APPENDIX B

Geodynamics Geophysical Survey

Wrightsville Beach Coastal Storm Risk Management

Emergency Repair – Evaluation of Borrow Area Alternatives

New Hanover County, North Carolina

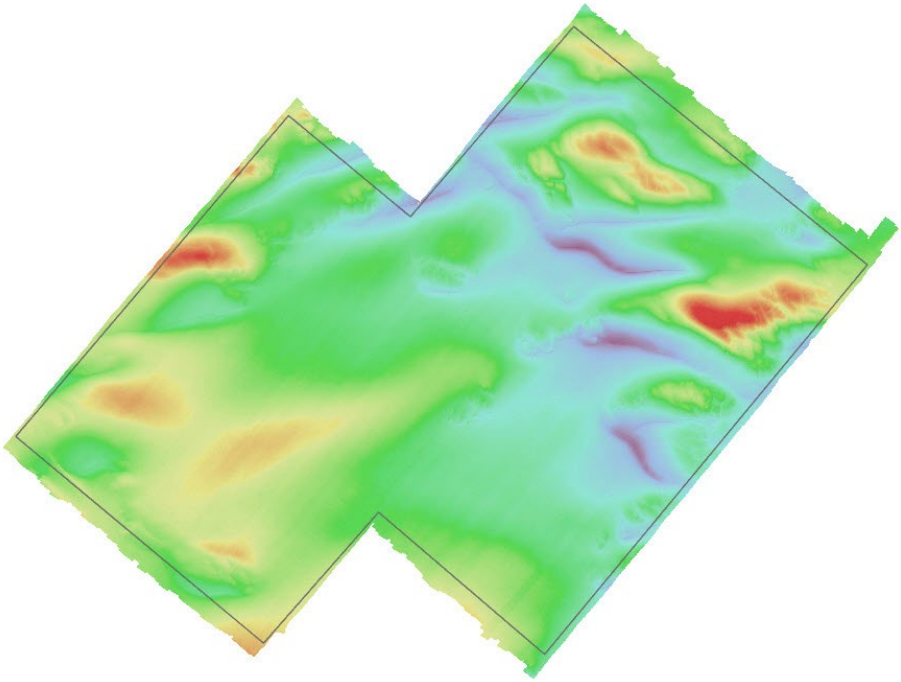
JANUARY 2023

Prepared by:

Environmental Resources Section
U.S. Army Corps of Engineers, Wilmington District

Wrightsville Beach Cultural Resource Geophysical Survey

March – April 2022



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1.0 INTRODUCTION

1.1 Project Description

Geodynamics was contracted by the United State Army Corps of Engineers (USACE) Wilmington District to provide hydrographic surveying services for an area encompassing approximately 4.45 square miles offshore of Wrightsville Beach, North Carolina. This included conducting a high-resolution geophysical survey area nearshore Wrightsville Beach using multibeam echosounder (MBES), sub-bottom profiler (SBP), Transverse Gradiometer (TVG) and side scan sonar (SSS) sensors for seafloor and subseafloor investigations across 30 m (~98 ft) spaced survey lines.

1.2 Project Area

The survey area spans the shoreline of Wrightsville Beach, NC from Masonboro Inlet to approximately 2.5 NM south of the inlet. The survey block extends from shore approximately 1.7 to 3.75 NM and spans approximately 2.3 NM in length. Figure 1 shows the survey area and 30 m spaced planned survey lines along with the 8 intersecting quality control crosslines spaced at 500 m.

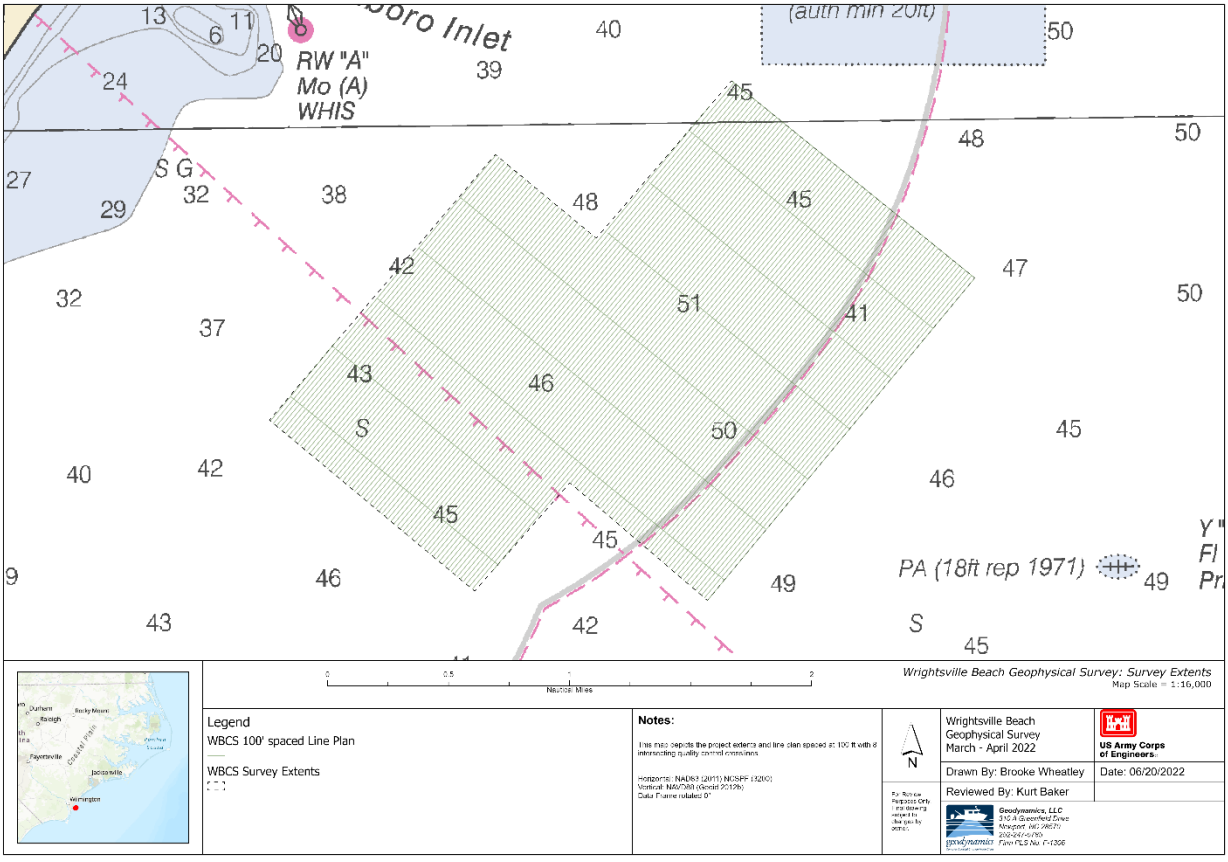


Figure 1. Map displaying project area.

1.3 Report Purpose

This report provides a description of all survey activity including acquisition and processing methodologies, procedures, and quality control/quality assurance processes. Atmospheric and environmental conditions as well as summarized activities for each day of acquisition are

included. Survey control and survey geodetics are also included in this report. A general discussion of results, including notable features identified in the data, is provided to aide further application of these products.

2.0 SURVEY APPROACH

2.1 Equipment

2.1.1 Vessels

The Research Vessel (R/V) Benthos (Table 1), owned and operated by Geodynamics, is a vessel of opportunity well suited for this multi-sensor survey. R/V Benthos was mobilized with all sensors at Geodynamics' headquarters in Newport, North Carolina, and all sensor calibrations were verified before transit to the survey site in Wrightsville Beach, North Carolina.

Table 1: General Vessel Specifications of the R/V Benthos.

General Vessel Specifications	
Vessel name	R/V Benthos
Owner	Geodynamics
Dimensions	34 x 10.5' x 2.5'
USCG	Designated Research Vessel
Flag	U.S.
Registry	North Carolina
Reg No	NC-8224 DW
Tonnage	15
Lab space	3 Operator Stations
Lavatory	Full head
Min / Max Speed	2.5 / 45 knots
Propulsion	2 x 300HP Yamaha Outboard Motor
Auxiliary Power	8 kilowatt Westerbeke Generator
Fuel Cap.	280 gallons
GPS	Simrad
Magnetic Compass	Richie
Radar	Simrad 4G
Autopilot	Simrad AP-28
VHF	Simrad R-25
Internet	Pepwave MAX

2.1.2 Hardware

Table 2 lists the survey equipment used for this survey.

Table 2: Survey equipment utilized for the project.

	Hardware Equipment	Function	Manufacturer	Model

Navigation & Attitude	Primary GNSS Receiver - Positioning and Orientation System for Marine Vessels (POS MV)	Position/Attitude/Heading	Applanix	320 v5
	Primary GNSS Antenna (port)	Position/Attitude/Heading	Trimble/ Aeroantenna	540AP
	Secondary GPS-GNSS Antenna (starboard)	Position/Attitude/Heading	Trimble/ Aeroantenna	540AP
	Inertial Motion Unit (IMU)	Position/Attitude/Heading	Applanix	IMU-65
	2 GPS Cables (20 m)	Position/Attitude/Heading	Trimble	n/a
	IMU Cable (30 m)	Position/Attitude/Heading	Applanix	IP68
	Cellular Internet	Mobile Internet	Verizon	SIM Card
	Fugro Marinestar G2+	SBAS Corrections	Fugro	n/a
SSS	Side Scan Sonar	Object Detection	Edgetech	4205
	SSS Topside Unit	Acquisition	Edgetech	4205
	SSS Deck Cables	SSS Telemetry	Edgetech	n/a
	SSS Hydraulic Winch	Transducer Deployment	Pullmaster	PL2
MBES	Sonar Processing Unit (PU)	Bathymetry	Kongsberg	2040C PU
	2 15m Sonar Cables	Bathymetry	Kongsberg	EM2040
	Surface Sound Velocimeter	Bathymetry	Applied Microsystems	Micro Sound Velocity (SV)
	Sound Profile Velocimeter	Bathymetry	Applied Microsystems	Minos-X
	2 Sonar Heads	Bathymetry	Kongsberg	2040C-Dual Head
Sub-bottom	CHIRP Sub-bottom Profiler	Imagery/Geology	Edgetech	216S
	SBP J-Frame Winch	Transducer Deployment	Warn	VRX 25-S
	SBP Topside Unit	Acquisition	Edgetech	3100-P
	SBP deck cables (30m)	SBP Telemetry	Edgetech	n/a
Magneto meter	Marine Magnetometer	Marine Archeology	Geometrics	G-882
	TVG Frame	Marine Archeology	Geometrics	1.5 m TVG Frame, straight tow

2.1.3 Software

Table 3 lists the software used for data acquisition.

Table 3: Software used during survey

Software	Function	Version	Manufacturer

Qinsy	Navigation management	9.4.4	QPS
POSView	Navigation and attitude	10.5	Applanix
SIS	MBES Data Acquisition and Patch Test	4.3.2	Kongsberg
Seacast	Sound Velocity	4.3	AML
Sound Speed Manager	Sound Velocity	-	CARIS
Discover	SSS and Chirp SBP Data Acquisition	41.0.1.116	Edgetech
MagLog Lite	Magnetometer Data Acquisition	-	Geometrics
Excel	Field Notes	2018	Microsoft

2.2 Geodesy

Data acquired onboard both RV Benthos utilized the Fugro Marinestar G2+ SBAS (Satellite Based Augmentation System). This system provides decimeter resolution both horizontally and vertically in real-time. Marinestar G2+ is a global SBAS and is therefore referenced to the ITRF2014 (International Terrestrial Reference Frame of 2014).

All data have been transformed into the NAD83 (2011) coordinate reference frame, and into the North Carolina State Plane system (Feet, WKID: 3200), either onboard during acquisition through Qinsy Online transformations, or during post-processing. Individual routines for each sensor's transformation and projection can be found in their respective sections.

The NAD83 (2011) North Carolina State Plane Feet coordinate system/projection were verified daily using RTK 2 m pole checks on established and verified benchmarks within the North Carolina Continually Operating Reference Station (NC CORS) network. Static observable data for the Castle Hayne (NCCH) station was used during post processing.

All delivered data and coordinates provided are relative to NAD 1983 (2011) North Carolina State Plan US Survey Feet in the horizontal plane and NAVD 1988 (using Geoid 12B) in the vertical plane.

Table 4: NCCH Continuously Operating Reference Station

Coordinate	HCS/VCS	Coordinate Value	
Latitude	NAD 83 (2011)	34 20 40.22863 N	
Longitude	NAD 83 (2011)	077 52 29.89899 W	
Ellipsoid Ht	NAD 83 (2011)	-22.085	

Designation: CASTLE HAYNE 2007 CORS ARP CORS ID: NCCH PID: DK7086	

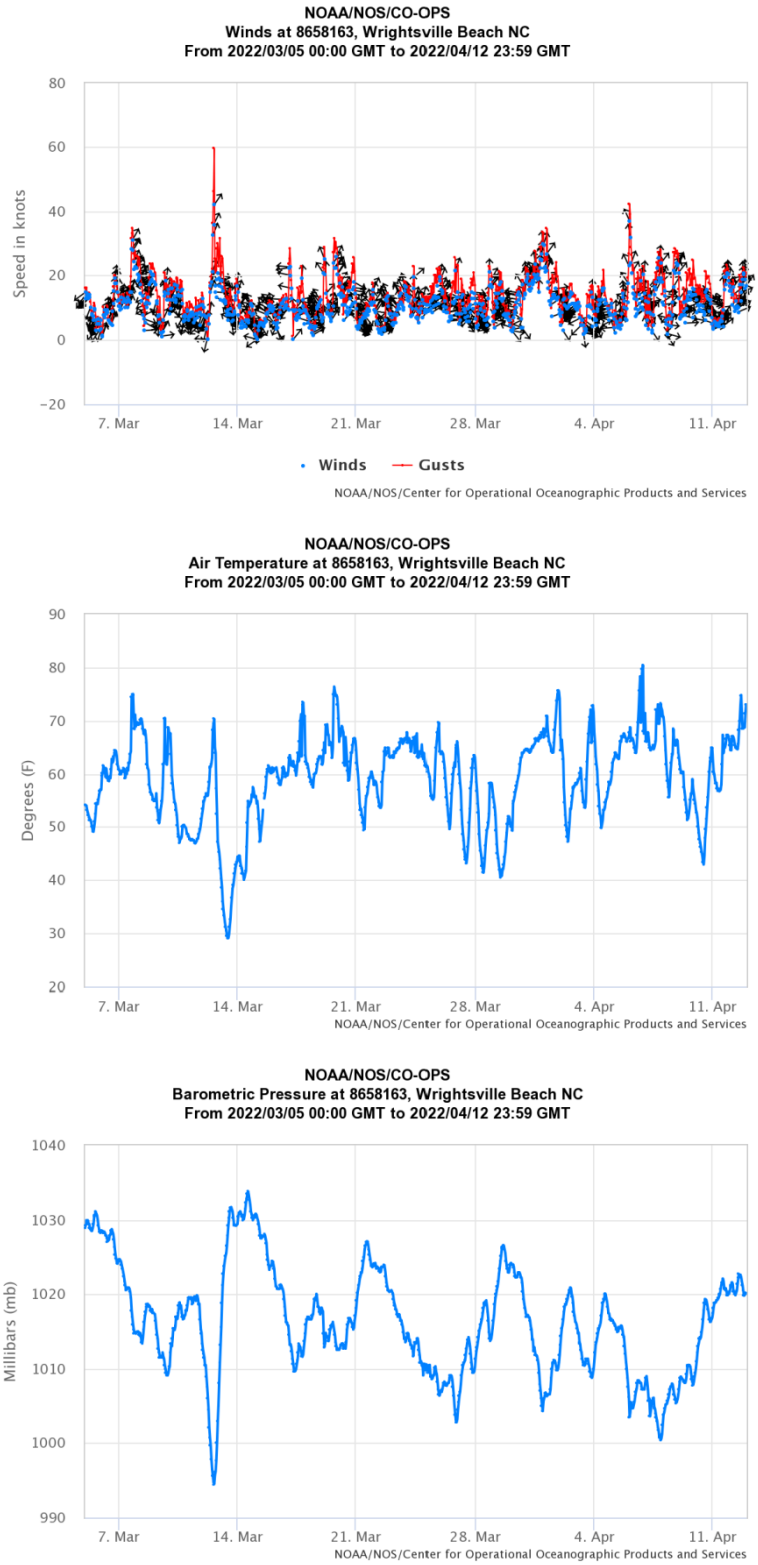
2.3 Project Schedule and Weather

Survey activities were conducted between March 5 and April 12 of 2022. There was a total of 16 active survey days. Table 5 shows the general timeline of acquisition activities.

Table 5: Survey activities throughout the project

Date	Julian Day	Description of Survey Operations
3/5/2022	64	RV Benthos MBES, SSS, chirp SBP, MAG on polygon 100' lines
3/13/2022	72	RV Benthos MBES, SSS, chirp SBP, MAG on polygon 100' lines
3/14/2022	73	RV Benthos MBES, SSS, chirp SBP, MAG on polygon 100' lines
3/15/2022	74	RV Benthos MBES, SSS, chirp SBP, MAG on polygon 100' lines and MBES only on patch test area AR370
3/16/2022	75	RV Benthos MBES, SSS, chirp SBP, MAG on polygon 100' lines
3/17/2022	76	RV Benthos MBES, SSS, chirp SBP, MAG on polygon 100' lines
3/18/2022	77	RV Benthos MBES, SSS, chirp SBP, MAG on polygon 100' lines
3/21/2022	80	RV Benthos MBES, SSS, chirp SBP, MAG on polygon 100' lines
3/22/2022	81	RV Benthos MBES, SSS, chirp SBP, MAG on polygon 100' lines
3/23/2022	82	RV Benthos MBES, SSS, chirp SBP, MAG on polygon 100' lines
3/27/2022	86	RV Benthos MBES, SSS, chirp SBP, MAG on polygon 100' lines
3/28/2022	87	RV Benthos MBES, SSS, chirp SBP, MAG on polygon 100' lines
3/29/2022	88	RV Benthos MBES, SSS, chirp SBP, MAG on polygon 100' lines
4/3/2022	93	RV Benthos MBES, SSS, chirp SBP, MAG on polygon 100' lines
4/11/2022	101	RV Benthos MBES, SSS, chirp SBP, MAG on polygon 100' lines and crosslines
4/12/2022	102	RV Benthos MBES, SSS, chirp SBP, MAG on polygon 100' lines, crosslines, and recovery lines

The tide and meteorological observations for each day of survey were collected at the nearest NOAA tide station, Wrightsville Beach, NC (Figure 2).



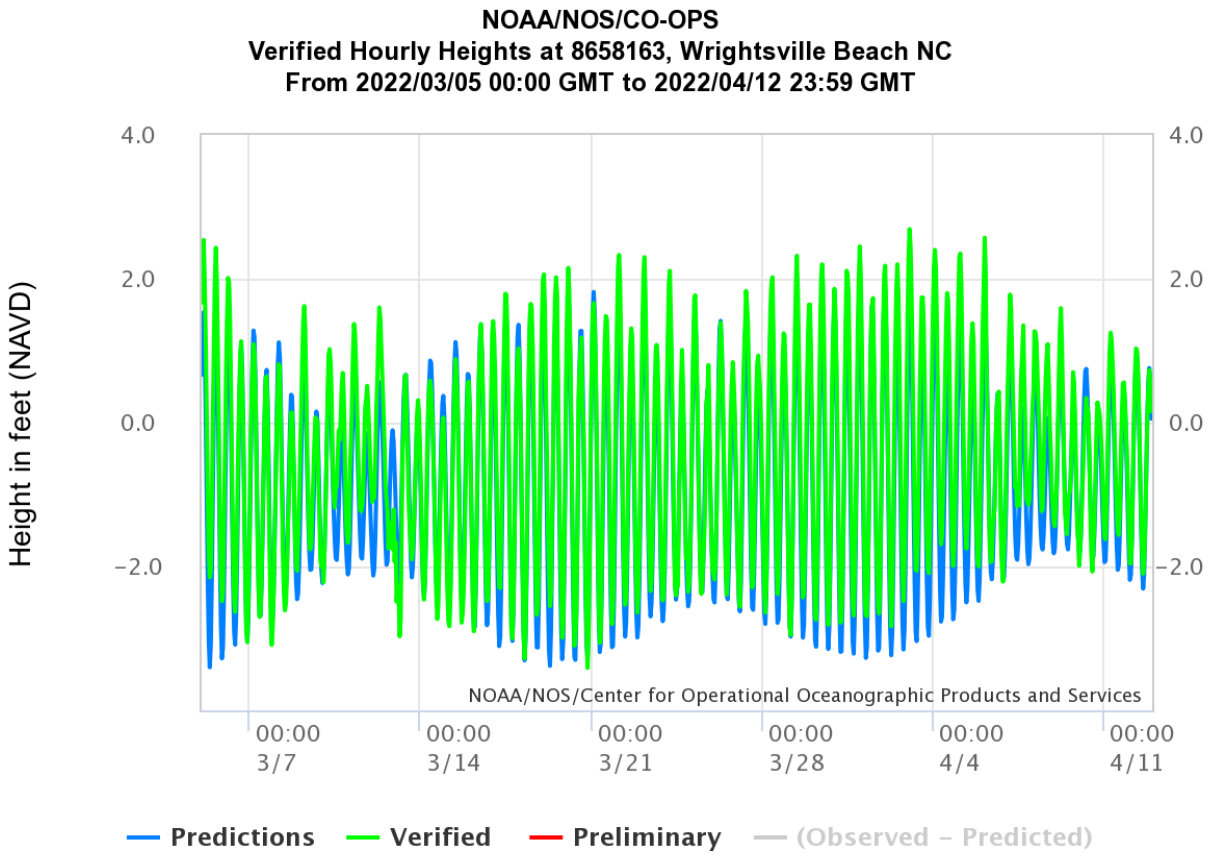


Figure 2. Tidal and meteorological conditions during survey from Wrightsville Beach, NC - Station ID: 8658163

2.4 Personnel

Table 6: A list of all survey personnel and management staff for this project.

