Click Position 30.3106767984 -89.3220003148 (WGS84) 30.3104802281 -89.3219544828 (NAD27LL) 30.3106767984 -89.3220003148 (LocalLL) (X) 276719.10 (Y) 3355495.87 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: U:\HydroData\Team_BayStLouis\SSS\jd162\20140611212906_Binned.jsf • Ping Number: 97662 • Range to target: 5.80 Meters • Fish Height: 1.90 Meters • Heading: 212.600 Degrees • Event Number: 0 • Line Name: 20140611212906_Binned • Water Depth: 2.35 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.32 Meters • Target Height: 0.32 Meters • Target Length: 0.86 Meters • Target Shadow: 1.21 Meters • Mag Anomaly: • Avoidance Area: • Classification1: debris • Classification2: • Area: Mississippi Sound (AL) • Block: • Description:

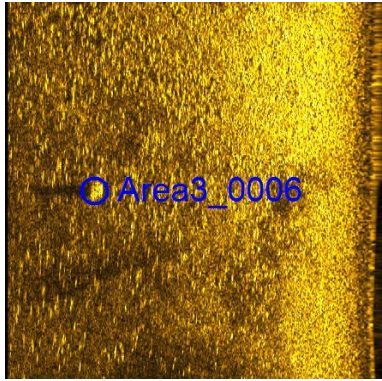
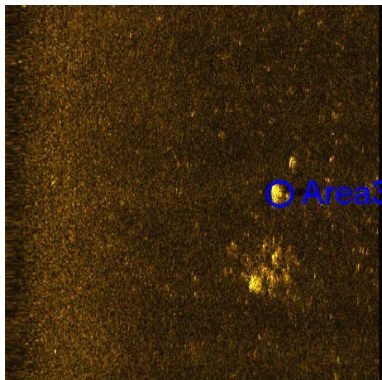
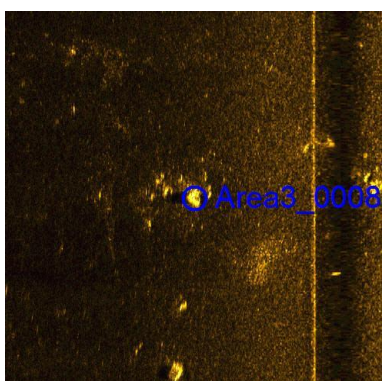
	<p>Area2_0003</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/11/2014 9:44:30 PM • Click Position 30.3110324975 -89.3230731300 (WGS84) 30.3108359424 -89.3230272494 (NAD27LL) 30.3110324975 -89.3230731300 (LocalLL) (X) 276616.72 (Y) 3355537.42 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: U:\HydroData\Team_BayStLouis\SSS\jd162\20140611214311_Binned.jsf • Ping Number: 121252 • Range to target: 11.11 Meters • Fish Height: 2.24 Meters • Heading: 24.500 Degrees • Event Number: 0 • Line Name: 20140611214311_Binned • Water Depth: 2.63 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.33 Meters • Target Height: 0.48 Meters • Target Length: 3.71 Meters • Target Shadow: 3.12 Meters • Mag Anomaly: • Avoidance Area: • Classification1: debris • Classification2: • Area: Mississippi Sound (AL) • Block: • Description: Log
	<p>Area2_0004</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/11/2014 9:44:31 PM • Click Position 30.3110352120 -89.3230397160 (WGS84) 30.3108386567 -89.3229938367 (NAD27LL) 30.3110352120 -89.3230397160 (LocalLL) (X) 276619.94 (Y) 3355537.65 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: U:\HydroData\Team_BayStLouis\SSS\jd162\20140611214311_Binned.jsf • Ping Number: 121271 • Range to target: 8.35 Meters • Fish Height: 2.26 Meters • Heading: 26.100 Degrees • Event Number: 0 • Line Name: 20140611214311_Binned • Water Depth: 2.78 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.21 Meters • Target Height: 0.32 Meters • Target Length: 0.58 Meters • Target Shadow: 1.45 Meters • Mag Anomaly: • Avoidance Area: • Classification1: debris • Classification2: • Area: Mississippi Sound (AL) • Block: • Description:

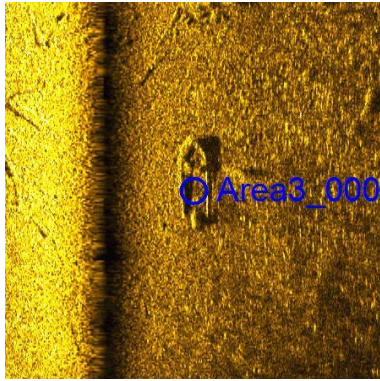
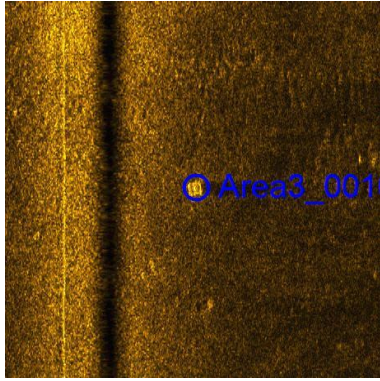
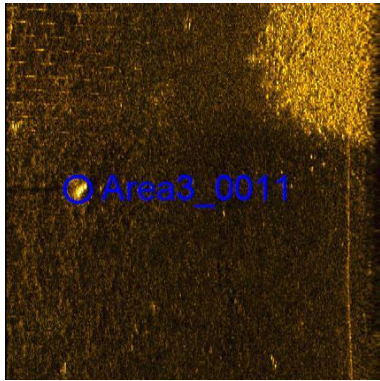
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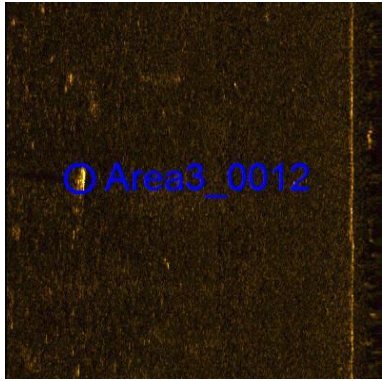
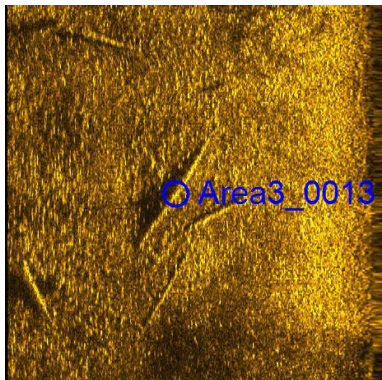
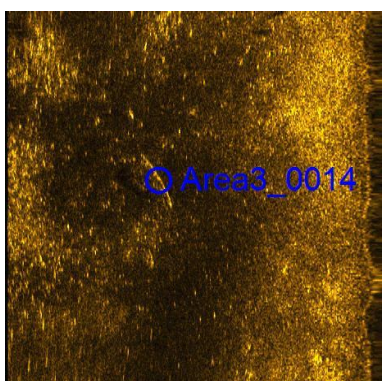
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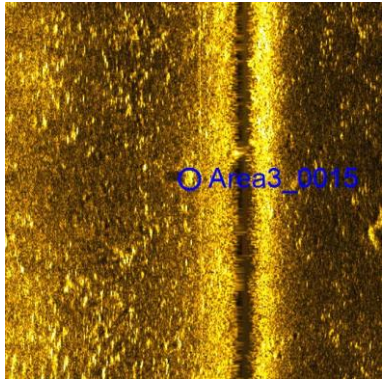
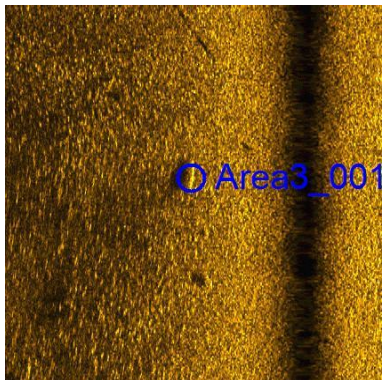
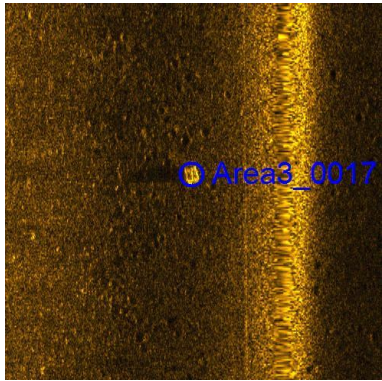
Target Image	Target Info	User Entered Info
	<p>Area3_0001</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/12/2014 4:20:59 PM • Click Position 30.3195288684 -89.3147159155 (WGS84) 30.3193324005 -89.3146702265 (NAD27LL) 30.3195288684 -89.3147159155 (LocalLL) (X) 277439.77 (Y) 3356462.88 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: C:\Users\lw746681\Desktop\EDGE_SSS\jd163\20140612161352_Binned.jsf • Ping Number: 256548 • Range to target: 12.25 Meters • Fish Height: 2.74 Meters • Heading: 358.300 Degrees • Event Number: 0 • Line Name: 20140612161352_Binned • Water Depth: 3.05 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 1.86 Meters • Target Height: 0.35 Meters • Target Length: 1.31 Meters • Target Shadow: 1.86 Meters • Mag Anomaly: • Avoidance Area: • Classification1: rock outcrop • Classification2: • Area: • Block: • Description: Debris/Rock