Participant	Title	Affiliation
Chris Freeman	President, Point of Contact	Geodynamics
Dave Bernstein	Program Director	Geodynamics
Josh Landry	Operations Director	Geodynamics
Kurt Baker	Survey Manager / Project Manager	Geodynamics
Josh Savage	Vessel Operator	Geodynamics
Nolan Day	Hydrographer	Geodynamics
Tariq Moya	Hydrographer	Geodynamics
Davis Batten	Hydrographer / Processor	Geodynamics
Rachel Dudas	Hydrographer	Geodynamics
Clay Walker	Hydrographer	Geodynamics
Brooke Wheatley	Processor	Geodynamics

Rebekah Gossett	Processor	Geodynamics
Evalynn Barbare	Processor	Geodynamics

3.0 METHODOLOGY

3.1 Acquisition

Acquisition for the Wrightsville Beach Geophysical Survey was conducted with the R/V Benthos (Figure 3). Vessel survey systems rely on an Applanix POS MV V5 for navigation, attitude, and heading. Physical survey systems consist of over the side multibeam sonar mounts and A-frame with hydraulic and electric winch controls for geophysical survey gear deployment and recovery.

Figure 3: R/V Benthos

3.1.1 Navigation and Positioning

The Applanix Positioning and Orientation System for Marine Vessels (POS MV) Ocean master provided georeferencing and motion compensation to all hydrographic sensors. This system is permanently installed on the R/V Benthos. The POS MV integrate vessel attitude with horizontal positioning information obtained from the dual antenna spread, supporting both Global Positioning System (GPS) and GNSS satellites, and directly relays attitude data to Kongsberg's Seafloor Information Systems (SIS), QPS Qinsy acquisition software, and the MAGLOG LITE acquisition software. The POS MV provides real-time roll and pitch accuracy RMS to 0.02°, heading to 0.02° (with a 2 m antenna baseline), heave accuracy to 5 cm or 5% (whichever is greater), and decimeter positional accuracy when using Fugro Marinestar G2+ SBAS corrections.

Figure 4: POS MV OceanMaster

Positioning for all sensors was aided by Fugro's Marinestar GPS and GNSS services. Marinestar provides sub-meter positional accuracy worldwide based upon Fugro's global network of reference sites and geostationary satellites and integrates seamlessly within the POSView acquisition software. Qinsy Online software integrates POSView position and attitude data to provide motion corrected positions for relevant nodes such as the MBES sensor target centers and tow points for sensor positions derived from layback.

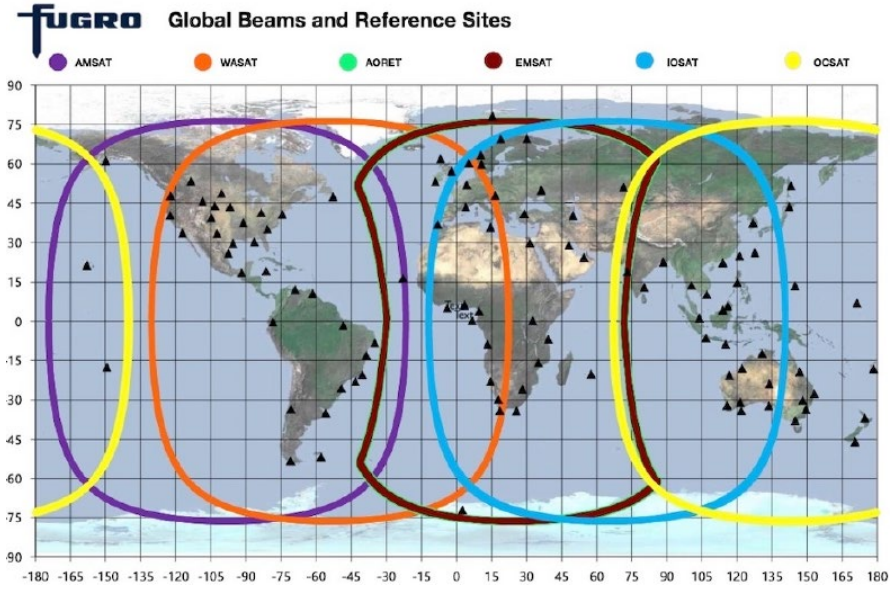


Figure 5: Overview of L-band satellite beams and their coverage areas.

The POSView software by Applanix was used with the POS MV system. This software provides a tightly-coupled integration of the attitude measurements recorded by the IMU and the SBAS augmented position measurements recorded by the GNSS antennas. POSView allowed the survey technician to monitor the attitude and positional accuracy throughout the survey in real time. POSView logged a POSPac file which contained all attitude, positioning, and error estimates of real-time attitude and positioning which allows for post processing in the event that improved positional accuracy is required.

3.1.2 Bathymetry

Bathymetry was collected on R/V Benthos with a dual head Kongsberg EM2040C system on an over-the-side mount from the port quarter of the vessel. The sonar heads are secured to the

vessel in a fixed and pre-defined location using industrial stainless-steel clamps. The precise positioning of the MBES heads to the IMU were established during a dimensional control survey in March of 2021. The current configuration was most recently patch tested and verified in November of 2021. The patch test and verification surveys were conducted to ensure self-alignment (sensor bias with respect to heading, pitch, and roll errors) as well as comparison against previously validated bathymetric data, both internal (Geodynamics) and external (USACE).

Figure 6: R/V Benthos MBES sonar heads over-the-side mount during dimensional control survey March 2021.

Throughout the survey multiple dynamic factors were monitored to ensure accurate and precise bathymetric data. The POS MV provided real-time vessel attitude, tide, and water levels for both real-time monitoring and post-processing. Sound velocity profiles were collected via the AML Minos-X (Figure 7), processed in SeaCast, and loaded directly into SIS for accurate beam forming and sound speed correction during acquisition. Sound speed near the surface was monitored in real-time at the sonar heads using an AML MicroSV. When the sound speed at the head changed by more than 2 m/s from the profile collected, another profile was acquired. All attitude, position, SV, and sounding data was recorded in SIS as *.all files.

Figure 7: AML Minos-X sound speed profiler used on R/V Benthos.

MBES data were collected in both Qinsy and SIS. The Qinsy interface provided accurate line tracking and navigation view, MBES coverage view and was used for real-time quality assurance/quality control (QA/QC), standard deviation models of overlapping data. The SIS software was used to define the sonar settings and parameters, as well as make changes to survey configuration or operation.

3.1.3 Sub-bottom Profiling

The R/V Benthos surveyed exclusively with the Edgetech CHIRP (Compressed High Intensity Radiated Pulse) SB-216S towed sub-bottom profiler. The 216S towed body is capable of 6-10 cm vertical resolution and up to 6 m of penetration in course and calcareous sand. The system was surface towed using Norwegian buoys at a fixed, measured distance from the J-frame and roughly 2 m below the sea surface. The QPS Qinsy software suite was used during survey to serve as a relational interface between the vessel navigation and the towpoint to provide manual layback corrected positions to the SBP controller software, Discover SBP.

Figure 8: Edgetech SB-216S sub-bottom profiler.

The Discover SBP software provides a scrolling display of sub-bottom penetration and resolution, allowing for real-time QA/QC. The CHIRP system was set to sweep from 2.0 – 15.0 kHZ at 20 ms and 75-100% power with a ping rate maximized for optimal resolution. During survey, display-only gains could be manipulated to improve data visualization. The sub-bottom data were recorded in Edgetech's proprietary JSF format, along with the SEG-Y and XTF formats.

3.1.4 Side Scan Sonar

As with SBP, the Qinsy software suite was used during survey to serve as an interface between the vessel navigation, the towpoint, and the Edgetech 4205 side scan sonar towfish to provide layback corrected positioning and heading to the SSS controller software, Discover SSS. Unlike SBP, the SSS towfish layback changed throughout survey, and the manual layback driver within Qinsy was used to adjust the survey the cable payout for providing the final layback-corrected position to Discover SSS. Discover provides a waterfall data display for real-time QA/QC monitoring of both channels acquired. Frequencies were set at 850 kHz (channels 5 and 6 at 50 m range) for the entirety of acquisition. Towfish altitude was adjusted to maintain between 10% and 20% of the SSS data range (5 to 10 m above the seafloor) where possible. Discover logged all raw sensor data along with UTC time and navigation stamps in Edgetech's proprietary JSF file format.

Figure 9: Edgetech 4205 side-scan sonar (image provided by Edgetech)

3.1.5 Magnetometer/Gradiometer

Two G-882 magnetometers with depth sensors and altimeter are installed in a 1.5 m wide Transverse Gradiometer Frame. The Gradiometer was towed astern of the vessel. The altitude is controlled by paying out or brining in tow cable sufficient maintain the survey requirements. The gradiometer was towed at sufficient (> 3x vessel length astern of the vessel) to avoid interference from the vessel. The TVG layback changed throughout survey, and the manual layback driver within Qinsy was used to adjust the survey the cable payout for providing the final layback-corrected position for post-processing.

Figure 10: Stock image of Geometrics G-882 Transverse Gradiometer

3.2 Processing

3.2.1 Navigation and Sensor Positioning

The post-processed horizontal datum for this project is the NAD83 (2011) with projected into the North Carolina State Plane Feet grid. The vertical datum for this project is the NAVD88 datum

using geoid 12b. As data were collected within the ITRF2014 frame using the Fugro Marinestar service, the POSPac MMS (Mobile Mapping Solutions) software was utilized for datum transformation during attitude and positioning post-processing.

POSPac MMS is a user-friendly suite of tools used to create an accurate solution of position, orientation, and dynamics from the GNSS and IMU data collected with the POS MV. Raw POS data collected in the field is imported into POSPac MMS and a SBET (Smoothed Best Estimate of Trajectory) is created using various methods of post-processing. The post-processed SBET is then integrated into the multibeam sonar data to enhance horizontal and vertical accuracy and the reliability of the GPS data.

The POSPac MMS post-processing method utilized for this project was “IN-Fusion Single Base”. The “IN-Fusion Single Base” utilizes corrections from a land based base station operating on an established coordinate. For this project, the base station corrections were provided by the North Carolina CORS NCCH and thus the SBET was exported in the NAD83 (2011) frame.

The positioning of the side-scan, TVG, and sub-bottom sonars were calculated using offset factors applied within the Qinsy software. The manual layback position of the sub-bottom and side-scan was calculated and transmitted to Discover. For both outputs the Qinsy software performed a real-time transformation of the ITRF2014 positional data and provided the offset position of the sensor in the NAD83 (2011) frame.

3.2.2 Bathymetry

All MBES data were post-processed using the Applanix POSPac MMS software, using the NCCH (North Carolina Castle Hayne) static observable data. The NC CORS Network is based in the NAD83 (2011) frame, and therefore the SBET (Smoothed Best Estimate of Trajectory) used for MBES processing was also based in the NAD83 (2011) frame, thus properly transforming the multibeam data into the NAD83 (2011) frame during MBES processing.

All bathymetric survey data were processed using CARIS Hydrographic Information Processing Systems (HIPS) and Sonar Information Processing System (SIPS) software and gridded in a Combined Uncertainty and Bathymetry Estimator (CUBE) surface at a final resolution of 3 ft. The POSPac file was processed and computed into an SBET, which was applied to the necessary bathymetric data along with GPS Tides and sound velocity profiles. The processing workflow is in Figure 10 below.

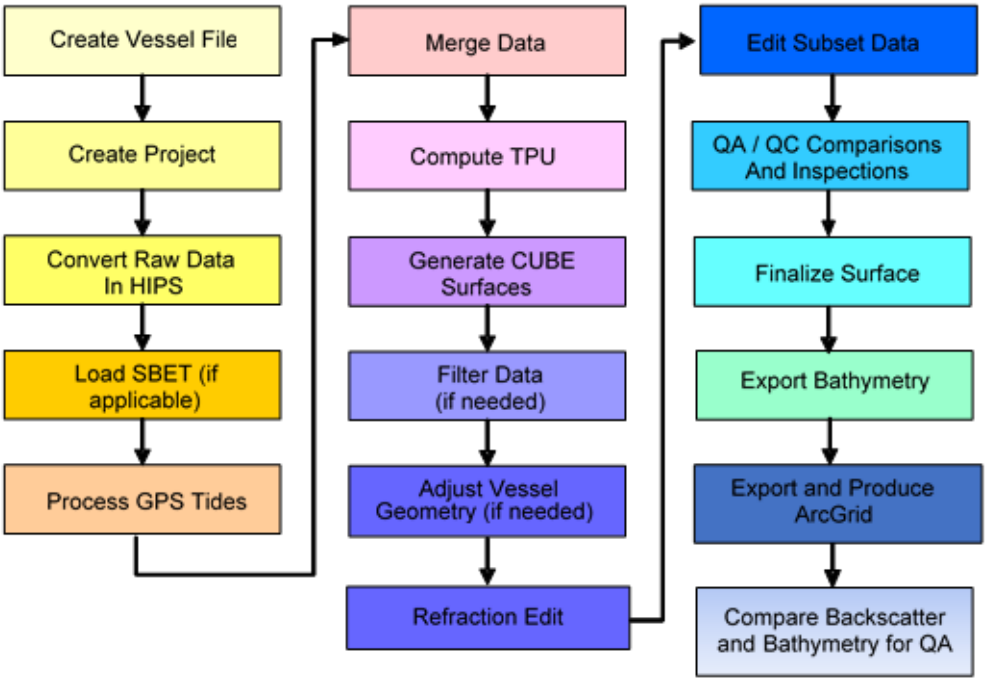


Figure 11: Major steps in Bathymetric Data Processing

The CARIS vessel configuration file, called the HIPS Vessel File, is an Extensible Mark-up Language (XML) file that can describe details of the installation and calibration of the instruments installed and their precise positioning relative to each other and the vessel's reference frame. Embedded information within the HVF is used by multiple processes in CARIS to merge sensors, offsets and calculate sounding uncertainty. For this project, measured sensor offsets and calculated patch test offsets were applied in SIS or POSView prior to acquisition, therefore, the "apply" option for the offset values in the HVF were set to "no". However, sensor offsets are still placed in the HVF as well as other manufacturer specifications to properly account for TPU.

The raw multibeam bathymetry data collected in SIS provides rough estimates of water depth and bathymetry. To view the raw data and water levels as it was collected, a zero-tide must be applied which neglects all tidal influences on depths. Corrections applied to the raw data in real-time included sound speed corrections from the most recent and appropriate sound speed cast, as well as initial heave, pitch, roll, and heading corrections from the POS MV, but become fully integrated during processing steps.

Tidal observation data must be loaded for every track line before the soundings can be viewed as corrected depths and positions, correcting for astronomical and meteorological changes in water levels. Real-time tidal and water level changes were corrected by computing "GPS Tides" in CARIS. This procedure uses the GNSS height and vessel heave to dynamically deduct the vessel's vertical displacement through the water column as well as correct for the astronomical changes in water level heights over the course of the survey.

A CUBE surface is a model which uses multiple hypotheses to represent potential depth variances along the seafloor based on a TPU that is calculated in CARIS. The CARIS TPU module computes horizontal and vertical uncertainty values, requiring user-entered offsets, estimated error values for the tide, sound speed measurements and published errors from equipment specifications. TPU calculations are used in the CUBE algorithm to calculate a surface where 'nodes' or 'tiles' are assigned to soundings with the lowest vertical uncertainties and are internally self-consistent.

Upon initial QC inspections and reviews for targets or features on the seafloor, a combination of swath and surface filters were executed in CARIS to reduce manual editing. The main filter used was a swath filter to remove erroneous outer beams.
One of the last steps of multibeam processing is to manually "clean" or remove erroneous data inherent to all echosounders. This is commonly due to aeration, pelagics, multiples, or outer swath noise or artifacts. Soundings were edited using a combination of Subset Editor and Swath Editor. Swath Editor provided an initial editor to review and clean individual lines, providing a slice that preserves both large and small-scale features in the swath and reveals true outliers. The erroneous data were flagged as rejected as to not be included in the final surface. The Swath Editor also provided a means for reviewing the navigation and attitude data for spikes or gaps. Subset Editor was used as a means of reviewing the data and cleaning erroneous soundings. Overlapping lines are loaded into the Subset Editor, providing the processor with a confidence check for detecting features, assessing systematic errors, flagging fliers, and reviewing rejected soundings. This technique provides the user flexibility to review the data in both 2-dimensional (2D) and 3-dimensional (3D) views. Surfaces were constantly recomputed and reviewed for remaining fliers and cleaned as necessary.
The 3 ft CUBE surface was exported after final QC review as a floating point GeoTiff raster in NAD83 (2011) NC State Plane Meters, NAVD88 (m), and converted to NC State Plane Feet in XY and feet for vertical and is provided as a raster dataset compatible in ArcGIS 10.0 software.

3.2.3 Sub-bottom Profiling

The signal-to-noise ratio (S/N) of the raw data was of sufficient quality to permit the data to be processed using the following simple 4-step workflow:
Step 1 – JSF Import: Import JSF files with initial scalar to optimize full envelope to CSF file in SonarWiz
Step 2 – Review Navigation and Bottom Track: Layback was analyzed and adjusted as needed using bathymetric surface to align with features in SBP. Seafloor was bottom tracked to develop surface for datum alignment.
Step 3 – Datum Alignment: Data were converted from CSF to SEG-Y, then imported SEG-Y with regional bathymetric grid to align the digitized seafloor to the NAVD88 datum.

3.2.4 Side Scan Sonar

SSS data from the Edgetech 4205 was processed in SonarWiz according to the generalized processes in Figure 15 below.

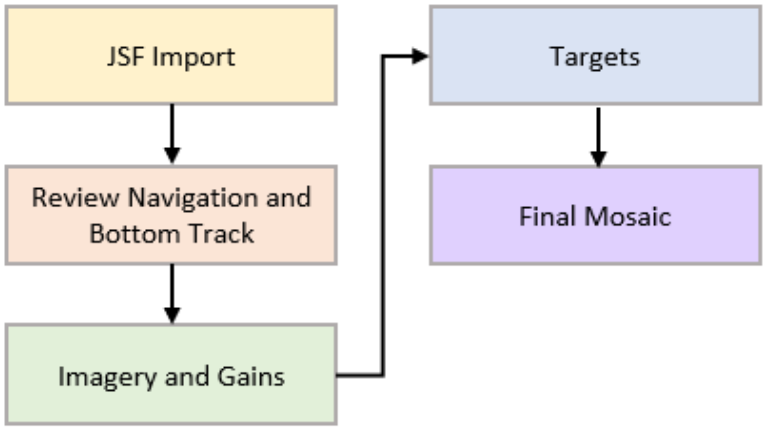


Figure 12: Major Steps for Side Scan Sonar Data Processing

The JSF were imported into SonarWiz, and the subsequent CSF files were created with navigation smoothed. Navigation and layback were reviewed by comparing overlapping data and comparing to the bathymetric surface and backscatter imagery. Layback was applied in post-processing based upon alignment to overlapping data and comparison to real-time layback calculations within Qinsy. The SSS imagery were then opened in the bottom track utility in SonarWiz to remove the water column. An Empirical Gain Normalization (EGN) filter was applied to all SSS lines to improve and harmonize gains. A de-stripe filter was also applied to reduce artifacts from vessel motion and the water column. Once the imagery was optimized for viewing and analysis, each line was viewed in waterfall for targets. A mosaic of the imagery with 0.5 ft resolution was created in SonarWiz and exported to ArcGIS Pro as a 3-Band raster.

3.2.5 Magnetometer/Gradiometer

TVG Navigation Editing

Data processing was conducted using Oasis Montaj and the UXO-Marine Module. Once imported, the navigation data was checked for spikes or duplicates in both the position and altitude. Any spikes identified will be manually removed from the data with resultant gaps interpolated across to a limit agreed with the client. Navigation and Altitude data flags were created for any sections where the navigation quality or gradiometer altitude was outside the specified contractual limits. These flags were used to remove such data from being included in any of the gridded or coverage results, as well as being exportable to identify data gaps for infill/re-runs.

TVG Signal Processing

The magnetometer data was checked for spikes, which are typically caused by electrical interference or motion. The data from each sensor was levelled using a median correction. A background field was calculated by applying a series of non-linear filters to fit a long wavelength curve to each line. This long wavelength curve is subtracted from the altitude corrected data to leave a residual magnetic field profile containing only the short wavelength anomalies. This was first generated by running a set of standard filters. Each line was reviewed on an individual basis and the filters were adjusted as appropriate. The process was repeated with the first pass aiming to generate a residual grid highlighting geology, and the second to generate a residual grid highlighting anomalies. The calculated residual magnetic field is used to calculate gradients in the X (across track) & Y (along track) directions with a vertical derivative used to calculate the gradient in the Z (vertical) direction. The component gradients are to be used to calculate the analytic signal. This is the 3D gradient of the residual magnetic field, quantifying the rate of change of the

magnetic field. The analytic signal is effective for discriminating targets as all anomalies become positive peaks.

4.0 QUALITY ASSURANCE AND QUALITY CONTROL

4.1 Bathymetry

In this survey, multibeam bathymetric data were acquired along 30 m set lines throughout the survey area using R/V Benthos. Additionally, crosslines were collected for quality control and to aid in the interpretation of the sub-bottom data. The final multibeam surface was cross-checked against the crossline data as well as the existing NOAA nautical chart (11539). To complete this analysis, the NOAA vDatum software was utilized to provide the vertical transformation from MLLW (chart datum) to NAVD88 (project datum). These differences were calculated in CARIS and ArcGIS Pro respectively and produced the results seen below.

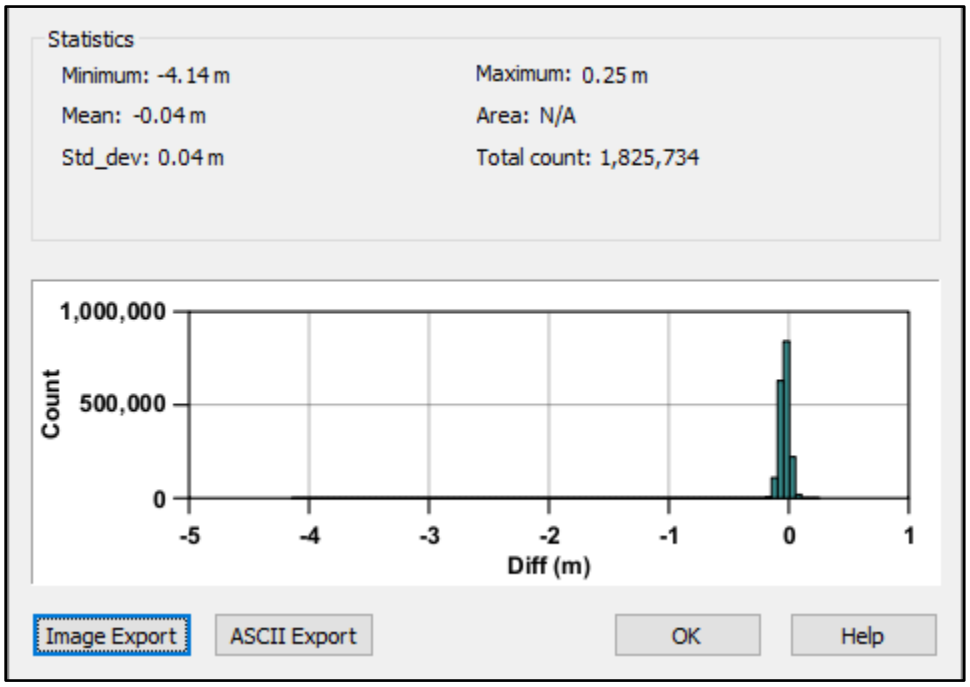


Figure 13: Histogram of the values of the difference surface between the 30 m set lines and the crosslines.

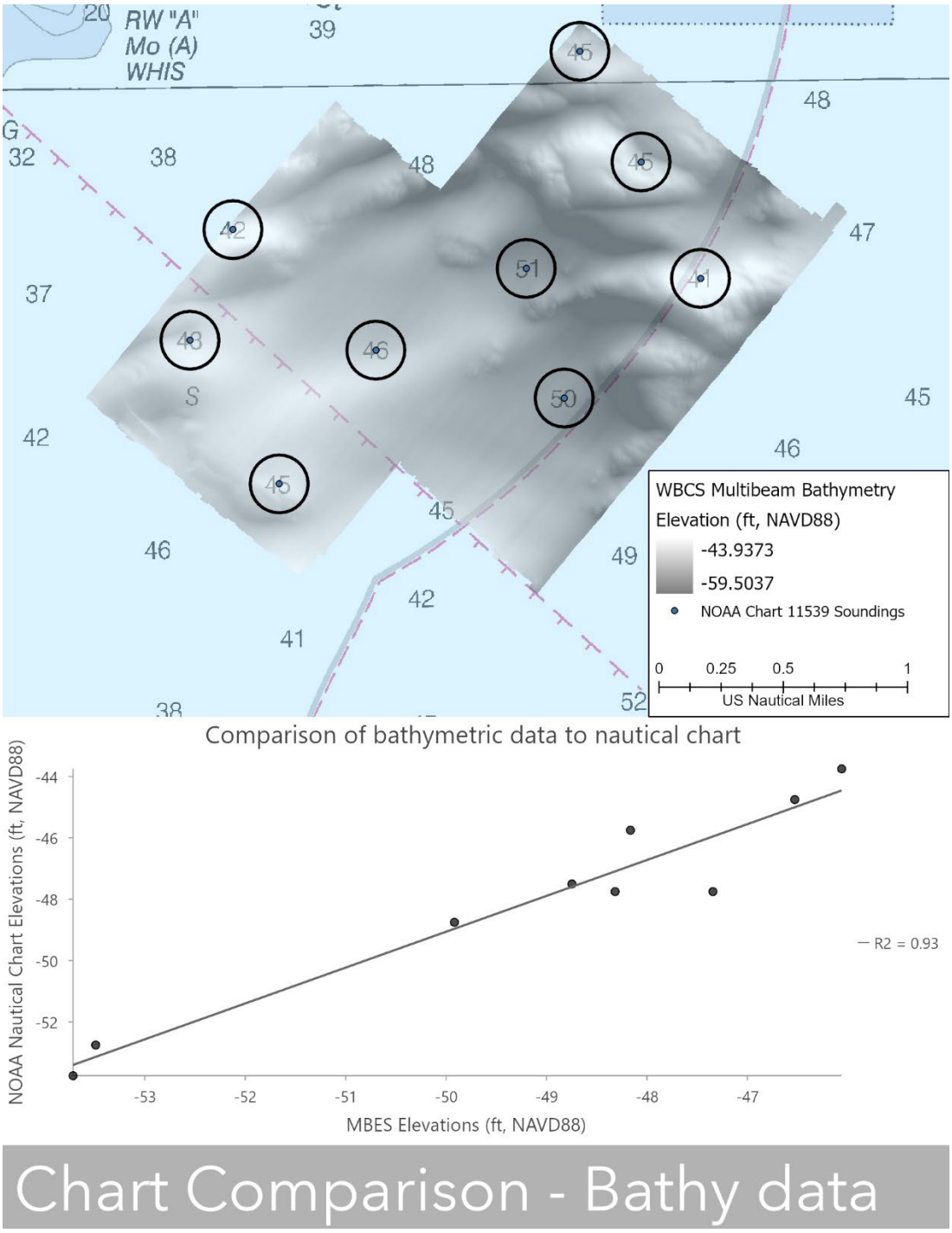


Figure 14: Chart comparison between NOAA provided nautical chart (11539) and the bathymetric dataset.

Additionally, the Caris processing software has multiple methods by which ensure the data is sufficient in quality and quantity given project specifications. The “Uncertainty” graph provides visual information regarding the summation of the potential errors within the dataset as described within the processing section. The “Data Density” graph illustrates the number of soundings associated with each grid node for the deliverable bathymetric dataset. For this project, the bathymetric data were extremely dense given the 30m line spacing.

Finally, a custom TVU assessment based upon NOAA HSSD standards used for nautical charting was conducted on the multibeam dataset. This assessment calculated the vertical uncertainty as a fraction of the allowable TVU based upon NOAA HSSD standards.

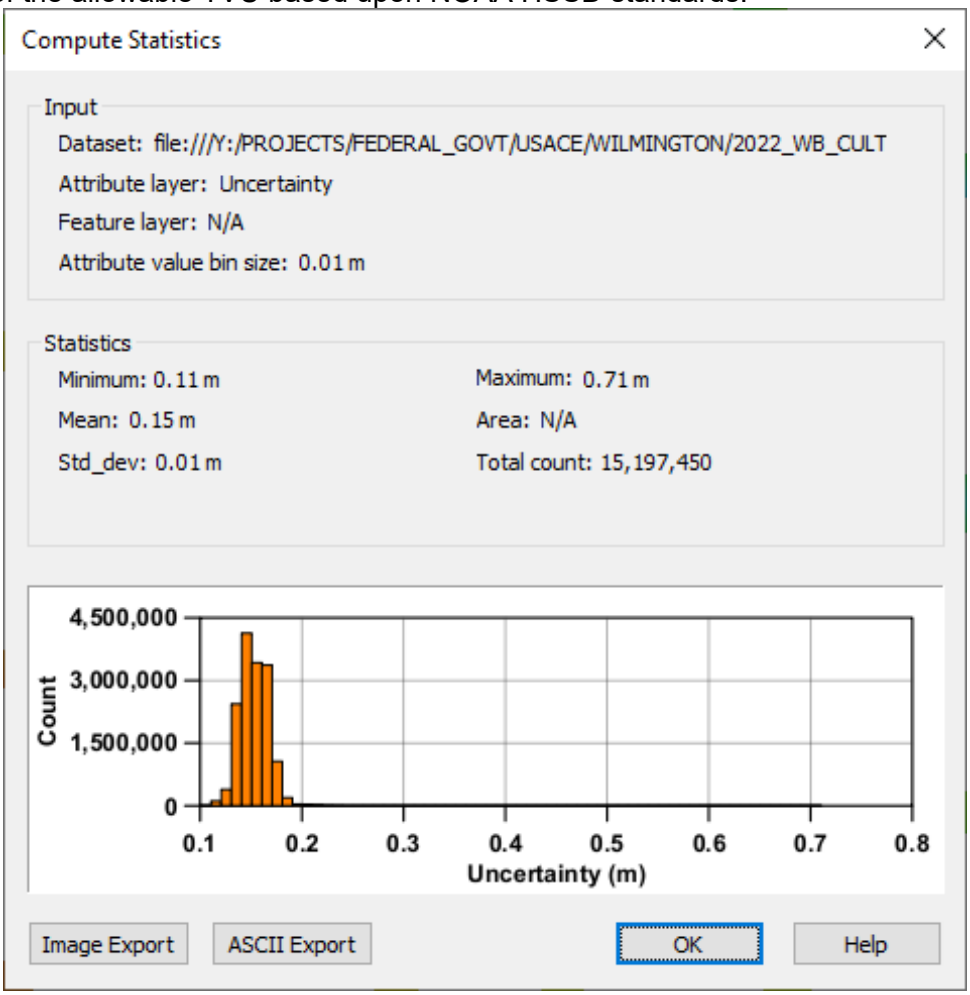


Figure 15: Distribution of uncertainty for the final bathymetric surface.

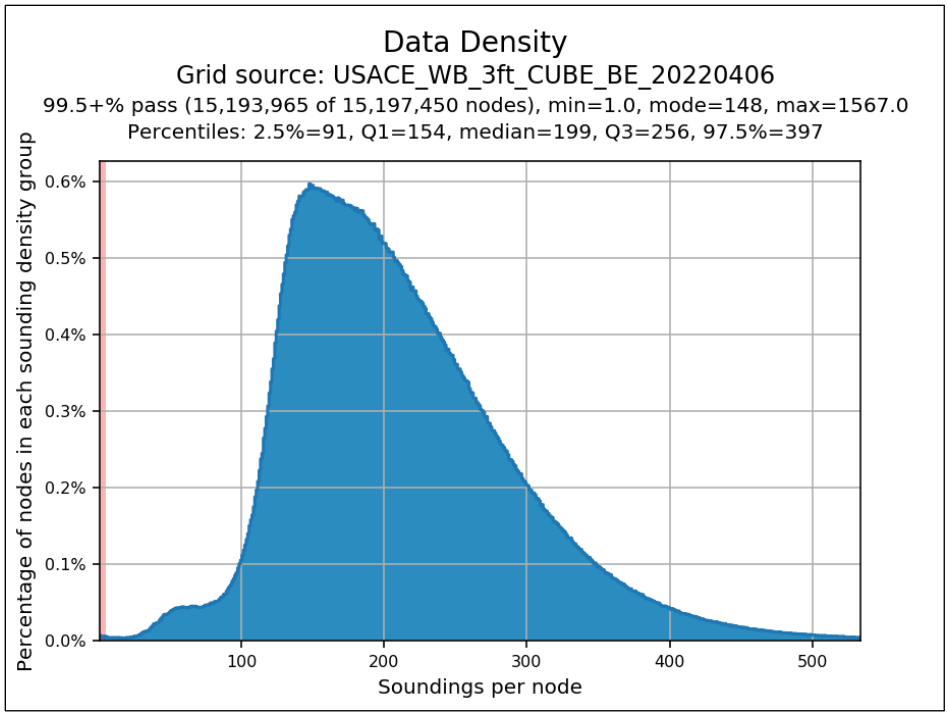


Figure 16: Node density analysis for the Wrightsville Beach bathymetric dataset.

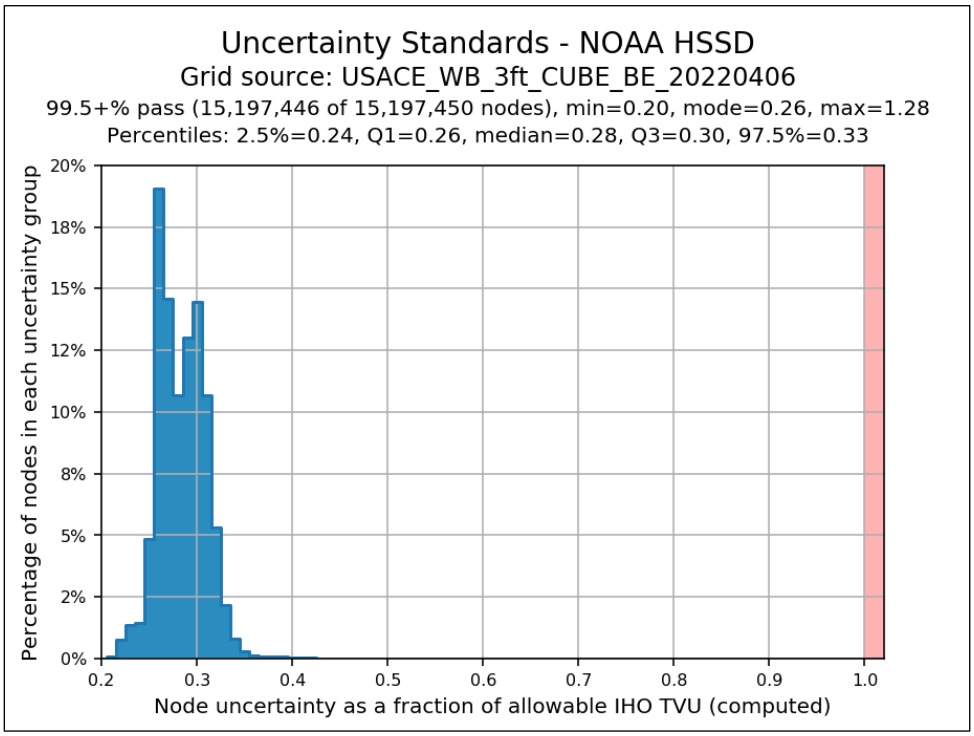


Figure 17: TVU analysis based upon NOAA HSSD specifications.

4.2 Geophysical

This section highlights results obtained from Oasis Montaj during the processing of the magnetometer data. The primary purpose of this section is to illustrate the proper altitude and speed were maintained during the course of the survey. Additionally, plots showing the alignment between the field values obtained by each magnetometer for multiple surveys lines provide confidence in each individual sensor's field.

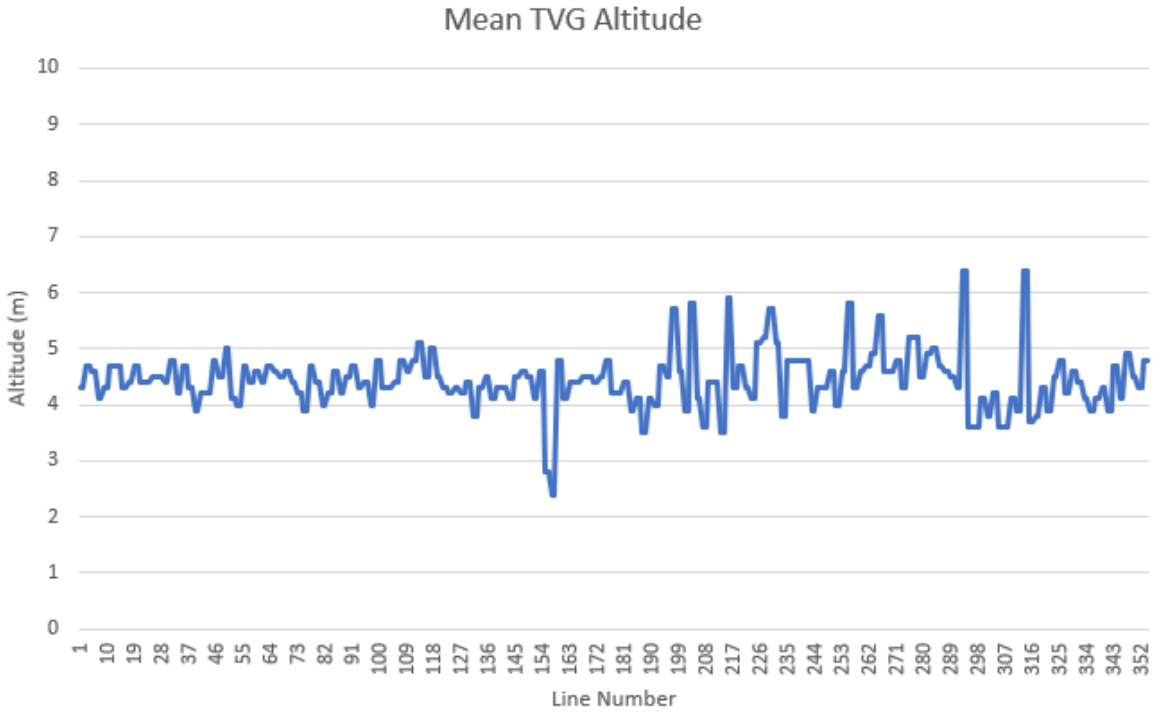


Figure 18: Oasis Montaj generated statistics for the average altitude of each recorded TVG survey line.

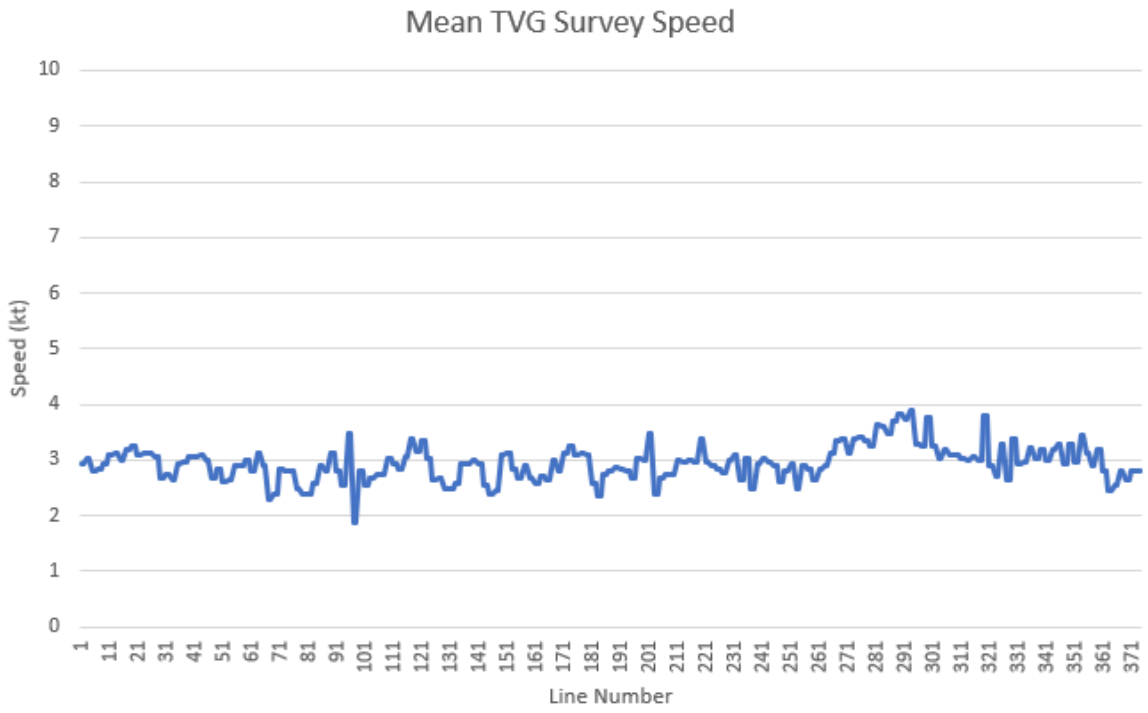


Figure 19: Oasis Montaj generated statistics for the average speed for each TVG survey line.