	<p>Area3_0002</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/12/2014 4:42:37 PM • Click Position 30.3092498808 -89.3149658044 (WGS84) 30.3090532266 -89.3149202757 (NAD27LL) 30.3092498808 -89.3149658044 (LocalLL) (X) 277392.49 (Y) 3355323.86 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: C:\Users\lw746681\Desktop\EDGE_SSS\jd163\20140612164208_Binned.jsf • Ping Number: 291394 • Range to target: 14.82 Meters • Fish Height: 3.26 Meters • Heading: 13.800 Degrees • Event Number: 0 • Line Name: 20140612164208_Binned • Water Depth: 3.16 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.69 Meters • Target Height: 0.41 Meters • Target Length: 0.96 Meters • Target Shadow: 2.15 Meters • Mag Anomaly: • Avoidance Area: • Classification1: debris • Classification2: • Area: • Block: • Description: Log/Piling

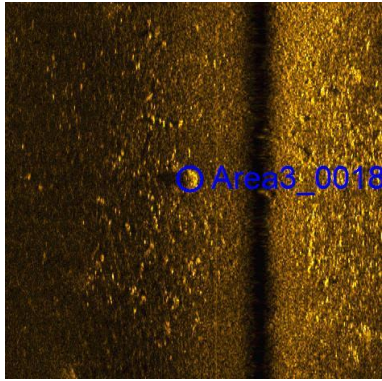
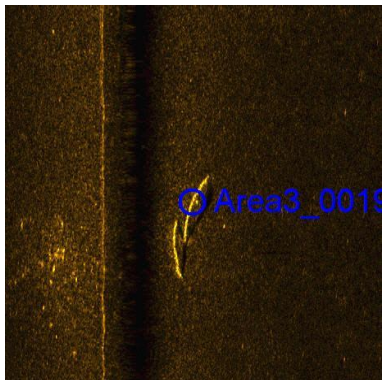
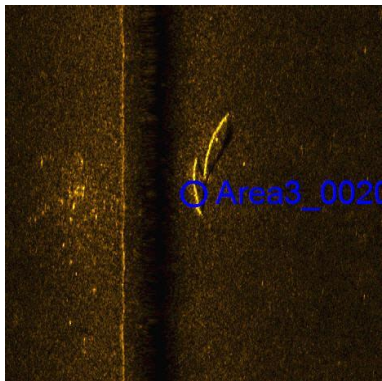
	<p>Area3_0003</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/12/2014 4:45:23 PM • Click Position 30.3133021733 -89.3149715238 (WGS84) 30.3131055934 -89.3149259279 (NAD27LL) 30.3133021733 -89.3149715238 (LocalLL) (X) 277401.10 (Y) 3355773.10 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: C:\Users\lw746681\Desktop\EDGE_SSS\jd163\20140612164208_Binned.jsf • Ping Number: 295846 • Range to target: 11.74 Meters • Fish Height: 2.77 Meters • Heading: 356.800 Degrees • Event Number: 0 • Line Name: 20140612164208_Binned • Water Depth: 2.81 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.25 Meters • Target Height: 0.37 Meters • Target Length: 0.67 Meters • Target Shadow: 1.88 Meters • Mag Anomaly: • Avoidance Area: • Classification1: piling • Classification2: • Area: • Block: • Description:
	<p>Area3_0004</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/12/2014 5:03:35 PM • Click Position 30.3186145241 -89.3144214950 (WGS84) 30.3184180370 -89.3143758329 (NAD27LL) 30.3186145241 -89.3144214950 (LocalLL) (X) 277466.02 (Y) 3356360.94 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: C:\Users\lw746681\Desktop\EDGE_SSS\jd163\20140612165725_Binned.jsf • Ping Number: 325130 • Range to target: 7.91 Meters • Fish Height: 2.47 Meters • Heading: 183.500 Degrees • Event Number: 0 • Line Name: 20140612165725_Binned • Water Depth: 3.28 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.84 Meters • Target Height: 0.43 Meters • Target Length: 0.89 Meters • Target Shadow: 1.77 Meters • Mag Anomaly: • Avoidance Area: • Classification1: debris • Classification2: • Area: • Block: • Description:
	<p>Area3_0005</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/12/2014 5:04:06 PM • Click Position 30.3191449412 -89.3150359231 (WGS84) 30.3189484688 -89.3149902277 (NAD27LL) 30.3191449412 -89.3150359231 (LocalLL) (X) 277408.12 (Y) 3356420.95 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: C:\Users\lw746681\Desktop\EDGE_SSS\jd163\20140612165725_Binned.jsf • Ping Number: 325942 • Range to target: 15.31 Meters • Fish Height: 2.85 Meters • Heading: 175.900 Degrees • Event Number: 0 • Line Name: 20140612165725_Binned • Water Depth: 2.91 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.20 Meters • Target Height: 0.34 Meters • Target Length: 0.93 Meters • Target Shadow: 2.11 Meters • Mag Anomaly: • Avoidance Area: • Classification1: debris • Classification2: • Area: • Block: • Description:

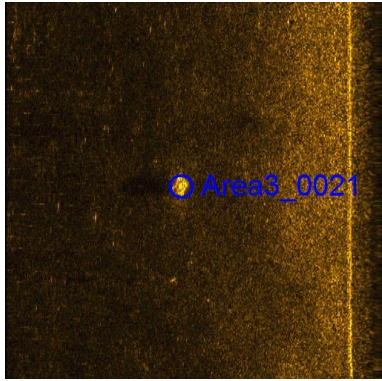
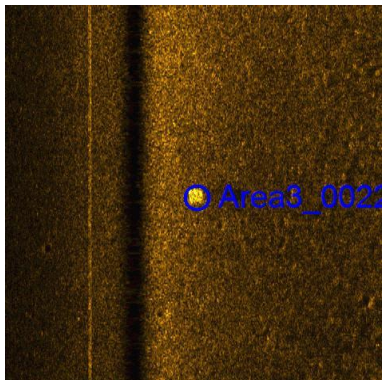
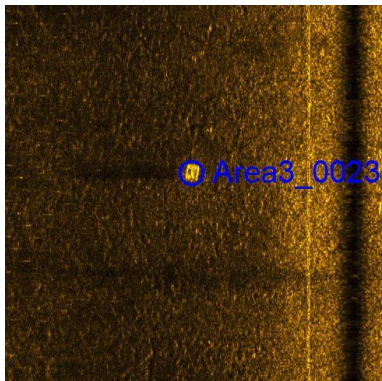