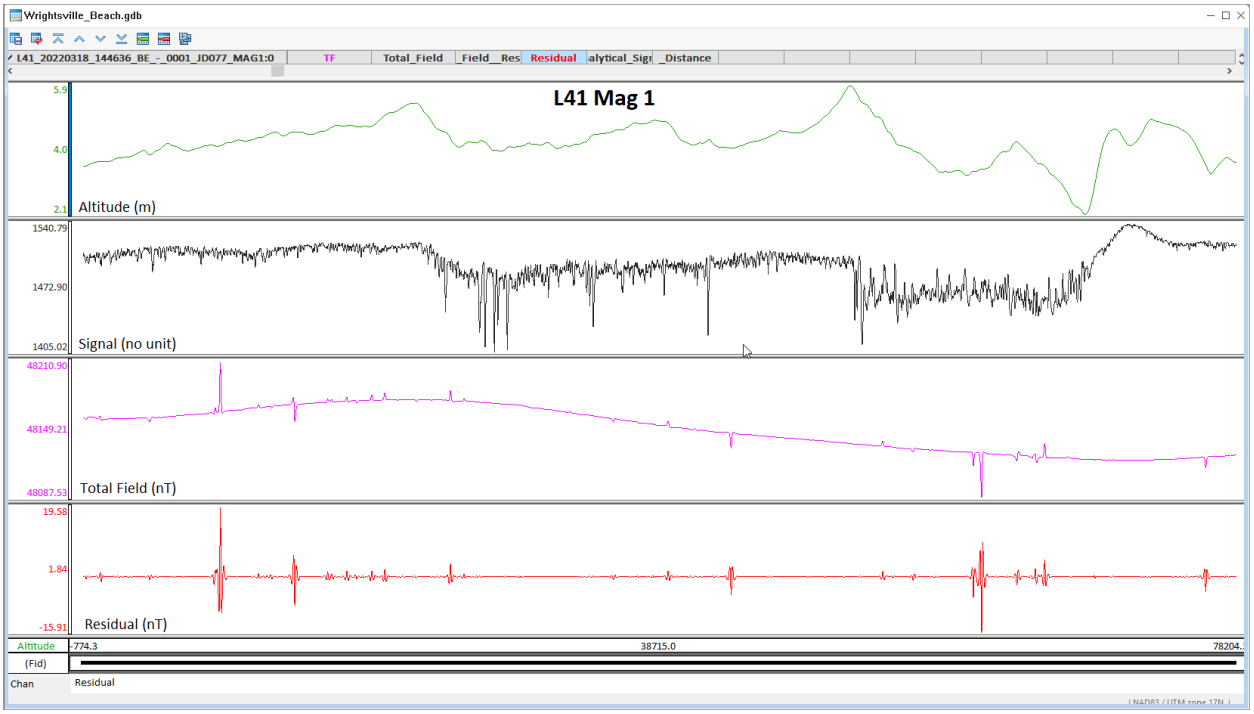


Figure 20: Oasis Montaj generated plots for the port magnetometer for Line 41.

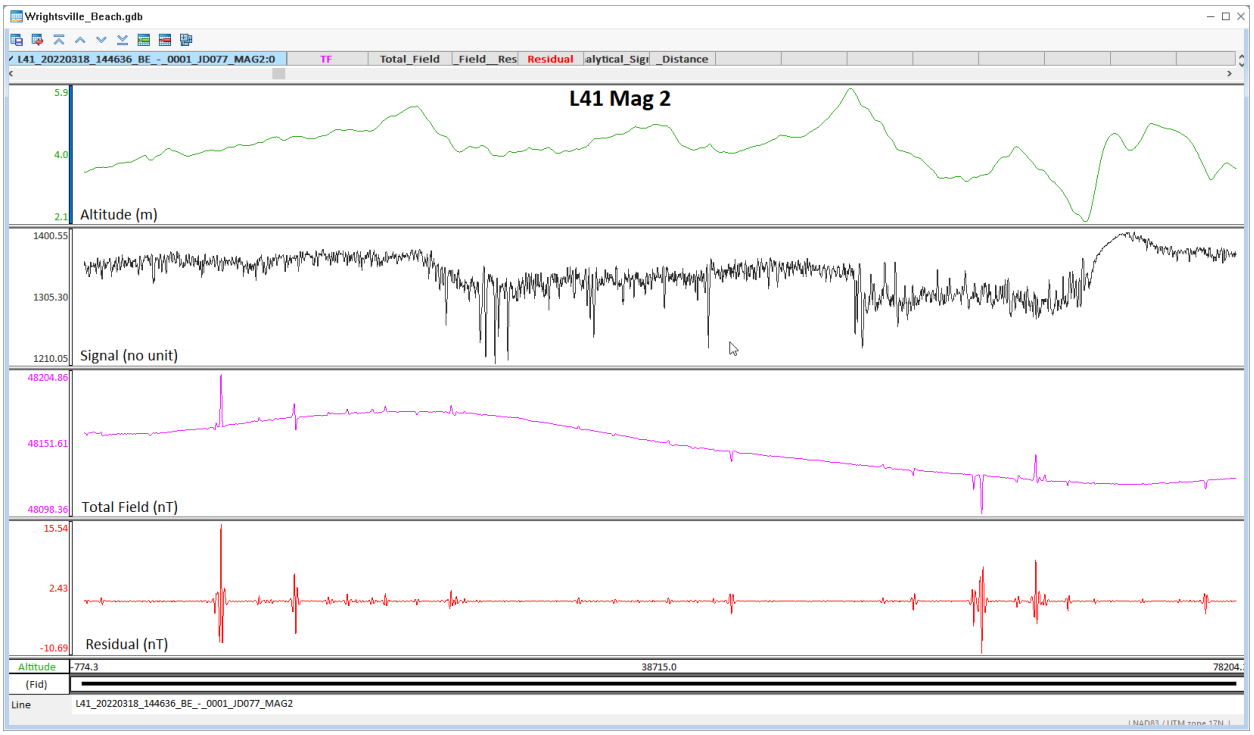


Figure 21: Oasis Montaj generated plots for the starboard magnetometer for Line 41.

5.0 RESULTS

The results from the geophysical survey were consistent across survey platforms. In general, multibeam bathymetry and backscatter imagery aligned well to the side-scan data, and features identified within side-scan data and magnetic data were consistent. After processing and quality control routines this dataset is sufficient to perform a cultural resource assessment.

5.1.1 Bathymetry

Bathymetric data provided sufficient information to report water depths throughout the survey area at a 3 ft resolution. The MBES data covers elevations from -43 ft to -60 ft NAVD88. The data reveal a large area of apparent sand, outlined with softer appearing sediment extending to the northeastern and northwestern sections of the survey area. Along the northeastern edge of sandy substrate, there is a region of valleys composed of softer appearing sedimentation with a relief of approximately 1.5 m. Near the northwestern extent, a slight but pronounced area of relief is apparent. This region has been highlight within the data deliverable and within the screenshot image below.

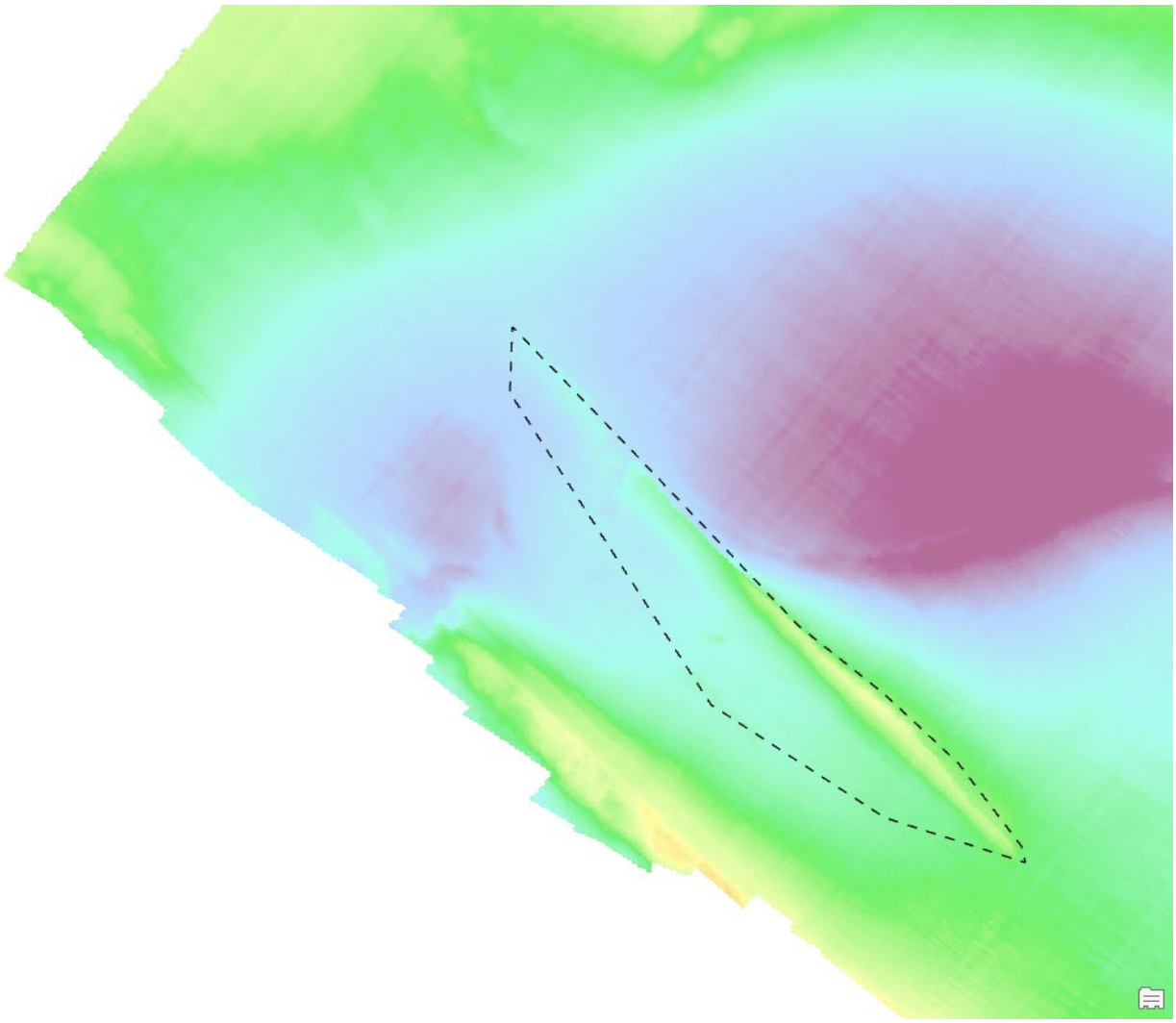


Figure 22: Northwest extent showing vertical relief within the bathymetric dataset.

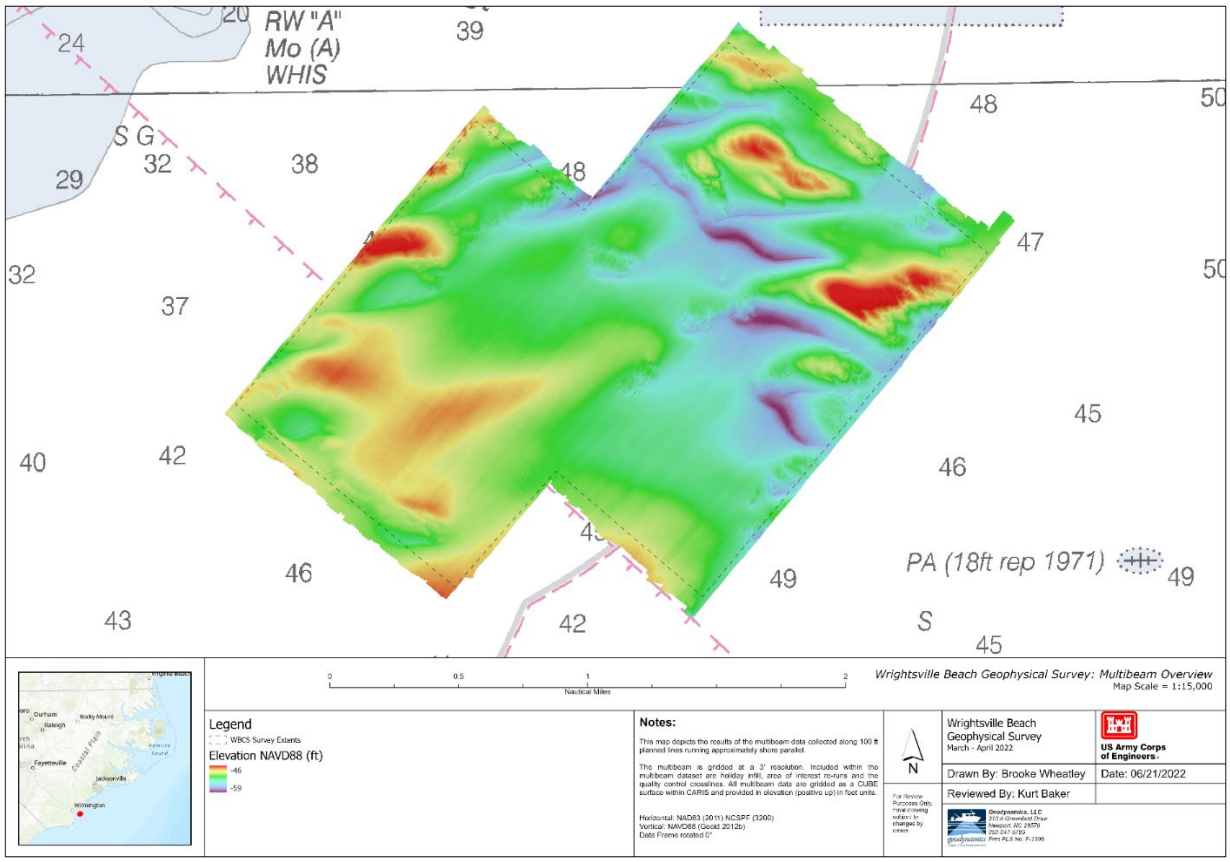


Figure 23. Multibeam bathymetry gridded at 3 ft resolution.

5.1.2 Sub-bottom Profiling

Sub-bottom data shows general features at the expected depths for the sensor. The data shows alignment and agreement when between intersecting lines when viewed within a 3-dimensional fence diagram. The intent of the sub-bottom profiler data was to assist in the identification of features identified within the MBES, SSS, and TVG datasets. As no features of concern were identified, the sub-bottom profiler data remains available for future analysis, however with no deliverables attached.

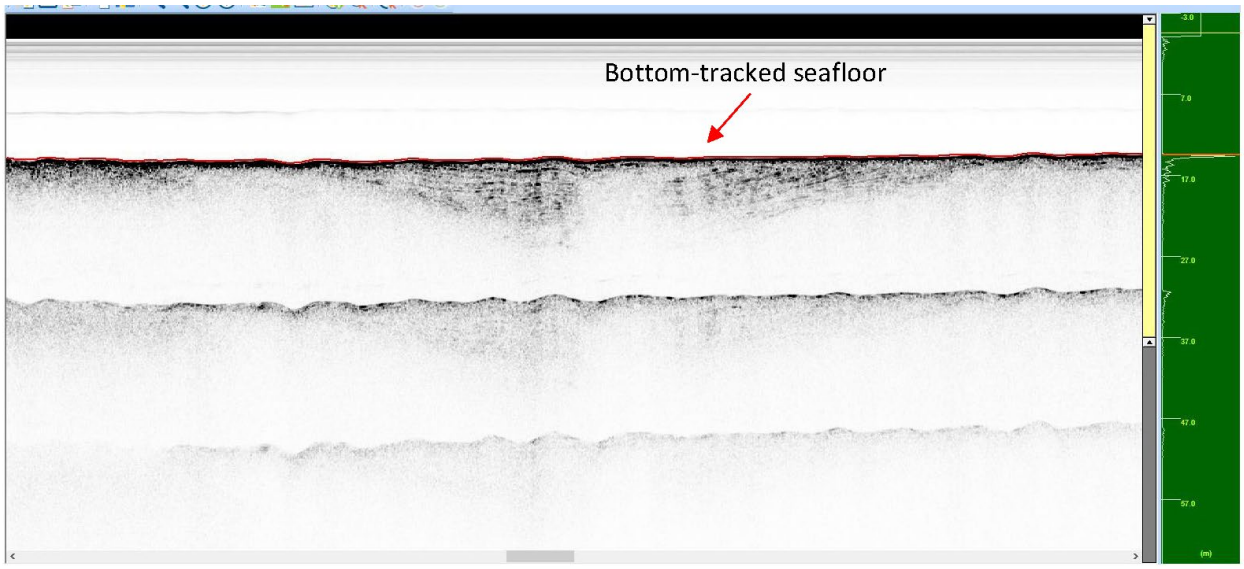


Figure 24: Bottom-tracked sub-bottom file, depicting the first acoustic return, the seafloor.

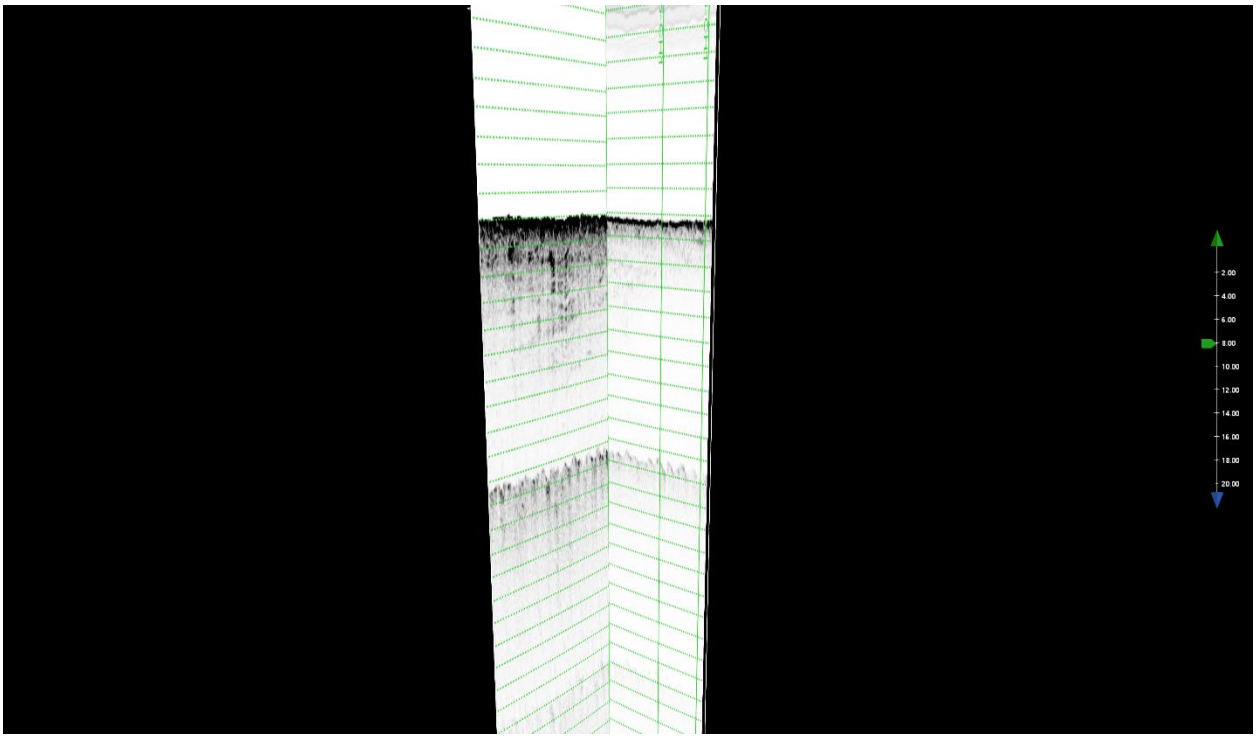


Figure 25: 3D rendering of intersecting sub-bottom lines within the WBCS survey extent with no gains applied. Green lines are equally spaced every 5 ft. The strong reflector at ~50 ft is a multiple.