	<p>Area3_0006</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/12/2014 5:12:48 PM • Click Position 30.3095493565 -89.3153492544 (WGS84) 30.3093527109 -89.3153037056 (NAD27LL) 30.3095493565 -89.3153492544 (LocalLL) (X) 277356.28 (Y) 3355357.82 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: C:\Users\lw746681\Desktop\EDGE_SSS\jd163\20140612171223_Binned.jsf • Ping Number: 339990 • Range to target: 17.17 Meters • Fish Height: 2.72 Meters • Heading: 7.800 Degrees • Event Number: 0 • Line Name: 20140612171223_Binned • Water Depth: 2.44 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.62 Meters • Target Height: 0.47 Meters • Target Length: 0.97 Meters • Target Shadow: 3.63 Meters • Mag Anomaly: • Avoidance Area: • Classification1: piling • Classification2: • Area: • Block: • Description:
	<p>Area3_0007</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/12/2014 5:17:44 PM • Click Position 30.3166677630 -89.3151765704 (WGS84) 30.3164712464 -89.3151309105 (NAD27LL) 30.3166677630 -89.3151765704 (LocalLL) (X) 277388.99 (Y) 3356146.61 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: C:\Users\lw746681\Desktop\EDGE_SSS\jd163\20140612171223_Binned.jsf • Ping Number: 347928 • Range to target: 16.35 Meters • Fish Height: 2.82 Meters • Heading: 358.400 Degrees • Event Number: 0 • Line Name: 20140612171223_Binned • Water Depth: 2.79 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 1.09 Meters • Target Height: 0.35 Meters • Target Length: 1.28 Meters • Target Shadow: 2.37 Meters • Mag Anomaly: • Avoidance Area: • Classification1: debris • Classification2: • Area: • Block: • Description:
	<p>Area3_0008</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/16/2014 3:35:30 PM • Click Position 30.3133524795 -89.3157888192 (WGS84) 30.3131559072 -89.3157431899 (NAD27LL) 30.3133524795 -89.3157888192 (LocalLL) (X) 277322.61 (Y) 3355780.28 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: C:\Users\lw746681\Desktop\EDGE_SSS\jd167\20140616152353_Binned.jsf • Ping Number: 164619 • Range to target: 8.74 Meters • Fish Height: 2.28 Meters • Heading: 183.100 Degrees • Event Number: 0 • Line Name: 20140616152353_Binned • Water Depth: 2.49 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.64 Meters • Target Height: 0.31 Meters • Target Length: 0.83 Meters • Target Shadow: 1.42 Meters • Mag Anomaly: • Avoidance Area: • Classification1: debris • Classification2: • Area: • Block: • Description:

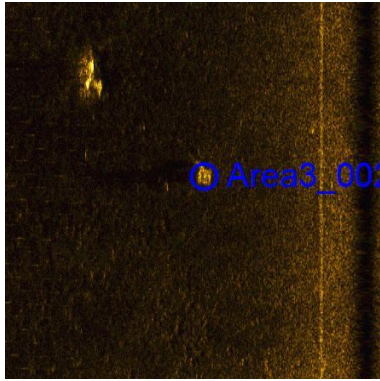
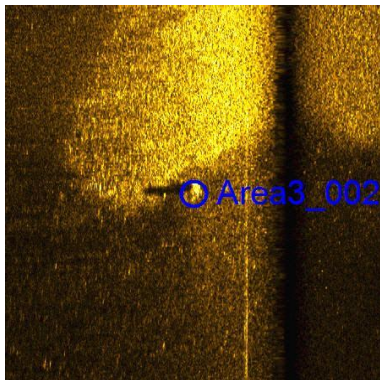
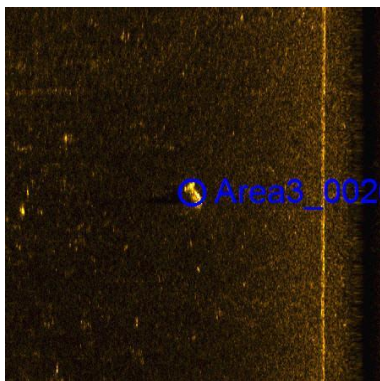
	<p>Area3_0009</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/17/2014 5:08:27 PM • Click Position 30.3094285652 -89.3198998109 (WGS84) 30.3092319548 -89.3198540830 (NAD27LL) 30.3094285652 -89.3198998109 (LocalLL) (X) 276918.31 (Y) 3355353.36 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: C:\Users\lw746681\Desktop\EDGE_SSS\jd168\20140617170809_Binned.jsf • Ping Number: 382668 • Range to target: 5.30 Meters • Fish Height: 2.38 Meters • Heading: 350.100 Degrees • Event Number: 0 • Line Name: 20140617170809_Binned • Water Depth: 3.45 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 1.65 Meters • Target Height: 0.45 Meters • Target Length: 5.39 Meters • Target Shadow: 1.35 Meters • Mag Anomaly: • Avoidance Area: • Classification1: wreck • Classification2: • Area: • Block: • Description:
	<p>Area3_0010</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/17/2014 2:11:24 PM • Click Position 30.3229616567 -89.3195988316 (WGS84) 30.3227652907 -89.3195528919 (NAD27LL) 30.3229616567 -89.3195988316 (LocalLL) (X) 276977.93 (Y) 3356853.03 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: C:\Users\lw746681\Desktop\EDGE_SSS\jd168\20140617140104_Binned.jsf • Ping Number: 97599 • Range to target: 5.23 Meters • Fish Height: 1.18 Meters • Heading: 1.800 Degrees • Event Number: 0 • Line Name: 20140617140104_Binned • Water Depth: 1.71 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.83 Meters • Target Height: 0.49 Meters • Target Length: 0.68 Meters • Target Shadow: 3.79 Meters • Mag Anomaly: • Avoidance Area: • Classification1: debris • Classification2: • Area: • Block: • Description:
	<p>Area3_0011</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/16/2014 5:25:45 PM • Click Position 30.3241527687 -89.3165656289 (WGS84) 30.3239564002 -89.3165197898 (NAD27LL) 30.3241527687 -89.3165656289 (LocalLL) (X) 277272.34 (Y) 3356979.11 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: C:\Users\lw746681\Desktop\EDGE_SSS\jd167\20140616171613_Binned.jsf • Ping Number: 313369 • Range to target: 18.16 Meters • Fish Height: 1.95 Meters • Heading: 355.400 Degrees • Event Number: 0 • Line Name: 20140616171613_Binned • Water Depth: 2.25 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.48 Meters • Target Height: 0.30 Meters • Target Length: 0.97 Meters • Target Shadow: 3.27 Meters • Mag Anomaly: • Avoidance Area: • Classification1: debris • Classification2: • Area: • Block: • Description:

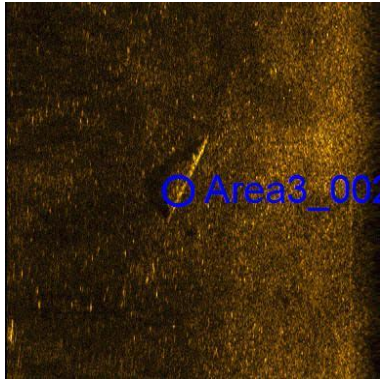
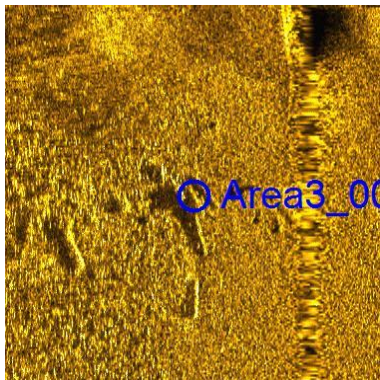
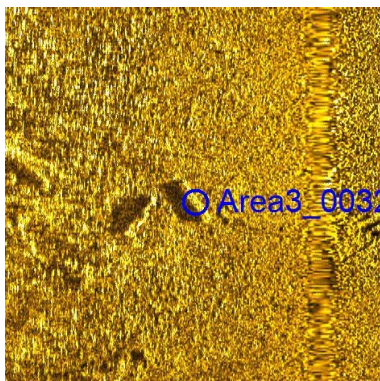
	<p>Area3_0012</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/16/2014 5:53:24 PM • Click Position 30.3183031453 -89.3168085500 (WGS84) 30.3181066718 -89.3167627982 (NAD27LL) 30.3183031453 -89.3168085500 (LocalLL) (X) 277235.73 (Y) 3356331.11 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: C:\Users\w746681\Desktop\EDGE_SSS\jd167\20140616174748_Binned.jsf • Ping Number: 357872 • Range to target: 18.06 Meters • Fish Height: 2.15 Meters • Heading: 354.200 Degrees • Event Number: 0 • Line Name: 20140616174748_Binned • Water Depth: 2.34 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.51 Meters • Target Height: 0.36 Meters • Target Length: 1.78 Meters • Target Shadow: 3.69 Meters • Mag Anomaly: • Avoidance Area: • Classification1: debris • Classification2: • Area: • Block: • Description:
	<p>Area3_0013</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/16/2014 6:43:02 PM • Click Position 30.3103238053 -89.3169462954 (WGS84) 30.3101271870 -89.3169006702 (NAD27LL) 30.3103238053 -89.3169462954 (LocalLL) (X) 277204.42 (Y) 3355446.80 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: C:\Users\w746681\Desktop\EDGE_SSS\jd167\20140616182834_Binned.jsf • Ping Number: 437793 • Range to target: 12.30 Meters • Fish Height: 2.53 Meters • Heading: 179.900 Degrees • Event Number: 0 • Line Name: 20140616182834_Binned • Water Depth: 2.58 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.45 Meters • Target Height: 0.33 Meters • Target Length: 7.60 Meters • Target Shadow: 1.87 Meters • Mag Anomaly: • Avoidance Area: • Classification1: debris • Classification2: • Area: • Block: • Description: Log
	<p>Area3_0014</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/16/2014 6:43:17 PM • Click Position 30.3099811814 -89.3169217253 (WGS84) 30.3097845567 -89.3168761068 (NAD27LL) 30.3099811814 -89.3169217253 (LocalLL) (X) 277206.01 (Y) 3355408.77 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: C:\Users\w746681\Desktop\EDGE_SSS\jd167\20140616182834_Binned.jsf • Ping Number: 438181 • Range to target: 13.35 Meters • Fish Height: 2.66 Meters • Heading: 172.600 Degrees • Event Number: 0 • Line Name: 20140616182834_Binned • Water Depth: 2.52 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.30 Meters • Target Height: 0.39 Meters • Target Length: 3.53 Meters • Target Shadow: 2.35 Meters • Mag Anomaly: • Avoidance Area: • Classification1: debris • Classification2: • Area: • Block: • Description: Log