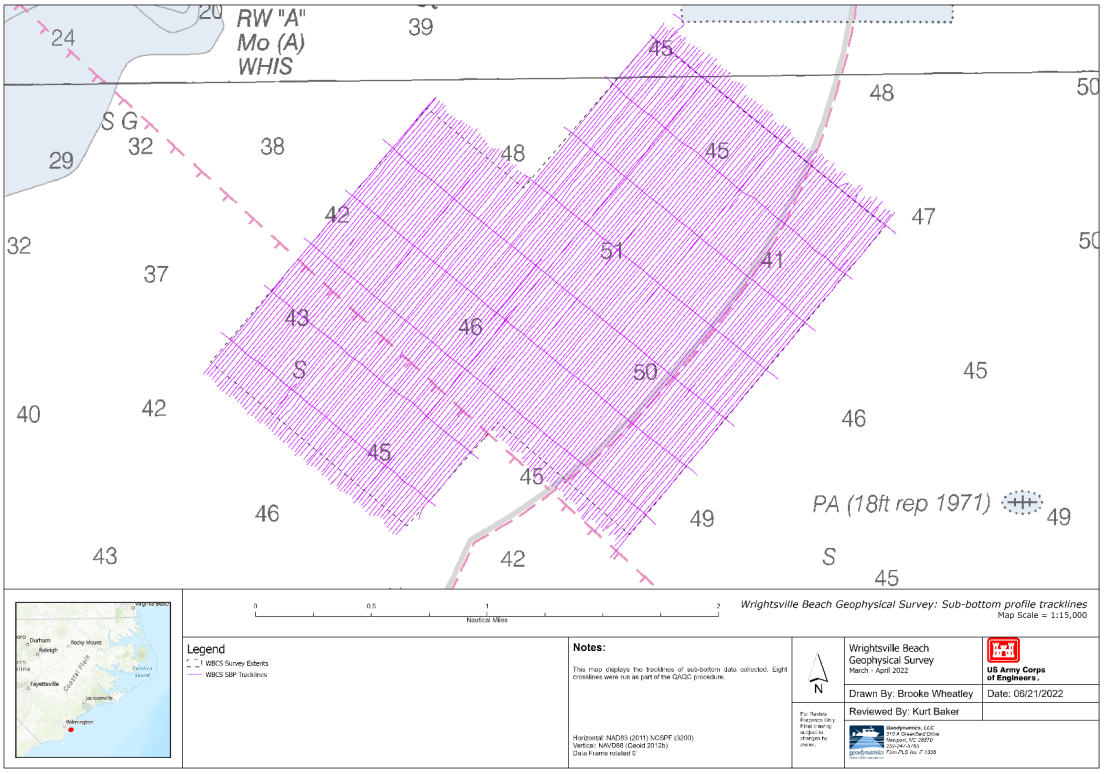


Figure 26: Tracklines of sub-bottom data collected.

5.1.3 Side-Scan Sonar

Side-scan sonar data shows good agreement between reciprocal lines and of features observed in the bathymetry. The data presents areas of high return, indicating coarse sedimentation as well as areas of low return, suggesting softer, less consolidated sedimentation (Figure 22). Significant contacts detected in the dataset include numerous tires and debris (Figure 23). Contacts were predominately tires (6,343 of the 6,415 contacts).

Distribution of tires was quantified using the “Point Density” tool within the ArcGIS Pro software. For this analysis, the subset of targets identified as “tires” was selected. Parameters for this model were set to search a circular radius of an acre in area (~117 ft radius) and report the density in units of acres. This approach was taken to produce results The resulting dataset was then manually classified into 3 separate and distinct polygon shapefiles: low (1 -3 tires per acre), medium (4 – 20 tires per acre), and high (21 – 83) tires per acre.

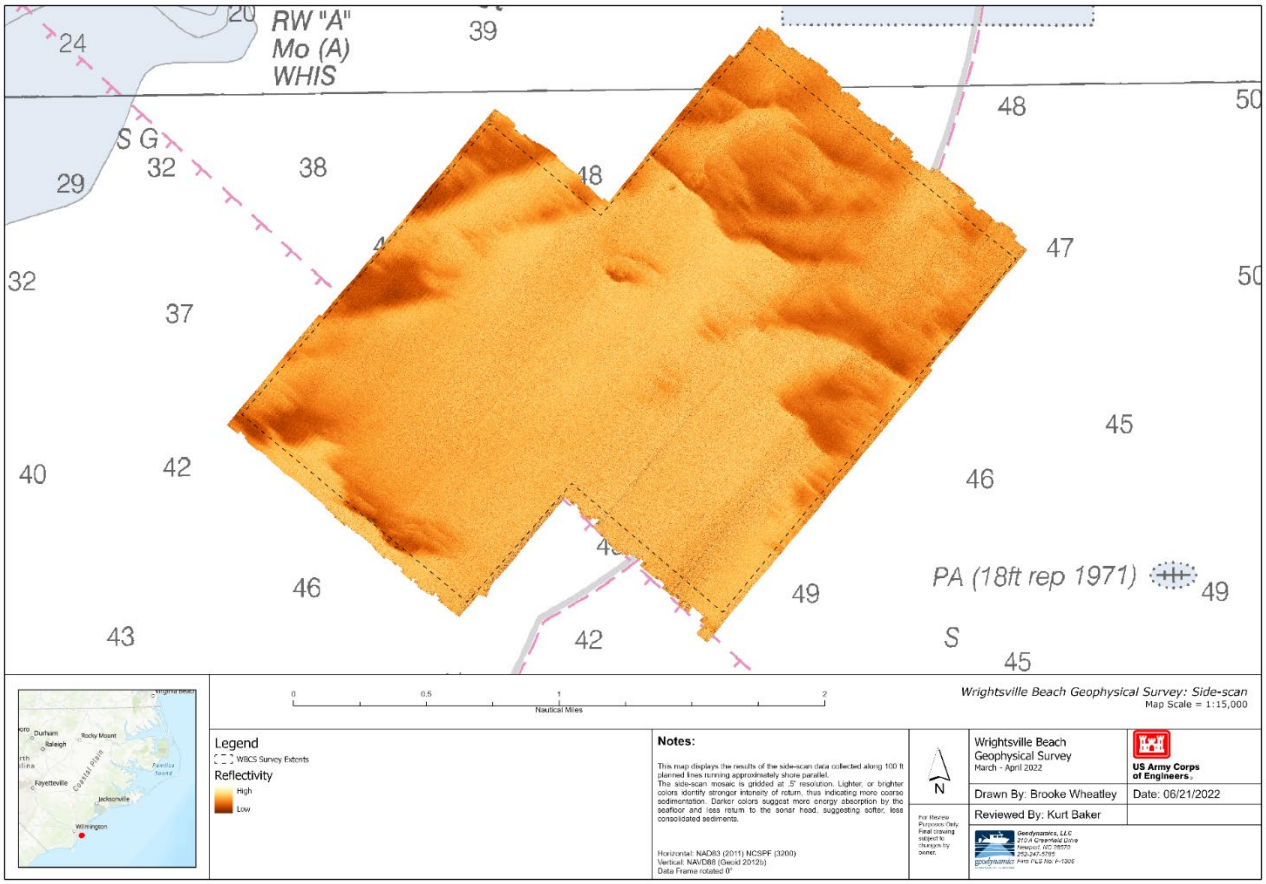


Figure 27: Side-scan sonar data mosaiced at 0.5 ft resolution.

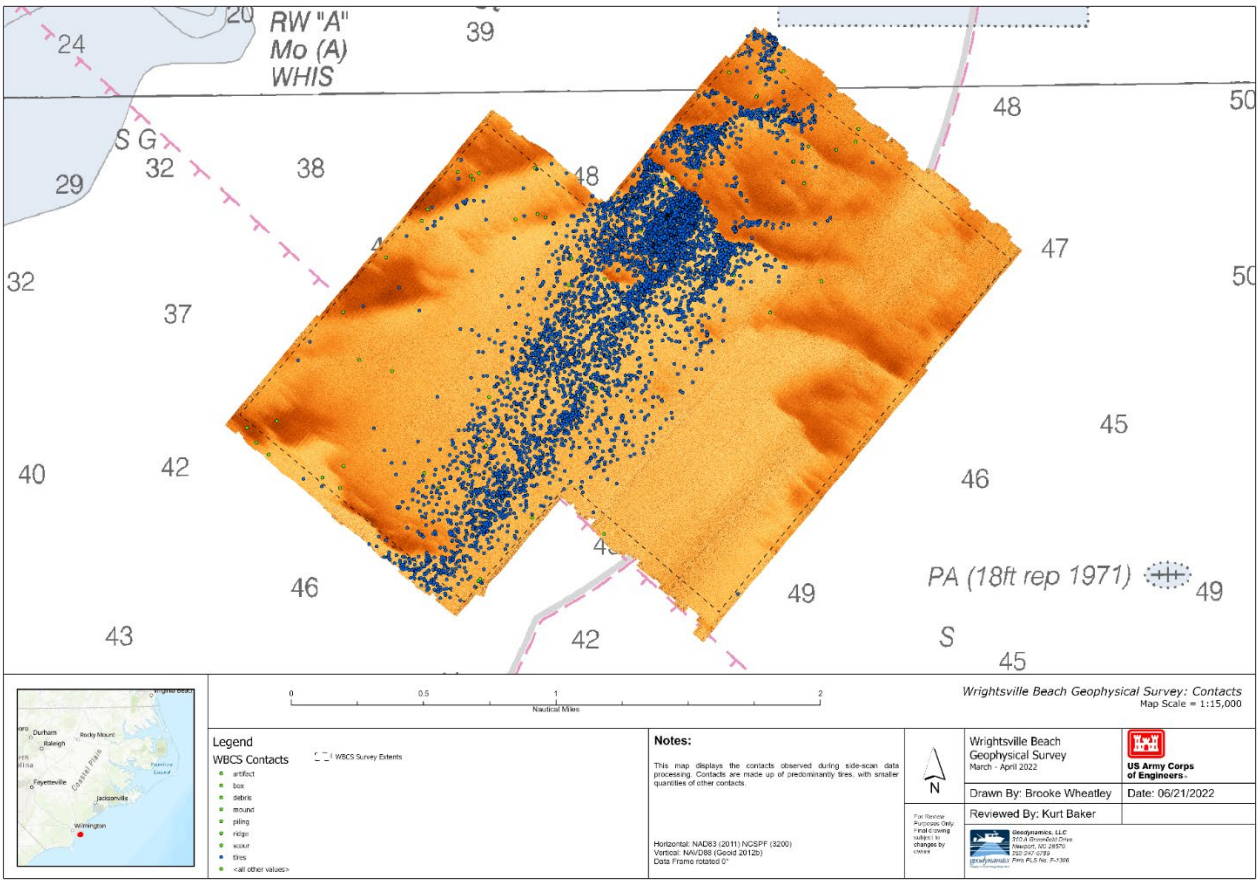


Figure 28: Contacts detected in side-scan sonar data.

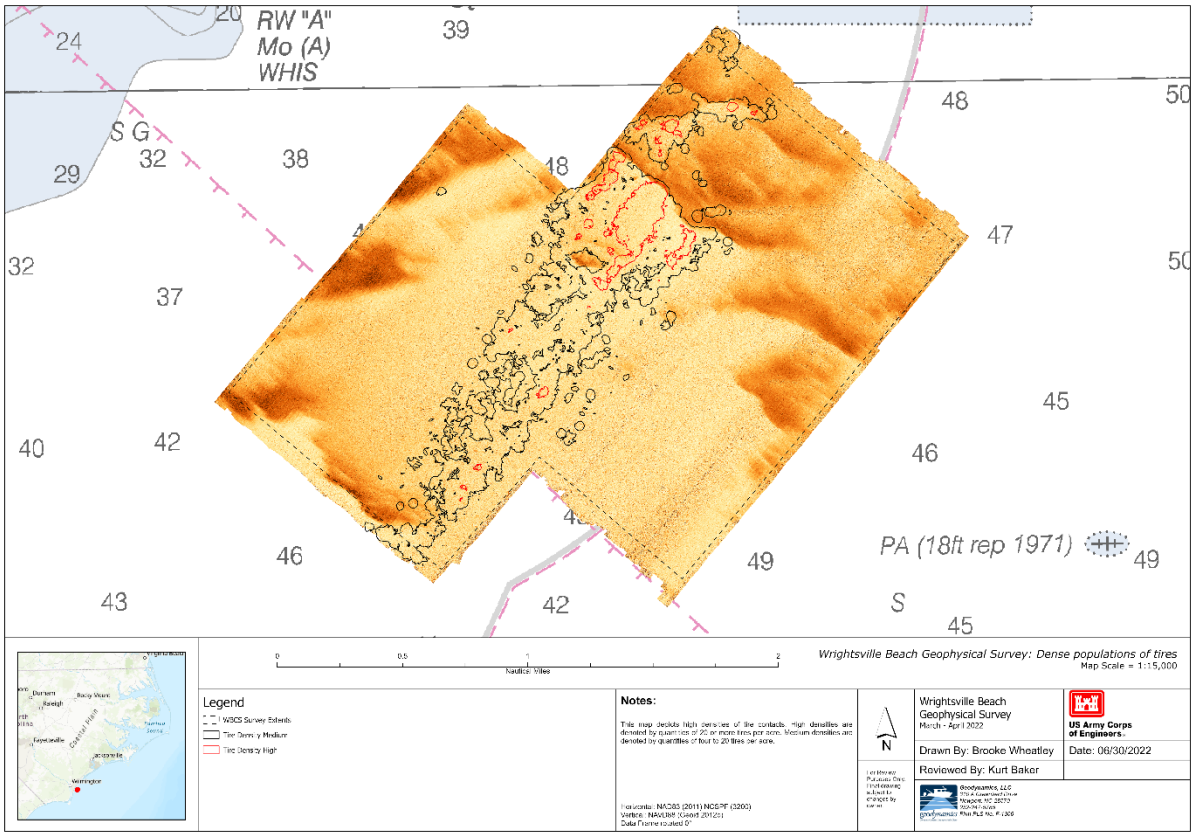


Figure 29: Polygons depicting areas of high concentrations of contacted identified as tires.

5.1.4 Magnetometer/Gradiometer

The gradiometer data showed excellent agreement between the individual magnetometers, increasing the confidence of apparent magnetometer anomalies. The magnetometer data was gridded and the residuals contoured, with results consistent with the side-scan sonar data contacts. The central region of the survey extents showed a much higher quantity of magnetic returns as compared to the inshore and offshore extents. Additionally, the region directly to the northeast of the greatest accumulation of sonar targets contained many magnetic anomalies not directly associated with sonar targets. These locations are presumed to potentially be residual chain and cable debris from the originial securing of the the tire reefs.

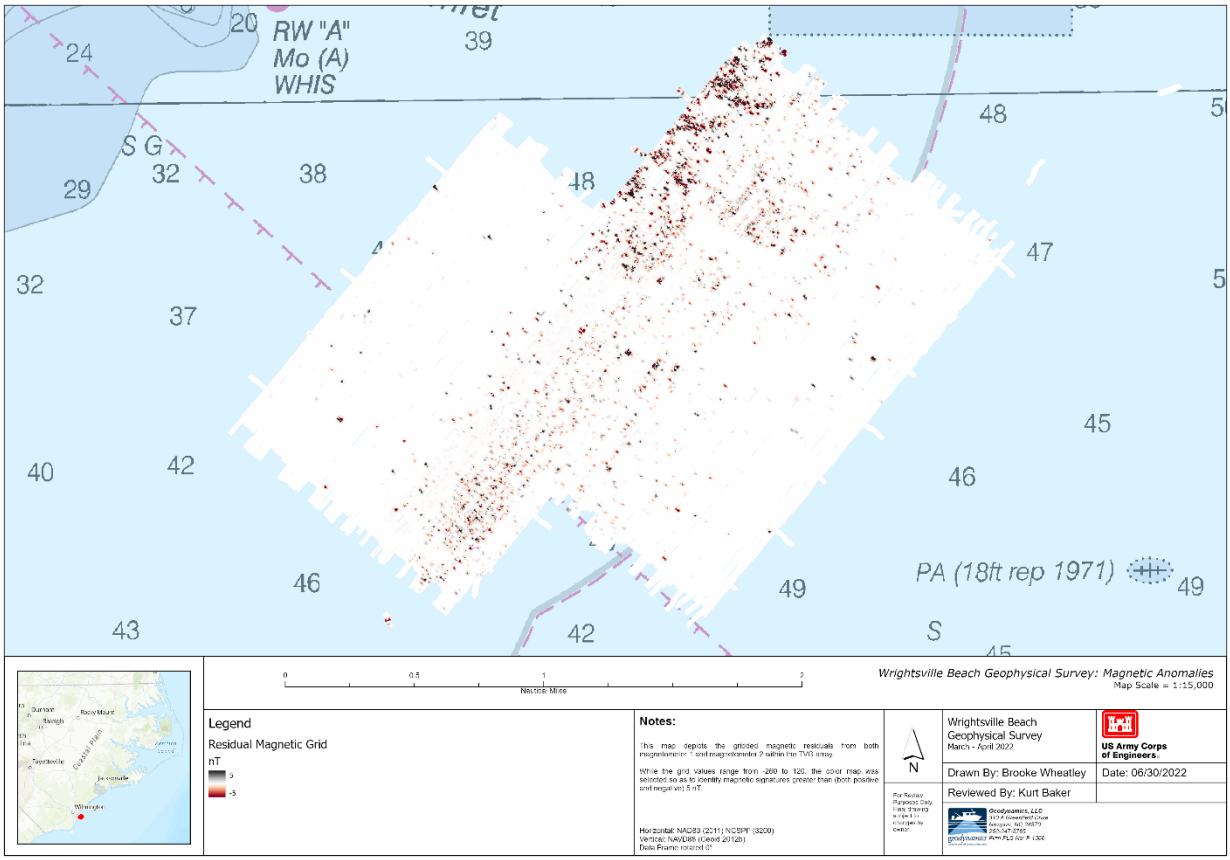


Figure 30: Map showing gridded magnetic residuals. White indicates a neutral or regular magnetic signal, whereas blue and red highlight areas of magnetic anomalies.

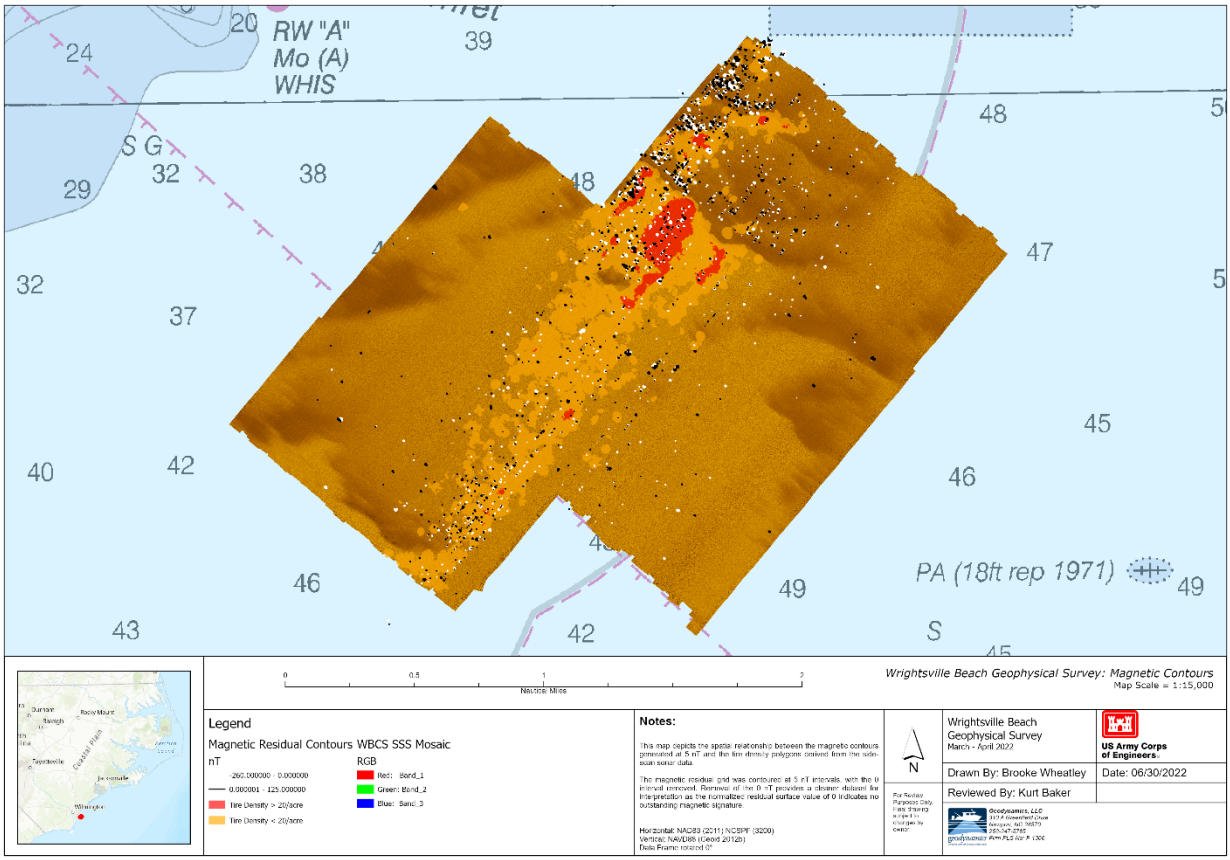


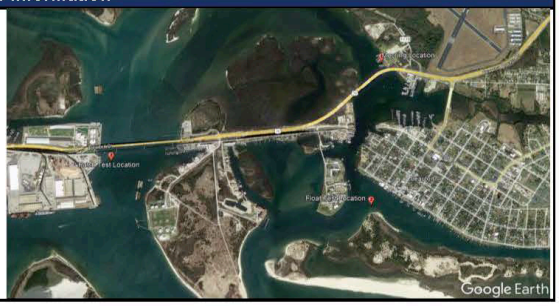
Figure 31: Map showing the contours in 5 nT intervals from the gridded magnetic residual surface. This data is overlaid on the tire density map with side-scan data as a background.