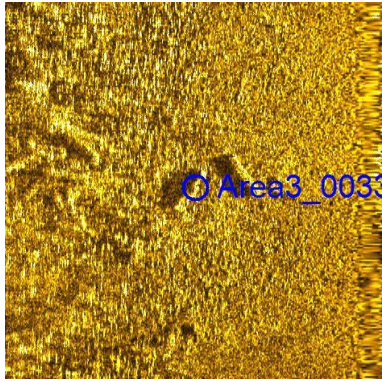
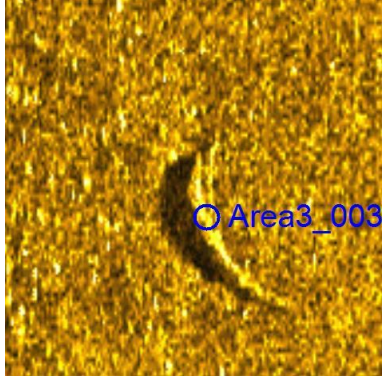
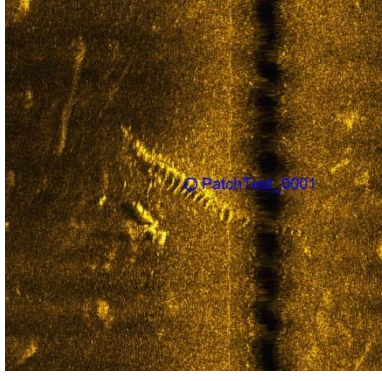
	<p>Area3_0015</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/16/2014 7:04:34 PM • Click Position 30.3201198167 -89.3176896800 (WGS84) 30.3199233836 -89.3176438631 (NAD27LL) 30.3201198167 -89.3176896800 (LocalLL) (X) 277155.10 (Y) 3356534.23 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: C:\Users\lw746681\Desktop\EDGE_SSS\jd167\20140616185759_Binned.jsf • Ping Number: 472455 • Range to target: 3.15 Meters • Fish Height: 1.27 Meters • Heading: 179.400 Degrees • Event Number: 0 • Line Name: 20140616185759_Binned • Water Depth: 1.64 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.62 Meters • Target Height: 0.34 Meters • Target Length: 0.88 Meters • Target Shadow: 1.24 Meters • Mag Anomaly: • Avoidance Area: • Classification1: debris • Classification2: • Area: • Block: • Description:
	<p>Area3_0016</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/16/2014 7:15:13 PM • Click Position 30.3101651560 -89.3177412735 (WGS84) 30.3099685413 -89.3176956193 (NAD27LL) 30.3101651560 -89.3177412735 (LocalLL) (X) 277127.60 (Y) 3355430.78 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: C:\Users\lw746681\Desktop\EDGE_SSS\jd167\20140616191434_Binned.jsf • Ping Number: 489612 • Range to target: 6.75 Meters • Fish Height: 2.41 Meters • Heading: 6.300 Degrees • Event Number: 0 • Line Name: 20140616191434_Binned • Water Depth: 2.69 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.32 Meters • Target Height: 0.35 Meters • Target Length: 2.02 Meters • Target Shadow: 1.22 Meters • Mag Anomaly: • Avoidance Area: • Classification1: debris • Classification2: • Area: • Block: • Description: Log
	<p>Area3_0017</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/16/2014 7:55:42 PM • Click Position 30.3238157824 -89.3184936214 (WGS84) 30.3236194232 -89.3184477114 (NAD27LL) 30.3238157824 -89.3184936214 (LocalLL) (X) 277086.16 (Y) 3356945.54 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: C:\Users\lw746681\Desktop\EDGE_SSS\jd167\20140616194446_Binned.jsf • Ping Number: 554793 • Range to target: 5.50 Meters • Fish Height: 1.60 Meters • Heading: 351.500 Degrees • Event Number: 0 • Line Name: 20140616194446_Binned • Water Depth: 1.45 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.91 Meters • Target Height: 0.55 Meters • Target Length: 0.87 Meters • Target Shadow: 2.97 Meters • Mag Anomaly: • Avoidance Area: • Classification1: debris • Classification2: • Area: • Block: • Description:

	<p>Area3_0018</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/16/2014 8:04:52 PM • Click Position 30.3202167071 -89.3184986962 (WGS84) 30.3200202822 -89.3184528456 (NAD27LL) 30.3202167071 -89.3184986962 (LocalLL) (X) 277077.52 (Y) 3356546.56 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: C:\Users\lw746681\Desktop\EDGE_SSS\jd167\20140616195920_Binned.jsf • Ping Number: 569562 • Range to target: 4.15 Meters • Fish Height: 1.18 Meters • Heading: 176.900 Degrees • Event Number: 0 • Line Name: 20140616195920_Binned • Water Depth: 1.42 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.91 Meters • Target Height: 0.32 Meters • Target Length: 1.05 Meters • Target Shadow: 1.63 Meters • Mag Anomaly: • Avoidance Area: • Classification1: large rocks • Classification2: • Area: • Block: • Description: Rock/Debris
	<p>Area3_0019</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/16/2014 8:48:32 PM • Click Position 30.3126910733 -89.3188627490 (WGS84) 30.3124945140 -89.3188170085 (NAD27LL) 30.3126910733 -89.3188627490 (LocalLL) (X) 277025.45 (Y) 3355713.00 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: C:\Users\lw746681\Desktop\EDGE_SSS\jd167\20140616203754_Binned.jsf • Ping Number: 639872 • Range to target: 3.37 Meters • Fish Height: 2.01 Meters • Heading: 180.600 Degrees • Event Number: 0 • Line Name: 20140616203754_Binned • Water Depth: 1.62 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.11 Meters • Target Height: 0.48 Meters • Target Length: 4.07 Meters • Target Shadow: 1.22 Meters • Mag Anomaly: • Avoidance Area: • Classification1: debris • Classification2: • Area: • Block: • Description: log
	<p>Area3_0020</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/16/2014 8:48:33 PM • Click Position 30.3126619967 -89.3188513243 (WGS84) 30.3124654368 -89.3188055846 (NAD27LL) 30.3126619967 -89.3188513243 (LocalLL) (X) 277026.48 (Y) 3355709.76 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: C:\Users\lw746681\Desktop\EDGE_SSS\jd167\20140616203754_Binned.jsf • Ping Number: 639905 • Range to target: 2.28 Meters • Fish Height: 1.99 Meters • Heading: 178.300 Degrees • Event Number: 0 • Line Name: 20140616203754_Binned • Water Depth: 1.63 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.26 Meters • Target Height: 0.32 Meters • Target Length: 3.51 Meters • Target Shadow: 0.58 Meters • Mag Anomaly: • Avoidance Area: • Classification1: debris • Classification2: • Area: • Block: • Description: Log

	<p>Area3_0021</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/17/2014 2:01:10 PM • Click Position 30.3087262974 -89.3194382219 (WGS84) 30.3085296705 -89.3193925241 (NAD27LL) 30.3087262974 -89.3194382219 (LocalLL) (X) 276961.11 (Y) 3355274.60 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: C:\Users\w746681\Desktop\EDGE_SSS\jd168\20140617140104_Binned.jsf • Ping Number: 81109 • Range to target: 11.86 Meters • Fish Height: 2.07 Meters • Heading: 2.800 Degrees • Event Number: 0 • Line Name: 20140617140104_Binned • Water Depth: 2.59 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.83 Meters • Target Height: 0.43 Meters • Target Length: 1.36 Meters • Target Shadow: 3.20 Meters • Mag Anomaly: • Avoidance Area: • Classification1: debris • Classification2: • Area: • Block: • Description:
	<p>Area3_0022</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/17/2014 3:09:58 PM • Click Position 30.3228855791 -89.3205248690 (WGS84) 30.3226892191 -89.3204788937 (NAD27LL) 30.3228855791 -89.3205248690 (LocalLL) (X) 276888.70 (Y) 3356846.42 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: C:\Users\w746681\Desktop\EDGE_SSS\jd168\20140617150619_Binned.jsf • Ping Number: 191898 • Range to target: 3.71 Meters • Fish Height: 1.09 Meters • Heading: 178.400 Degrees • Event Number: 2 • Line Name: 20140617150619_Binned • Water Depth: 1.39 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.80 Meters • Target Height: 0.42 Meters • Target Length: 0.94 Meters • Target Shadow: 2.45 Meters • Mag Anomaly: • Avoidance Area: • Classification1: debris • Classification2: • Area: • Block: • Description:
	<p>Area3_0023</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/17/2014 4:06:17 PM • Click Position 30.3265445374 -89.3223450261 (WGS84) 30.3263482585 -89.3222989182 (NAD27LL) 30.3265445374 -89.3223450261 (LocalLL) (X) 276721.96 (Y) 3357255.63 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: C:\Users\w746681\Desktop\EDGE_SSS\jd168\20140617160523_Binned.jsf • Ping Number: 282568 • Range to target: 9.48 Meters • Fish Height: 1.22 Meters • Heading: 179.200 Degrees • Event Number: 0 • Line Name: 20140617160523_Binned • Water Depth: 1.49 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.74 Meters • Target Height: 0.47 Meters • Target Length: 0.88 Meters • Target Shadow: 6.02 Meters • Mag Anomaly: • Avoidance Area: • Classification1: debris • Classification2: • Area: • Block: • Description:

	<p>Area3_0024</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/17/2014 4:38:39 PM • Click Position 30.3272323804 -89.3235976967 (WGS84) 30.3270361240 -89.3235515277 (NAD27LL) 30.3272323804 -89.3235976967 (LocalLL) (X) 276603.05 (Y) 3357334.35 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: C:\Users\w746681\Desktop\EDGE_SSS\jd168\20140617163518_Binned.jsf • Ping Number: 334693 • Range to target: 9.47 Meters • Fish Height: 1.22 Meters • Heading: 0.600 Degrees • Event Number: 0 • Line Name: 20140617163518_Binned • Water Depth: 1.74 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.71 Meters • Target Height: 0.41 Meters • Target Length: 1.08 Meters • Target Shadow: 4.88 Meters • Mag Anomaly: • Avoidance Area: • Classification1: debris • Classification2: • Area: • Block: • Description:
	<p>Area3_0025</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/17/2014 5:10:29 PM • Click Position 30.3123834286 -89.3200730584 (WGS84) 30.3121868736 -89.3200272748 (NAD27LL) 30.3123834286 -89.3200730584 (LocalLL) (X) 276908.34 (Y) 3355681.28 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: C:\Users\w746681\Desktop\EDGE_SSS\jd168\20140617170809_Binned.jsf • Ping Number: 385952 • Range to target: 5.34 Meters • Fish Height: 1.70 Meters • Heading: 1.400 Degrees • Event Number: 0 • Line Name: 20140617170809_Binned • Water Depth: 1.70 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.71 Meters • Target Height: 0.55 Meters • Target Length: 1.05 Meters • Target Shadow: 2.69 Meters • Mag Anomaly: • Avoidance Area: • Classification1: piling • Classification2: • Area: • Block: • Description:
	<p>Area3_0026</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/17/2014 5:10:37 PM • Click Position 30.3125564601 -89.3201334845 (WGS84) 30.3123599087 -89.3200876956 (NAD27LL) 30.3125564601 -89.3201334845 (LocalLL) (X) 276902.92 (Y) 3355700.58 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: C:\Users\w746681\Desktop\EDGE_SSS\jd168\20140617170809_Binned.jsf • Ping Number: 386148 • Range to target: 10.05 Meters • Fish Height: 1.61 Meters • Heading: 349.800 Degrees • Event Number: 0 • Line Name: 20140617170809_Binned • Water Depth: 1.78 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.56 Meters • Target Height: 0.35 Meters • Target Length: 1.44 Meters • Target Shadow: 2.79 Meters • Mag Anomaly: • Avoidance Area: • Classification1: debris • Classification2: • Area: • Block: • Description:

	<p>Area3_0027</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/17/2014 5:19:05 PM • Click Position 30.3106154372 -89.3205180789 (WGS84) 30.3104188536 -89.3204723068 (NAD27LL) 30.3106154372 -89.3205180789 (LocalLL) (X) 276861.53 (Y) 3355486.16 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: C:\Users\w746681\Desktop\EDGE_SSS\jd168\20140617171809_Binned.jsf • Ping Number: 399788 • Range to target: 11.99 Meters • Fish Height: 2.11 Meters • Heading: 359.500 Degrees • Event Number: 0 • Line Name: 20140617171809_Binned • Water Depth: 2.14 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.35 Meters • Target Height: 0.34 Meters • Target Length: 5.45 Meters • Target Shadow: 2.36 Meters • Mag Anomaly: • Avoidance Area: • Classification1: debris • Classification2: • Area: • Block: • Description:
	<p>Area3_0031</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/17/2014 5:18:19 PM • Click Position 30.3093301619 -89.3204587709 (WGS84) 30.3091335544 -89.3204130224 (NAD27LL) 30.3093301619 -89.3204587709 (LocalLL) (X) 276864.32 (Y) 3355343.56 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: C:\Users\w746681\Desktop\EDGE_SSS\jd168\20140617171809_Binned.jsf • Ping Number: 398548 • Range to target: 6.86 Meters • Fish Height: 2.44 Meters • Heading: 8.300 Degrees • Event Number: 0 • Line Name: 20140617171809_Binned • Water Depth: 2.45 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.32 Meters • Target Height: 0.37 Meters • Target Length: 2.00 Meters • Target Shadow: 1.29 Meters • Mag Anomaly: • Avoidance Area: • Classification1: debris • Classification2: • Area: • Block: • Description: Log/Piling