APPENDIX 1: PATCH AND VERIFICATION REPORTS

geodynamics AN NV5 COMPANY

Multibeam
Sonar System Calibration
RV Benthos
BE_Patch_Verification_20211101.xlsx

Site Information	
Date	11/1/2021
Site Location	Morehead City, NC
Weather Conditions	Partly Cloudy
Wind Speed	6 kts
Wind Direction	N
Sea State	1-2 ft
Latitude	34°43'10.33"N
Longitude	76°41'37.31"W
Personnel	Cpt. Josh Savage, Morgan Smith, Dave Bernstein



Operational &Systems Information			
Sonar	Kongsberg EM2040C DualHead	Pr. Antenna	540AP: 17985
Port Head	2549	Sc. Antenna	540AP: 17989
STBD Head	2548	Surface Sound Speed	AML Oceanographic Micro X 7762
Kongsberg PU	385406: 20188 & 20159	Surface Sensor	AML Oceanographic SV Xchange 204291
SIS	Kongsberg 4.3.2	Sound Speed Profiler	AML Oceanographic Base X2 26045
Kongsberg PU	385406: 20188 & 20159	Pressure Sensor	AML Oceanographic P Xchange 306187
POS Unit	Applanix POS MV V5 OceanMaster	Velocity Sensor	AML Oceanographic SV Xchange 206265
		Software	SeaCast 4.4.0
POSView	10.2	Computer	Cincoze
Firmware	Applanix POS MV Version 10.21	Operating System	Microsoft Windows 10 Pro: 10.0.19042

Patch Test Values (SIS/QINSy)				
Component	Roll	Pitch	Yaw	Latency
SH1 (PORT)	34.227	-0.294	359.495	-
SH2 (STBD)	-35.823	-0.307	359.450	-
Attitude 1, Com2	0.000	0.000	0.000	-
Timing (Second)	-	-	-	0.000

GAMS Parameters			
Category	Value	Baseline Vector	
Two Antenna Spread (m)	2.000	X (m)	-0.025
Heading Cal. Threshold	0.500	Y (m)	1.999
Heading Correction (deg)	0.000	Z (m)	-0.014

Sonar Offsets / Biases (SIS/QINSy)					
Lever Arm	X (m)		Y (m)		Z (m)
Ref. to IMU Target	0.000		0.000		0.000
Ref. to Primary GNSS	-0.189		-1.018		-2.404
Ref. to Vessel Lever Arm	-0.947		-1.662		1.314

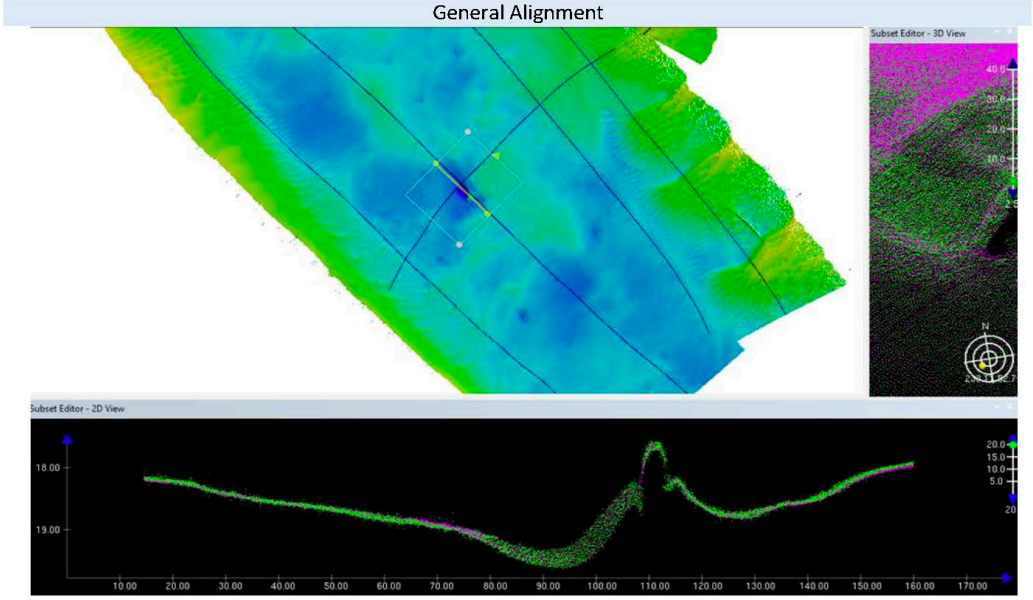
geodynamics AN NV5 COMPANY

Multibeam
Sonar System Calibration
RV Benthos
BE_Patch_Verification_20211101.xlsx

POSMV Configuration					
Lever Arm	X (m)		Y (m)		Z (m)
Ref. to IMU Target	0.000		0.000		0.000
Ref. to Primary GNSS	-0.189		-1.018		-2.404
Ref. to Vessel Lever Arm	-0.947		-1.662		1.314
Ref. to Sensor 1	-0.947		-1.662		1.314
IMU w.r.t. Ref. Frame (°)	0.000		0.000		0.000
Target to Sensing Center	0.004		0.001		0.066
Resultant Lever Arm	0.004		0.001		0.066

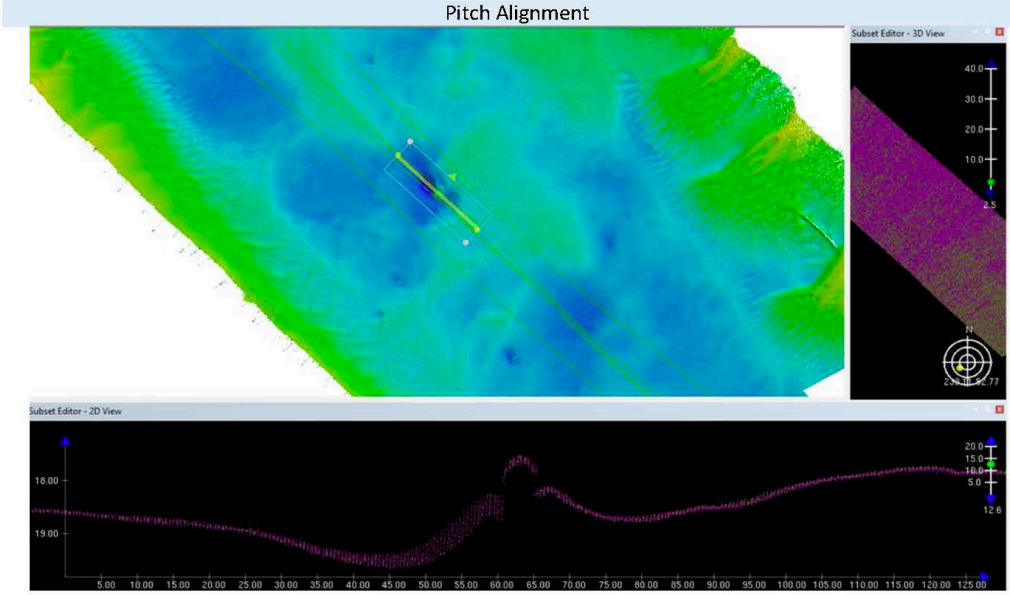
Calibration Notes
This calibration was completed onboard the RV Benthos on 01 November, 2021 in a region of the Morehead City Port with a clear bottom feature and broad flat area near the project water depth. A series of lines were collected in accordance with the procedures laid out by the sonar equipment manufacturer, Kongsberg. Results were good and provide high confidence in the ability of this mobilization to produce high quality and repeatable data.

Calibration Images
General Alignment



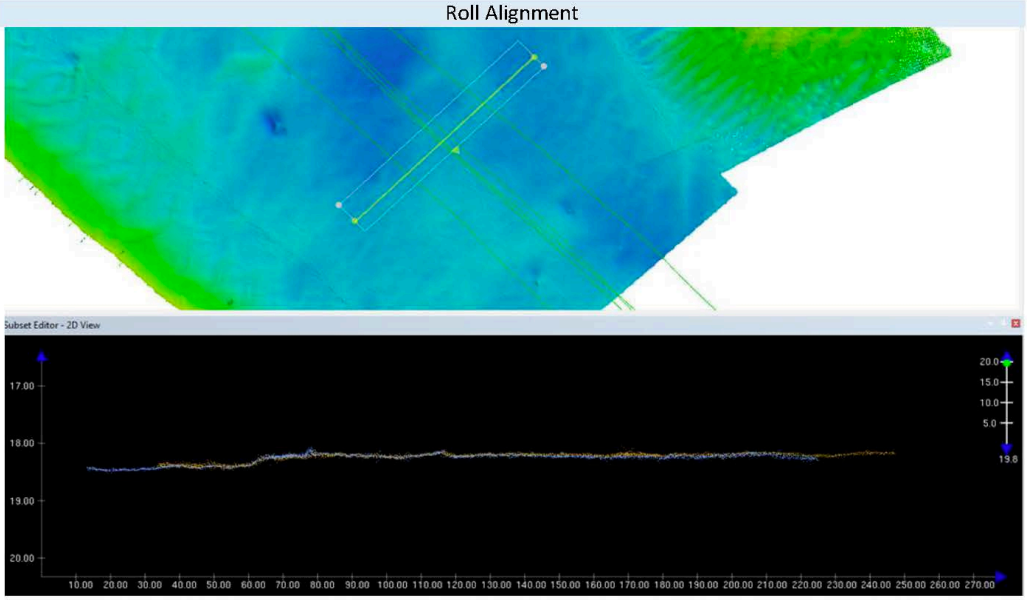
Multibeam
Sonar System Calibration
RV Benthos
BE_Patch_Verification_20211101.xlsx

Pitch Alignment



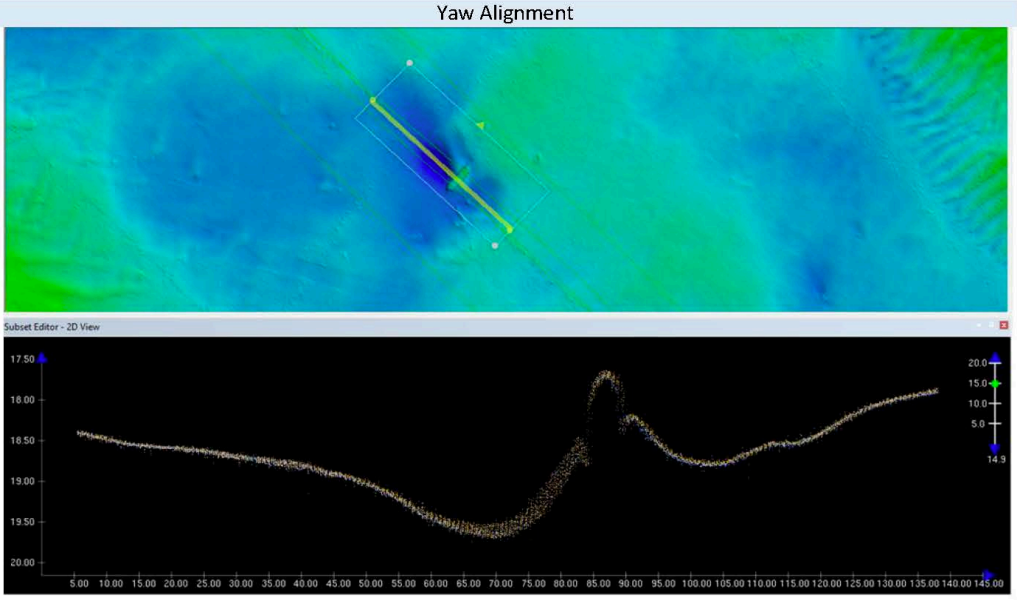
Multibeam
Sonar System Calibration
RV Benthos
BE_Patch_Verification_20211101.xlsx

Roll Alignment



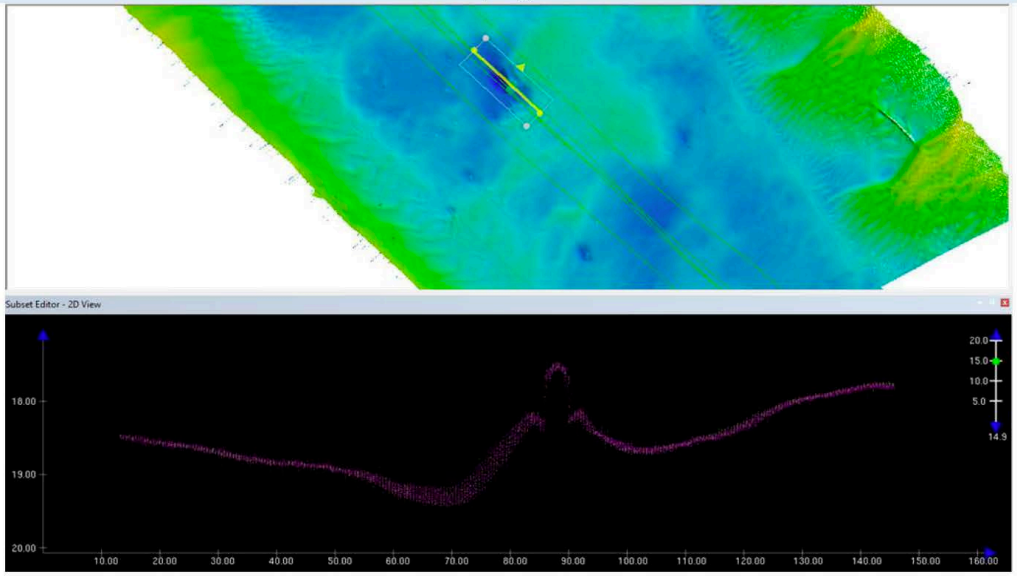
Multibeam
Sonar System Calibration
RV Benthos
BE_Patch_Verification_20211101.xlsx

Yaw Alignment



Multibeam
Sonar System Calibration
RV Benthos
BE_Patch_Verification_20211101.xlsx

Latency Alignment



APPENDIX 2: SURVEY CONTROL

Survey Control

Project Timeframe:	3/05/2022 - 4/14/2022			
Project:	U.S. Army Corps of Engineers Wilmington District - Wrightsville Beach Cultural Resources Survey			
Survey Location:	Wrightsville Beach, New Hanover County, North Carolina			
Survey Crew:	Nolan Day	Tariq Moya	Rachel Dudas	Davis Batten
	Clay Walker			
			Units	***Repeater Use:***
Coordinate System/Units:	NAD83 NC State Plane		SPF	N/A
Vertical:	NAVD88	**Geoid:** 2012b		
	Receiver	**GPS Antenna**	**Radio**	**Radio Broadcasting**
Base Station Equipment:	Trimble R10	Trimble R10	N/A	N/A

Notes: This project was conducted over a period of 1.5 months during times of optimal weather and tidal conditions. Benchmark checks were conducted using the NC CORS VRS network.

Base Station Information

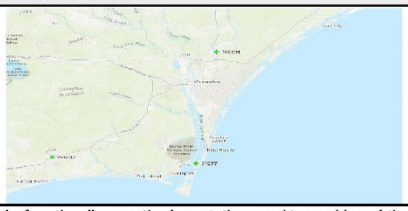
Designation: NC CORS VRS NETWORK
PID: N/A
H Order: N/A
V order: N/A
Geoid: 2012b

State Plane Coordinates

Easting (X): N/A
Northing (Y): N/A
Z: N/A

WGS-84 Coordinates

Longitude: N/A
Latitude: N/A
Elevation (m): N/A



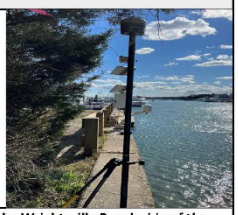
Notes: Network of continually operating base stations used to provide real-time kinematic corrections to survey units via the internet.

Benchmark Station Reference

Designation: S 233
PID: EA0624
H Order: N/A
V order: Second, Class 0
Geoid: 2012b

State Plane Coordinates

Easting (X): 2359085.95
Northing (Y): 172441.214
Z(m): 6.25



Notes: Benchmark is located on the southern retaining wall for the Wrightsville Beach Drawbridge on the Wrightsville Beach side of the bridge. XY values are not published and derived from Geodynamics.

Benchmark Report

Date	Time	Weather	Benchmark	N	E	Z	ΔN	ΔE	ΔZ
3/5/2022	7:50	Partly Cloudy	S 233	172441.324	2359085.87	6.329	-0.110	0.083	-0.079
	Base Station Used: NC CORS								
3/13/2022	15:04	Clear	S 233	172441.29	2359085.89	6.309	-0.076	0.058	-0.059
	Base Station Used: NC CORS								
3/15/2022	21:16	Clear	S 233	172441.259	2359085.84	6.213	-0.045	0.112	0.037
	Base Station Used: NC CORS								
3/16/2022	7:04	Clear	S 233	172441.262	2359085.84	6.344	-0.048	0.110	-0.094
	Base Station Used: NC CORS								
3/17/2022	16:22	Partly Cloudy	S 233	172441.296	2359085.86	6.153	-0.082	0.086	0.097
	Base Station Used: NC CORS								
3/18/2022	22:05	Partly Cloudy	S 233	172441.285	2359085.89	6.075	-0.071	0.059	0.175
	Base Station Used: NC CORS								
3/20/2022	13:18	Clear	S 233	172441.324	2359085.87	6.329	-0.110	0.083	-0.079
	Base Station Used: NC CORS								

3/21/2022	19:40	Partly Cloudy	S 233	172441.319	2359085.83	6.190	-0.105	0.116	0.060
	Base Station Used: NC CORS								
3/22/2022	19:45	Partly Cloudy	S 233	172441.385	2359085.81	6.329	-0.171	0.137	-0.079
	Base Station Used: NC CORS								
3/23/2022	12:54	Overcast	S 233	172441.281	2359085.87	6.249	-0.067	0.085	0.001
	Base Station Used: NC CORS								
3/28/2022	17:32	Clear	S 233	172441.324	2359085.87	6.329	-0.110	0.083	-0.079
	Base Station Used: NC CORS								
3/29/2022	09:18	Partly Cloudy	S 233	172441.255	2359085.83	6.230	-0.041	0.117	0.020
	Base Station Used: NC CORS								
4/3/2022	21:09	Clear	S 233	172441.267	2359085.89	6.051	-0.053	0.056	0.199
	Base Station Used: NC CORS								
4/11/2022	17:05	Clear	S 233	172441.226	2359085.85	6.114	0.012	-0.105	-0.136
	Base Station Used: NC CORS								

GPS consistency (measured in feet)

Average Easting (X) error	-0.077
Average Northing (Y) error	0.076
Average Elevation error	-0.001

APPENDIX 3: SURVEY NOTES

Daily Survey Field Notes				
Date:	3/5/2022	**Day of Year:**	64	
Time SOS (local):	8:05	**Time EOS (local):**	19:55	
Project:	Wrightsville Beach Cultural Resources Survey			
Survey Location:	1-3 miles offshore of Masonboro Inlet			
Hydro Crew:	Nolan Day	Tariq Moya	Brett Bolton	

Atmospheric Conditions		Water Conditions	
Sky:	Cloudy	**Swell:**	2-3 ft
Wind Speed:	5-10 KT	**Chop:**	0 - 0.5 ft
Wind Direction:	NE	**Temp:**	40-50 F
Temp:	50-60 F		

Survey Activities

Control

Benthos crew established survey control by checking benchmark S 233 which is located on the south east side of the Wrightsville Beach draw bridge. A network of continually operating base stations (NC CORS) was used to provide real-time kinematic corrections to survey units via the internet.

Hydro

Nolan and Tariq checked benchmark S 233 before the start of the survey day. At the dock the crew set up the Minos SVP. The SBP monitor was not displaying, so Tariq went out and bought a DVI adapter. We got all of the computers and softwares fired up and talking with the sensors. The crew got underway and arrived on site at 10:20. We did not have real time SV at the head, however we took casts promptly and strategically throughout the day. We conducted normal survey until 18:34. We conducted a roll line and a final cast. The crew arrived at Wrightsville Beach Marina at 19:06. A total of 5 SV casts were taken throughout the day. A total of 6 main scheme survey lines were acquired with all sensors.