	<p>Area3_0032</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/17/2014 5:17:16 PM • Click Position 30.3093427129 -89.3201246888 (WGS84) 30.3091461028 -89.3200789534 (NAD27LL) 30.3093427129 -89.3201246888 (LocalLL) (X) 276896.48 (Y) 3355344.29 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: C:\Users\w746681\Desktop\EDGE_SSS\jd168\20140617171252_Binned.jsf • Ping Number: 396873 • Range to target: 7.46 Meters • Fish Height: 2.57 Meters • Heading: 182.600 Degrees • Event Number: 0 • Line Name: 20140617171252_Binned • Water Depth: 3.02 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.45 Meters • Target Height: 0.38 Meters • Target Length: 2.77 Meters • Target Shadow: 1.38 Meters • Mag Anomaly: • Avoidance Area: • Classification1: debris • Classification2: • Area: • Block: • Description: Log/Piling

	<p>Area3_0033</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/17/2014 5:17:17 PM • Click Position 30.3093349617 -89.3200945646 (WGS84) 30.3091383513 -89.3200488306 (NAD27LL) 30.3093349617 -89.3200945646 (LocalLL) (X) 276899.36 (Y) 3355343.37 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: C:\Users\w746681\Desktop\EDGE_SSS\jd168\20140617171252_Binned.jsf • Ping Number: 396880 • Range to target: 10.42 Meters • Fish Height: 2.57 Meters • Heading: 182.600 Degrees • Event Number: 0 • Line Name: 20140617171252_Binned • Water Depth: 3.01 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.38 Meters • Target Height: 0.37 Meters • Target Length: 2.77 Meters • Target Shadow: 1.81 Meters • Mag Anomaly: • Avoidance Area: • Classification1: debris • Classification2: • Area: • Block: • Description: Log/Piling
	<p>Area3_0034</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/17/2014 5:17:02 PM • Click Position 30.3096553065 -89.3201133115 (WGS84) 30.3094587020 -89.3200675714 (NAD27LL) 30.3096553065 -89.3201133115 (LocalLL) (X) 276898.29 (Y) 3355378.92 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: C:\Users\w746681\Desktop\EDGE_SSS\jd168\20140617171252_Binned.jsf • Ping Number: 396506 • Range to target: 5.87 Meters • Fish Height: 2.42 Meters • Heading: 182.400 Degrees • Event Number: 0 • Line Name: 20140617171252_Binned • Water Depth: 2.98 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 0.38 Meters • Target Height: 0.31 Meters • Target Length: 3.33 Meters • Target Shadow: 0.94 Meters • Mag Anomaly: • Avoidance Area: • Classification1: debris • Classification2: • Area: • Block: • Description:
	<p>PatchTest_0001</p> <ul style="list-style-type: none"> • Sonar Time at Target: 6/11/2014 6:49:02 PM • Click Position 30.3109289492 -89.2428365020 (WGS84) 30.3107317278 -89.2427938046 (NAD27LL) 30.3109289492 -89.2428365020 (LocalLL) (X) 284333.91 (Y) 3355370.66 (Projected Coordinates) • Map Projection: UTM84-16N • Acoustic Source File: C:\Users\w746681\Desktop\EDGE_SSS\jd162\20140611184720_Binned.jsf • Ping Number: 366098 • Range to target: 4.56 Meters • Fish Height: 1.63 Meters • Heading: 248.600 Degrees • Event Number: 0 • Line Name: 20140611184720_Binned • Water Depth: 2.63 Meters 	<p>Dimensions and attributes</p> <ul style="list-style-type: none"> • Target Width: 1.54 Meters • Target Height: 0.21 Meters • Target Length: 11.39 Meters • Target Shadow: 0.71 Meters • Mag Anomaly: • Avoidance Area: • Classification1: bones • Classification2: • Area: • Block: • Description: Whale

VI. Uncertainty Management Strategy (Dr. Wells lecture note)