Daily Survey Field Notes				
Date:	3/13/2022	**Day of Year:**	72	
Time SOS (local):	6:38	**Time EOS (local):**	19:13	
Project:	Wrightsville Beach Cultural Resources Survey			
Survey Location:	1-3 miles offshore of Masonboro Inlet			
Hydro Crew:	Nolan Day	Tariq Moya	Clay Walker	

Atmospheric Conditions		Water Conditions	
Sky:	Clear	**Swell:**	2-3 ft
Wind Speed:	10-15 KT	**Chop:**	2-3 ft
Wind Direction:	NW	**Temp:**	40-50 F
Temp:	50-60 F		

Survey Activities

Control

Checked benchmark S 233

Hydro

The crew started the morning off by going over systems, order of operations and safety procedures on the vessel. Also, we spent time troubleshooting the SSS laptop. We got all of the sensors talking and got underway at 8:34. We arrived on site at 8:59. It took the crew about an hour to deploy all gear which included the multibeam heads, SSS, SBP, and the TVG. We added the manual layback in Qinsy for the SSS, SBP, and the TVG. Data collection commenced by 10:41. We collected until 17:12 when the SSS stopped pinging. We retreived the SSS to find the data cable had ripped out of the housing on the towfish. We then conducted a roll line, took a final cast, retreived all gear and started the transit back to the dock. At the dock we attempted to wet splice the data cable with no success. The crew and the office made a plan to take the SSS back to Morehead City the following day for proper repairs. A total of 5 SV casts were taken throughout the day. A total of 9 main scheme survey lines were acquired with all sensors.

Daily Survey Field Notes				
Date:	3/14/2022	**Day of Year:**	73	
Time SOS (local):	14:42	**Time EOS (local):**	19:59	
Project:	Wrightsville Beach Cultural Resources Survey			
Survey Location:	1-3 miles offshore of Masonboro Inlet			
Hydro Crew:	Nolan Day	Tariq Moya	Clay Walker	

Atmospheric Conditions		Water Conditions	
Sky:	Clear	**Swell:**	1-2 ft
Wind Speed:	5-10 KT	**Chop:**	0.5 - 1.0 ft
Wind Direction:	S	**Temp:**	40-50 F
Temp:	50-60 F		

Survey Activities

Control

N/A

Hydro

The SSS was successfully repaired at the Geodynamics shop in Morehead City. The crew met back at Wrightsville Beach Marina and got the SSS reinstalled and talking with the topside. The crew got underway and arrived on site at 15:27. The crew deployed all gear. Data collection commenced by 16:01. We stopped collecting data at 19:07. We conducted a roll line and a final cast. The crew arrived at the dock at 19:37. A total of 3 SV casts were taken throughout the day. A total of 4 main scheme survey lines were acquired with all sensors.

Daily Survey Field Notes				
Date:	3/15/2022	**Day of Year:**	74	
Time SOS (local):	7:23	**Time EOS (local):**	18:41	
Project:	Wrightsville Beach Cultural Resources Survey			
Survey Location:	1-3 miles offshore of Masonboro Inlet			
Hydro Crew:	Nolan Day	Tariq Moya	Clay Walker	

Atmospheric Conditions		Water Conditions	
Sky:	Cloudy	**Swell:**	1-2 ft
Wind Speed:	0-5 KT	**Chop:**	0 - 0.5 ft
Wind Direction:	SE	**Temp:**	40-50 F
Temp:	50-60 F		

Survey Activities

Control

Checked benchmark S 233

Hydro

The crew conducted normal survey operations until 16:55. We retreived the SSS, SBP, and the TVG. We left the multibeam heads in the water to conduct calibration test just north of the survey site on AR370 to verify our angular offsets. We conducted roll, pitch, and yaw lines. The crew arrived at the dock at 18:25. A total of 6 SV casts were taken throughout the day. A total of 12 main scheme survey lines were acquired with all sensors. A total of 6 verification test lines were acquired with MBES only.

Daily Survey Field Notes				
Date:	3/16/2022	**Day of Year:**	75	
Time SOS (local):	7:15	**Time EOS (local):**	15:01	
Project:	Wrightsville Beach Cultural Resources Survey			
Survey Location:	1-3 miles outside of Masonboro Inlet			
Hydro Crew:	Nolan Day	Tariq Moya	Clay Walker	

Atmospheric Conditions		Water Conditions	
Sky:	Cloudy	**Swell:**	3-4 ft
Wind Speed:	10-15 KT	**Chop:**	1-2 ft
Wind Direction:	NE	**Temp:**	40-50 F
Temp:	50-60 F		

Survey Activities

Control

Checked benchmark S 233

Hydro

Normal survey day until the conditions became unfavorable. We called the day for weather around 12:45 and arrived at the dock at 13:45. A total of 3 SV casts were taken throughout the day. A total of 5 main scheme survey lines were acquired with all sensors.

Daily Survey Field Notes				
Date:	3/17/2022	**Day of Year:**	76	
Time SOS (local):	12:24	**Time EOS (local):**	17:01	
Project:	Wrightsville Beach Cultural Resources Survey			
Survey Location:	1-3 miles offshore of Masonboro Inlet			
Hydro Crew:	Nolan Day	Tariq Moya	Clay Walker	

Atmospheric Conditions		Water Conditions	
Sky:	Cloudy	**Swell:**	3-4 ft
Wind Speed:	15-20 KT	**Chop:**	2-3 ft
Wind Direction:	SE	**Temp:**	40-50 F
Temp:	50-60 F		

Survey Activities

Control

Checked Benchmark S 233

Hydro

The conditions were moderately rough during the transit through Masonboro Inlet with 3-4ft swells and 15-20mph winds. We arrived on site and deployed the gear. We acquired 1 line and then determined the conditions too rough to survey. A total of 1 cast was taken. The crew arrived at the dock at 15:28.

Daily Survey Field Notes				
Date:	3/18/2022	**Day of Year:**	77	
Time SOS (local):	6:35	**Time EOS (local):**	19:17	
Project:	Wrightsville Beach Cultural Resources Survey			
Survey Location:	1-3 miles offshore of Masonboro Inlet			
Hydro Crew:	Nolan Day	Tariq Moya		

Atmospheric Conditions		Water Conditions	
Sky:	Cloudy	**Swell:**	2-3 ft
Wind Speed:	5-10 KT	**Chop:**	0.5 - 1.0 ft
Wind Direction:	SW	**Temp:**	40-50 F
Temp:	50-60 F		

Survey Activities

Control

Checked Benchmark S 233

Hydro

Normal survey day. We attatched a swiveling shackle to the Minos SVP cage to keep the line from twisting on each cast. The magnetometer stopped showing altitude so we retreived it and placed the altimeter in the correct position. We learned dropping the mag off of the stern as easy as possible prevented the rush of water from displacing the altimeter in its housing. We also changed the SVP depth reading in SeaCast from 1.0 to 0.5. A total of 7 SV casts were taken throughout the day. A total of 10 main scheme survey lines were acquired with all sensors.

Daily Survey Field Notes				
Date:	3/20/2022	**Day of Year:**	79	
Time SOS (local):	7:12	**Time EOS (local):**	12:58	
Project:	Wrightsville Beach Cultural Resources Survey			
Survey Location:	1-3 miles offshore of Masonboro Inlet			
Hydro Crew:	Nolan Day	Tariq Moya		

Atmospheric Conditions		Water Conditions	
Sky:	Clear	**Swell:**	2-3 ft
Wind Speed:	15-20 KT	**Chop:**	1-2 ft
Wind Direction:	NE	**Temp:**	40-50 F
Temp:	50-60 F		

Survey Activities

Control

Checked Benchmark S 233

Hydro

Our 4th man had a personal issue and could not show up for the day. We waited until 7:50 and then got underway. We arrived on site at 8:20. The conditions were moderately rough with 2-3ft swells and 15-20mph winds. We only deployed the multibeam heads and ran a mock survey line to gauge the conditions. We determined it too rough and unsafe to deploy the rest of the gear. We conducted 3rd party MBES data just off of the Wrightsville Beach and in ICW. The crew returned the dock at 16:52.

Daily Survey Field Notes				
Date:	3/21/2022	**Day of Year:**	80	
Time SOS (local):	7:10	**Time EOS (local):**	19:22	
Project:	Wrightsville Beach Cultural Resources Survey			
Survey Location:	1-3 miles outside of Masonboro Inlet			
Hydro Crew:	Nolan Day	Tariq Moya	Clay Walker	

Atmospheric Conditions		Water Conditions	
Sky:	Cloudy	**Swell:**	2-3 ft
Wind Speed:	5-10 KT	**Chop:**	1-2 ft
Wind Direction:	NW	**Temp:**	40-50 F
Temp:	50-60 F		

Survey Activities

Control

Checked benchmark S 233

Hydro

Normal survey day until 18:31 when we noticed the SBP winch line had broken from the shackle. We were able to manually pull the SBP back to the gunnel where we reattacthed the winch line. We got the SBP safely back on deck. The crew arrived back at the dock at 19:12. A total of 5 SV casts were taken throughout the day. A total of 11 main scheme survey lines were acquired with all sensors.

Daily Survey Field Notes

Date:	3/22/2022	**Day of Year:**	81
Time SOS (local):	7:07	**Time EOS (local):**	19:16
Project:	Wrightsville Beach Cultural Resources Survey		
Survey Location:	1-3 miles outside of Masonboro Inlet		
Hydro Crew:	Nolan Day	Tariq Moya	Clay Walker

Atmospheric Conditions		**Water Conditions**	
Sky:	Cloudy	**Swell:**	0 - 0.5 ft
Wind Speed:	5-10 KT	**Chop:**	0 - 0.5 ft
Wind Direction:	SE	**Temp:**	40-50 F
Temp:	50-60 F		

Survey Activities

Control

Checked benchmark S 233

Hydro

Before the transit too the survey site, the crew double checked the SBP connections and shackles. Normal survey day. The crew arrived back at the dock 19:13. A total of 5 SV casts were taken throughout the day. A total of 12 main scheme survey lines were acquired with all sensors.

Daily Survey Field Notes				
Date:	3/23/2022	**Day of Year:**	82	
Time SOS (local):	7:18	**Time EOS (local):**	12:27	
Project:	Wrightsville Beach Cultural Resources Survey			
Survey Location:	1-3 miles outside of Masonboro Inlet			
Hydro Crew:	Nolan Day	Tariq Moya	Clay Walker	

Atmospheric Conditions		Water Conditions	
Sky:	Light Rain	**Swell:**	3-4 ft
Wind Speed:	15-20 KT	**Chop:**	2-3 ft
Wind Direction:	SE	**Temp:**	40-50 F
Temp:	50-60 F		

Survey Activities

Control

Checked benchmark S 233 with consistently good results.

Hydro

The day started off with rough conditions with 3-4ft swells and 15-20 mph winds. We deployed all of the gear and attempted a line. We were seeing consistent blowouts in the multibeam data. The crew determined the conditions were too rough for quality data acquisition by 15:00. We safely retreived the SSS, SBP, and multibeam heads. We towed the magnetometer into the inlet for a safe retreival. A total of 2 SV casts were taken throughout the day. A total of 1 main scheme survey line was acquired with all senors.

Daily Survey Field Notes				
Date:	3/27/2022	**Day of Year:**	86	
Time SOS (local):	6:13	**Time EOS (local):**	16:55	
Project:	Wrightsville Beach Cultural Resources Survey			
Survey Location:	1-3 miles outside of Masonboro Inlet			
Hydro Crew:	Nolan Day	Tariq Moya	Clay Walker	

Atmospheric Conditions		Water Conditions	
Sky:	Clear	**Swell:**	2-3 ft
Wind Speed:	15-20 KT	**Chop:**	2-3 ft
Wind Direction:	SW	**Temp:**	40-50 F
Temp:	50-60 F		

Survey Activities

Control

Checked benchmark S 233

Hydro

The previous day 085 we conducted scheduled services on both motors. We got underway, and before we reached the inlet channel, the starboard motor shut down. We returned to the dock to troubleshoot. We discovered a film coming from the starboard motor and acted quickly to get the boat hauled out of the water for further investigation. Nolan and Tariq retreived the trailer from the airbnb and backed it down the ramp. In that time Josh and Clay discovered the issue to be a loose fuel filter. Josh checked the rubber gasket on the fuel filter and correctly re-installed it. We absorbed the loose fuel in the motor well and waited for confirmation to survey. We were cleared to survey and arrived to the survey site at 9:06. We ran the inshore survey lines due to the strong west wind. On the line sections in front of the inlet we were seeing what we thought was suspended sediment or sea grass. With the outgoing tide, the water column view of the mulitbeam heads was showing noise. Conditions worsened as the day went on and we decided to make a weather call at 15:43. We towed the magnetometer into the inlet for a safe retreival. A total of 3 SV casts were taken throughout the day. A total of 11 main scheme survey lines were acquired with all senors

Daily Survey Field Notes				
Date:	3/28/2022	**Day of Year:**	87	
Time SOS (local):	6:21	**Time EOS (local):**	17:14	
Project:	Wrightsville Beach Cultural Resources Survey			
Survey Location:	1-3 miles outside of Masonboro Inlet			
Hydro Crew:	Nolan Day	Tariq Moya	Clay Walker	

Atmospheric Conditions		Water Conditions	
Sky:	Clear	**Swell:**	3-4 ft
Wind Speed:	15-20 KT	**Chop:**	3-4 ft
Wind Direction:	SW	**Temp:**	40-50 F
Temp:	50-60 F		

Survey Activities

Control

Checked benchmark S 233

Hydro

The day started off with rough conditions. We managed to until 15:43 when we called the day for weather. We retreived the multibeam heads and the SSS at sea and towed the SBP and the magnetometer into the inlet for safe retreival. The crew arrived back to the dock at 16:37. A total of 4 SV casts were taken throughout the day. A total of 12 main scheme survey lines were acquired with all sensors.

Daily Survey Field Notes				
Date:	3/29/2022	**Day of Year:**	88	
Time SOS (local):	6:21	**Time EOS (local):**	20:15	
Project:	Wrightsville Beach Cultural Resources Survey			
Survey Location:	1-3 miles outside of Masonboro Inlet			
Hydro Crew:	Nolan Day	Tariq Moya	Clay Walker	

Atmospheric Conditions		Water Conditions	
Sky:	Cloudy	**Swell:**	1-2 ft
Wind Speed:	5-10 KT	**Chop:**	0.5 - 1.0 ft
Wind Direction:	NE	**Temp:**	40-50 F
Temp:	50-60 F		

Survey Activities

Control

Checked benchmark S 233

Hydro

The crew got started early and poked out into the sea to gauge the conditions. We determined it too rough to survey and we made the transit back to the dock to be on weather standby until around noon when conditions laid down. We arrived back on site at 12:27 but upon arrival, the generator shut down. We did some troubleshooting with no success. We then made the transit back to the dock to further troubleshoot. We identified the issue as a faulty emergency shut-off wire. The generator issue was resolved by 14:27 and the crew headed back out and arrived on site at 14:46. We surveyed until 19:48 and arrived at the dock at 20:12. A total of 3 SV casts were taken throughout the day. A total of 7 main scheme survey lines were acquired with all sensors.

Daily Survey Field Notes				
Date:	4/3/2022	**Day of Year:**	93	
Time SOS (local):	6:19	**Time EOS (local):**	19:41	
Project:	Wrightsville Beach Cultural Resources Survey			
Survey Location:	1-3 miles outside of Masonboro Inlet			
Hydro Crew:	Nolan Day	Tariq Moya	Rachel Dudas	

Atmospheric Conditions		Water Conditions	
Sky:	Cloudy	**Swell:**	1-2 ft
Wind Speed:	5-10 KT	**Chop:**	1-2 ft
Wind Direction:	NW	**Temp:**	40-50 F
Temp:	50-60 F		

Survey Activities

Control

Checked benchmark S 233

Hydro

Normal day of survey. The generator shut down at 15:51. Josh found another faulty wire, wrapped it with electrical tape, and got it back up and running. We surveyed until 18:44. The crew arrived at the dock at 19:37. A total of 7 SV casts were taken throughout the day. A total of 14 main scheme lines were acquired with all sensors, except the magnetometer was not logging for 1 of those 14 lines, which will be a recovery for a different day.

Daily Survey Field Notes				
Date:	4/11/2022	**Day of Year:**	101	
Time SOS (local):	6:34	**Time EOS (local):**	16:46	
Project:	Wrightsville Beach Cultural Resources Survey			
Survey Location:	1-3 miles outside of Masonboro Inlet			
Hydro Crew:	Nolan Day	Tariq Moya	Rachel Dudas	

Atmospheric Conditions		Water Conditions	
Sky:	Clear	**Swell:**	2-3 ft
Wind Speed:	15-20 KT	**Chop:**	2-3 ft
Wind Direction:	SW	**Temp:**	40-50 F
Temp:	50-60 F		

Survey Activities

Control

Checked benchmark S 233

Hydro

The crew completed main scheme data acquisition. We acquired 1 crossline before the conditions became unfavorable. We towed the magnetometer back into the inlet for safe retreival. The crew arrived back at the dock at 15:51. A total of 3 SV casts were taken throughout the day.

Daily Survey Field Notes				
Date:	4/12/2022	**Day of Year:**	102	
Time SOS (local):	6:39	**Time EOS (local):**	18:56	
Project:	Wrightsville Beach Cultural Resources Survey			
Survey Location:	1-3 miles outside of Masonboro Inlet			
Hydro Crew:	Nolan Day	Tariq Moya	Rachel Dudas	

Atmospheric Conditions		Water Conditions	
Sky:	Clear	**Swell:**	2-3 ft
Wind Speed:	10-15 KT	**Chop:**	2-3 ft
Wind Direction:	SW	**Temp:**	40-50 F
Temp:	50-60 F		

Survey Activities

Control

N/A

Hydro

Normal survey day of crosslines and recoveries. We managed to close out the survey by 17:20. The crew arrived back at the dock at 18:26. A total of 5 SV casts were taken throughout the day. A total of 8 cross lines were acquired with all sensors. A total of 9 recoveries were acquired.

APPENDIX 4: OFFICIAL SCOPE OF WORK

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT	1. CONTRACT ID CODE: J	PAGE OF PAGES: 1 / 20

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. (If applicable)
	10-Feb-2022	W81LJ820267850	

6. ISSUED BY	CODE	7. ADMINISTERED BY (If other than item 6)	CODE
U S ARMY CORPS OF ENGINEERS, WILMINGTON WILMINGTON DISTRICT ATTN: CONTRACTING DIVISION 69 DARLINGTON AVE WILMINGTON NC 28403-1343	W912PM	**See Item 6**	

8. NAME AND ADDRESS OF CONTRACTOR (No., Street, County, State and Zip Code)		
GEODYNAMICS, LLC GEODYNAMICS MS. SLOAN FREEMAN 310A GREENFIELD DR NEWPORT NC 28570-6544		9A. AMENDMENT OF SOLICITATION NO.
		9B. DATED (SEE ITEM 11)
	X	10A. MOD. OF CONTRACT/ORDER NO. W912PM22F0008
CODE 3EAK9 FACILITY CODE	X	10B. DATED (SEE ITEM 13) 28-Jan-2022

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offer ☐ is extended, ☐ is not extended.

Offer must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended by one of the following methods: (a) By completing Items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA (If required)

13. THIS ITEM APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(B).
	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
X	D. OTHER (Specify type of modification and authority) FAR 52.243-1 Alt III, Changes--Fixed Price

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)
Modification Control Number: k7ct9ae922654

A. To incorporate the awarded Scope of Work dated December 2021. This is a no cost modification.
B. All other terms and conditions remain unchanged.
C. As consideration to the modification agreed to herein, the contractor hereby releases the government from any and all liability under this delivery order from further equitable adjustments attributable to such facts and circumstances giving rise to the aforesaid modification.

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER (Type or print)		16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print) TEL: EMAIL:	
15B. CONTRACTOR/OFFEROR _____ (Signature of person authorized to sign)	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA BY _____ (Signature of Contracting Officer)	16C. DATE SIGNED

EXCEPTION TO SF 30
APPROVED BY OIRM 11-84

30-105-04

STANDARD FORM 30 (Rev. 10-83)
Prescribed by GSA
FAR (48 CFR) 53.243

W912PM21D0001
W912PM22F0008 (k7ct9ae922654)
Page 2 of 20

SECTION SF 30 BLOCK 14 CONTINUATION PAGE

SUMMARY OF CHANGES

SECTION 00 01 10 - TABLE OF CONTENTS

The below Table of Contents has been added

Exhibit/Attachment Table of Contents

DOCUMENT TYPE	DESCRIPTION	PAGES	DATE
Attachment 1	Map and Attachment		28-JAN-2022

SECTION 00 73 00 - SUPPLEMENTARY CONDITIONS

The following have been added by full text:
SCOPE OF WORK

SCOPE OF WORK

HYDROGRAPHIC AND CULTURAL RESOURCE SURVEYS OF POTENTIAL SAND BORROW AREAS

WRIGHTSVILLE BEACH, NORTH CAROLINA

DECEMBER 2021

1. **Background.** The U.S. Army Corps of Engineers Wilmington District (Corps) is exploring potential offshore sand borrow areas associated with the proposed Wrightsville Beach Coastal Storm Risk Management project (Figure 1). The purpose of this work is to assess hydrography and the presence and/or absence of both hard bottom and cultural resources within potential offshore sand borrow areas using appropriate survey methodologies. Data obtained through this task order will support refinement of the proposed Wrightsville Beach Coastal Storm Risk Management project's beach fill design and volume estimates as well as support geotechnical investigations in areas subjected to hydrographic and cultural resources surveys. This task order will also support identification of potential hard bottom and essential fish habitat (EFH) and the consultation process associated with Section 106 of the National Historic Preservation Act (NHPA) regarding submerged cultural resources.

2. **Project Site Description.** The survey area is located in the Atlantic Ocean, approximately four miles southeast of Wrightsville Beach, North Carolina (Figure 1; approximately 4.4 square miles).

3. **Survey Control.** All horizontal and vertical control used for surveys conducted under this task order shall be from the National Survey Reference System and be of a third order accuracy or better. All control loops must be tied to at least two or more control points. The Contractor shall submit appropriate records of all points used in U-SMART (U.S. Army Corps of Engineers Survey Monument Archival and Retrieval Tool). All work shall be relative to NAD 1983 (2011) North Carolina State Plane U.S. Survey Feet in the horizontal plane and NAVD 1988 (Geoid 12B) in the vertical plane.

4. **Description of Supplies/Services – Hydrographic Survey.** The Contractor shall acquire multibeam hydrographic survey data within the area designated as Figure 1 for the purposes of capturing existing conditions and mapping the sea floor elevations on a 400-foot grid.

   4.1. **Hydrographic Survey Phases**

   4.1.1. **Phase 1 – Multibeam Survey**. The Contractor shall acquire multibeam survey data within areas off Wrightsville Beach, NC for the purposes of capturing existing conditions and mapping the sea floor elevations. Coverage shall be 100% to comply with 15A NCAC 07H .0312 Paragraph 2(c). The multibeam survey data collection shall be contained within the identified survey area limits for the purposes of identifying and mapping hydrography (Figure 1). Prior to commencement of survey work, the Contractor shall provide the Corps with the proposed survey plan for approval. The Contractor shall be experienced in the post processing and interpretation of multibeam survey data and shall provide shape files of hydrography (including areas identified as potential hard bottom resources or other resources of interest based on the Contractor's experience working in the region).

   To the extent practicable, hydrographic multibeam surveys shall be combined with cultural resources survey field work described in Section 5.1.2 of this scope of work.

   4.1.2. **Phase II – Draft/Final Written Report**. An Executive Summary reporting the results of fieldwork and preliminary analyses should be completed within 14 days of the completion of fieldwork. A full written report summarizing all data collection activities shall be submitted as a Portable Document File (PDF) electronically and in bound hardcopy to the COR. The COR shall have the opportunity to review a draft version of the survey before it is considered final. The survey report shall include, but is not limited to, the following items:

   - Written description of workflow to complete the task order (start to finish) including a flowchart diagram and a detailed description of QA/QC process
   - Dates and times of each data collection activity
   - Atmospheric Conditions for each day of data collection activity
   - All Horizontal and Vertical Control used, including monument name, establishing agency, date established, description, and published horizontal and vertical values
   - Temporary Bench Mark (TBM) descriptions with vertical values
   - Copy of all field notes
   - Complete and detailed list of all survey equipment used, including a copy of the last factory calibration report
   - Photographs of the site and any significant features or data collection techniques used.
   - Representative screen captures of the select ground truthed locations, correlated with specific multibeam signature returns.
   - Rationale for identification and mapping of select hard bottom resources or other resources of interest based on the Contractor's experience working in the region; features shall be provided based on a combination of videography ground truth data and multibeam survey data interpretive expertise
   - Qualitative characterization of the general biological communities associated with any hard ground or other benthic resources identified.

5. **Description of Supplies/Services – Cultural Resources Survey.** This description of supplies/services reflects the provisions of Section 106 of the National Historic Preservation Act of 1966 (36 CFR 800, *Protection of Historic Properties)* and the Abandoned Shipwreck Act of 1987 (*Abandoned Shipwreck Act Guidelines*, National Park Service, *Federal Register*, Vol. 55, No. 3, December 4, 1990, pages 50116-50145). The Contractor shall conduct gradiometer, side-scan sonar, and sub-bottom profile surveys within the area shown in Figure 1 and in accordance with the

current standards of the NC Office of State Archaeology (NCOSA) and their Underwater Archaeology Branch (UAB) (https://files.nc.gov/dncr-arch/OSA_Guidelines_Dec2017.pdf;https://archaeology.ncdcr.gov/media/2/download?attachment). The purpose of this work is to discover magnetic and/or sonar anomalies that might represent cultural resources or other objects that would impact the viability determination of the borrow areas for use in the coastal storm risk management project and make recommendations regarding their eligibility status in terms of the National Historic Preservation Act. The Contractor shall be a professional underwater archaeologist with demonstrated experience in interpreting maritime cultural resources data in North Carolina.

General consultation under the proposed survey has already been initiated (Attachment 1). The Contractor shall reference the NCOSA/NCSHPO project number (ER-20-1245) for all coordination with the NCOSA/NCSO regarding this task order.

5.1. **Cultural Resources Survey Phases**

5.1.1. **Phase I – Archival / Background Research.** Consists of archival research, literature review, and interviews with local informants and other knowledgeable individuals, as applicable. Archival and background research, undertaken prior to any field survey, includes a review of relevant environmental, archaeological, and historical literature, documents, and other data. Archival / Background research will allow for a review of known resources within and near the survey area (Figure 1) and will provide a regional framework against which identified resources should be evaluated for significance. Background research shall include previous archaeological and historic investigations (unpublished and published) conducted in and adjacent to the immediate project area. The historical review should provide an outline of the major historical developments in the project area, including information on historically significant individuals, institutions, or events, as well as the history of land use for the survey property in relationship to maritime transportation and commerce and/or vice versa. Emphasis shall be placed on examination of historic and cartographic data relating to the locations of historic wrecks and hydrographic change. Repositories may include, but are not limited to the following: municipality records, university and private collections, photography collections, and regional and national archives. Emphasis shall also be placed on documentation related to exploration, colonization, development, agriculture, fishing, industry, trade, transportation, commerce, warfare, and shipbuilding. Appropriate information shall be collected that may provide information about targets, anomalies, and landforms and their relationship to known shipwrecks or submerged archaeological sites.

Additional archival research will be conducted, as necessary, to identify, evaluate, and assess the significance of any potentially significant sites, targets, and anomalies. The contractor shall examine historic background data and build upon that data to further construct and refine a background history of the targets, and anomalies as they relate to the project area, i.e., place identifiable targets in appropriate historical context. These contexts can be used as the framework in which to apply the criteria for NRHP evaluations.

Archival research will address the following:

- Past field surveys in the project area and the relevance of the major findings in the area currently under study, with in-text references and full citations;
- Pertinent data regarding archaeological reports, site forms, and local repositories, as appropriate, with in-text references and full citations;
- Pertinent data regarding historic wrecks, submerged archaeological sites, and hydrographic change using data collected from the site files, historic maps and charts, and other appropriate archival sources, mapped and cited appropriately;

- Pertinent historical data from records such as plat maps, tract books, aerial and topographic maps, atlases, tax records, photographs, local historical/archaeological societies and relevant historical documents, cited appropriately; and
- Pertinent historic aerials of the project area, with at least one appearing in the report, with in-text references/discussion and full citations.

In addition to archival research, pertinent information from informants, should be included, as relevant, and cited appropriately. If formal interviews are conducted, the contractor is required to provide transcripts of the interviews and waivers completed by the interviewee. The result of informal interviews can be cited as personal communication; this data should also appear in field notes.

The North Carolina Office of State Archaeology (NCOSA) is currently processing requests for site files remotely. The Contractor shall submit NCOSA-related requests to osafilesearch@ncdcr.gov. The NCOSA processes requests for archaeologists from various federal agencies, as well as for archaeological consultants/contractors who demonstrate Secretary of the Interior (SOI) qualifications. The Contractor shall submit NCOSA-related requests per requirements available online (https://archaeology.ncdcr.gov/programs/data-inventory-gis/site-file-research). The Contractor shall specify to the NCOSA in their request which types of data are requested.

5.1.2. **Phase II – Field Work.** The Contractor shall conduct an intensive cultural resources remote sensing survey within the polygon shown in Figure 1, which measures approximately 4.4 square miles. Field methods for the remote sensing survey shall be designed to collect sufficient information on features seen in gradiometer, side scan sonar, and sub-bottom profiler data to locate and evaluate their potential historical significance and/or the need for future investigations or avoidance measures. Investigations should explicitly determine the extents of any previously recorded archaeological sites and any newly identified sites, targets, or anomalies, and map the site components within the survey area. The submerged cultural resource remote sensing survey shall employ a transect interval of no greater than 30 meters. The boat speed shall not exceed five knots. The side scan sonar range shall collect data at least 100 percent overlapping (200% seafloor coverage) coverage of the project area and the sensor shall be towed above the seafloor at a height that is 10 to 20 percent of the range of the instrument. The gradiometer sensors shall be towed at a depth of no more than six (6) meters above the seafloor. The Contractor shall develop/confirm acceptability of field survey methods in consultation with the NCOSA prior to conducting field work investigations to ensure that survey methods and products will be acceptable for purposes of Section 106 consultation (Attachment 1). Contact information for the NCOSA's Underwater Archaeology Branch is available online (https://archaeology.ncdcr.gov/about/staff#uabstaff). Adherence to the methods shall be explicitly stated and illustrated both in the text and in the illustrations of the survey report.

Unless explicitly directed otherwise, the Contractor is to consider and treat all previously recorded resources as newly recorded resources except during evaluation: all previously recorded resources should be revisited, investigated, recorded, boundaries established, and content determined. Review of previous investigation data may inform methods and should be reviewed before field investigation. In evaluating the resource(s), the results of previous investigations should be described, cited, and incorporated into the evaluation of significance and eligibility of the resources for listing in the National Register of Historic Places (NRHP). Under no circumstances shall a previously recorded resource shall not be excluded from the investigation, either during fieldwork or in evaluation and report preparation, unless explicitly directed by the COR. Such directions will specifically be referenced in the report. In the event that an archaeological site, shipwreck, or potentially significant anomaly is identified, the Contractor is to investigate, record, establish the

horizontal extent, and, if possible, establish the vertical extent and determine cultural affiliation.

Artifacts and other materials should not be collected under this contract.

The Contractor must conduct the field survey in accordance with applicable Federal, State, and local laws and regulations, including those specific to the NCOSA. If the Contractor encounters any problems in accessing the survey area, or if the Contractor encounters any other problems in the process of implementing contract requirements, the Contractor should contact the COR immediately to resolve the issues as quickly as possible.

5.1.3. **Phase III – Remote Sensing Data Analysis.** The Contractor shall analyze and synthesize the archival research and survey data to evaluate any identified cultural resources. The Contractor shall maintain a complete record of all activities related to archival research and field investigations. This includes, for example, calibrations of instruments, height of sensors in the water column, layback distances, and procedures and fieldwork techniques. Archival data will be used to assist in interpretation of the field data. Field data analysis shall take place during and immediately following fieldwork for quality assurance purposes.

Magnetic data shall be contoured. A preliminary evaluation of the data collected will be made at the end of each workday in order to identify the need to adjust the survey methods or correct the quality of data within the previously surveyed area. Following completion of the fieldwork, the Contractor shall complete the analysis of the archival and field data sets to identify, characterize, and evaluate the anomalies, targets, and features, for potential historical significance and the need for and scope of future investigation or avoidance measures.

The Contractor is required to submit all datasets to the Corps for review following the specifications below.

A single master map of all features documented by remote sensing shall be prepared and provided as shapefiles or a geodatabase. The Contractor shall prepare and update any required documentation to meet the NCSHPO / NCOSA standards for documentation, including site file forms.

In the event that a new archaeological site, shipwreck, or anomaly is identified, the Contractor is to investigate, record, establish the horizontal extent, and, if possible, establish the vertical extent and determine cultural affiliation. The Contractor will evaluate the resource for significance and eligibility for listing in the NRHP. If necessary, the Contractor will delineate an avoidance buffer for the resource(s) in coordination with the NCOSA/NCSHPO. The Contractor will coordinate with the NCOSA/NCSHPO to complete any necessary site forms and provide appropriate location and sketch maps. Newly recorded sites and other resources will require new resource numbers, assigned by the NCOSA/NCSHPO. Site and resource numbers should be assigned before completion and submittal of the draft report to the NCOSA/NCSHPO and the COR, and official resources numbers should be used to reference resources.

To the extent practicable, cultural resources surveys shall be combined with hydrographic multibeam survey field work described in Section 4.1.1 of this scope of work.

5.1.4. **Phase IV – Survey Report and Data Submissions.** An Executive Summary reporting the results of fieldwork and preliminary analyses should be completed within 14 days of the completion of fieldwork and submitted to the COR. An initial electronic draft report shall use all information compiled during the investigation to produce a graphically illustrated, scientifically acceptable report that conforms to the Secretary of Interior's *Standards and*

Guidelines. Information shall be presented in textual, tabular, and graphic forms, whichever is most appropriate, effective, and advantageous to communicate necessary information. All tables shall have a number, title, appropriate explanatory notes, and a source note. Oversize drawings or plates shall normally not have an image larger than 11 inches by 14 inches with sufficient margin for binding on the left side and shall have a graphic scale and a north arrow. No logos shall be used anywhere in the report. NCOSA/NCSHPO standards shall supersede any of the above listed requirements, if applicable, such that the report can be successfully used for purposes of Section 106 consultation. This report, along with site file forms, shall be submitted to the Corps and NCOSA/NCSHPO (on the Corps' behalf) for review of general acceptability.

Report submission to the COR shall be one paper copy and one digital copy, to include site forms. Digitally-captured spatial data from the submerged cultural resources survey shall be packaged and submitted in a standard Geographic Information Systems (GIS) format, preferably an ESRI geodatabase. All electronic files submitted in the spatial database should be referenced to the appropriate State Plane projection using the North American Datum of 1983 (NAD 83). GIS data shall be submitted electronically for COR review, as well.

Report submission NCOSA/NCSHPO shall be one paper copy and one digital copy (pdf format). Additionally, a digital copy (pdf format) of the North Carolina Site Form for each site recorded shall be forwarded to the NCOSA/NCSHPO. Digital submissions to the NCOSA/NCSHPO shall be through environmental.review@ncdcr.gov. GIS data shall be submitted electronically for NCOSA/NCSHPO review, as well.

The Corps and NCOSA/NCSHPO reserve the right to request changes to the draft electronic version of the report and associated forms prior to receiving printed and bound forms of the draft report and forms. The reports and associated forms are to be watermarked DRAFT until the final report incorporating and addressing all comments and revisions made by the Corps and the NCOSA/NCSHPO have been accepted.

At a minimum, the draft/final report shall contain the following information, including appropriate photographs, maps, and drawings:

- Map(s)/chart(s) of the project area, with previously recorded and newly recorded cultural resources within and near the project area labelled;
- Description of the research sources utilized and the information resulting therein;
- Reproduction of at least one historic aerial of the project area with approximate survey boundaries indicated;
- Historical context with a synopsis of what types of archaeological sites and other cultural resources are likely to be found in the general vicinity of the project area;
- Full description and justification of the planned survey methods;
- Description of field team (names of authors and researchers, number of crew members, person-hours) and tools (e.g., make and model of remote sensing equipment);
- Global Positioning System (GPS) coordinates of identified anomalies, targets, clusters, or other potential cultural resources;
- Results, which should include:
- Summary of investigation methods and locations, including any changes to the methods based on field conditions.
- Maps of investigation locations, including the locations of all survey transects.
- Summary of data analysis, including methods.
- Descriptions of newly recorded or previously recorded and revisited cultural resources, including natural and cultural environment, occupational component(s), degree of disturbance, integrity, research potential, and an evaluation of the

significance of the resource(s) to aid in the Government's determination of NRHP eligibility. Descriptions should include photographs, maps, and sketch maps as appropriate. For previously recorded resources, summaries of work and data from each of any previous investigations should also be presented in discussions of individual resources.

- Descriptions of newly recorded or previously recorded and revisited cultural resources, magnetic anomalies, sonar targets, and/or sub-bottom anomalies, clusters of anomalies and targets, including occupational component(s), degree of disturbance, integrity, research potential, and provide sufficient information for the Government to make a preliminary evaluation of eligibility for listing on the NRHP. Descriptions should include maps and sketch maps. For previously recorded resources, summaries of work and data from each of any previous investigations should also be presented in discussions of individual resources.
- A map(s) showing all significant targets and anomalies separate from the general maps showing all targets and anomalies. If some targets and anomalies are interpreted as related clusters, these clusters shall be specifically outlined on the map, in addition to the individual targets and anomalies. The map shall reference relevant data tables.
- A map(s) showing all features identified by remote sensing sufficient to delineate site components.
- Photographs of areas of investigation.
- Recommendations and evaluations of all resources and suggested avoidance buffers, including both newly identified and revisited;
- List of references;
- Copy of this SOW in appendix;
- Resumes or CVs of principal researcher(s) in appendix;
- Completed Survey Log form and associated maps in appendix; and
- Completed Site File forms and associated maps in appendix.

Following the review and the acceptance of the electronic format draft report and site file forms by the COR and the NCOSA/SHPO, the Contractor shall deliver two (2) bound copies and one (1) electronic copy of the report (including site file forms) to the COR and to the NCOSA/SHPO. The report will be used for consultation with the SHPO, the appropriate federally-recognized tribes, and other parties. The Corps also reserves the right to request draft data to assist in analysis of the draft report. If requested, the Contractor will provide a review copy of the data to be submitted at the completion of the project. The data includes raw geophysical and derived GIS data collected, analyzed, and processed. This delivery should include at a minimum draft versions of all data expected to be discussed or referenced in the final report.

Once the draft report has been accepted by the Corps/COR and the NCOSA/NCSHPO and a comment matrix has been returned, the Contractor shall address and/or incorporate into the revised final report, to include any comments made by the reviewing parties. The final report shall address and resolve the reviewer's comments and shall be submitted (along with a reproducible master copy of the original text, drawings, and plates) to the COR and the NCOSA/NCSHPO.

Similar to the draft report, the final report submission to the COR shall be one paper copy and one digital copy, to include site forms. Final GIS data shall be submitted electronically to the COR, as well.

Final report submission to NCOSA/NCSHPO shall be one paper copy and one digital copy (pdf format). Additionally, a digital copy (pdf format) of the final North Carolina Site Form for each site recorded shall be forwarded to the NCOSA/NCSHPO. Digital submissions to the

NCOSA/NCSHPO shall be through environmental.review@ncdcr.gov. Final GIS data shall be submitted electronically to the NCOSA/NCSHPO, as well.

The Contractor shall deliver two (2) bound copies and one (1) electronic copy of the report (including site file forms) to the COR and to the NCOSA/SHPO (including the artifact catalog [if necessary], with Microsoft Excel or Access, and compatible GIS Shapefiles). The electronic version will be in PDF format and delivered on disc (CD or DVD). Final copies of all raw and processed data generated from the survey in formats prescribed above.

FINAL reports, artifacts, survey log, and site file forms, as well as all associated materials, shall be submitted no later than 75 days after the last day of fieldwork.

The Contractor shall provide all collected survey data following the specifications below:

- The navigation post-plot of the surveyed area including survey lines, line numbers or other designations, navigational shot points or event markers, and other relevant attributes shall be submitted by the Contractor to the Corps in an ArcGIS readable format (Microsoft Excel [.xls], Comma separated value [.csv], Text file [.txt], Database [.dbf] or Shapefile [shp]).
- The survey area location and relevant attributes shall be submitted by the Contractor to the Corps in an ArcGIS readable format (e.g., Microsoft Excel [.xls], Comma separated value [.csv], Text file [.txt], Database [.dbf] or Shapefile [.shp]).

The information used to create a table of magnetic anomalies and charting of magnetic anomalies shall be submitted by the Contractor to the Corps in an ArcGIS readable format (e.g., Microsoft Excel [.xls], Comma separated value [.csv], Text file [.txt], Database [.dbf] or Shapefile [.shp]). The following attributes should be included in the table of magnetic anomalies:

- Anomaly ID;
- Survey Area / Block;
- Survey line number;
- Gamma intensity of each identified anomaly (peak gradient amplitude);
- Duration (m);
- Characterization of the anomaly as a dipole, positive (+) or negative (-) monopole, or complex signature, based on the magnetic traces;
- Instrument height above the seafloor;
- Horizontal position, indicated as NAD 83 coordinates of the interpreted location of each unidentified anomaly in decimal degrees to 5 decimal places, based on magnetic traces and contoured data;
- Vertical position, indicated as estimated depth using half-width rule, Euler equation, or other means as described in the methods section; and
- Association with side scan sonar contacts or sub-bottom profiler features.

Additionally, the complete, processed and unprocessed gradiometer dataset shall also be submitted by the Contractor to the Corps. These data should be submitted in a tabular data format recognized by ArcGIS (e.g., Microsoft Excel [.xls], Comma separated value [.csv], Text file [.txt], Database [.dbf] or Shapefile [.shp]). At a minimum, the following items should be included within the data table(s):

- Easting/Longitude;
- Northing/Latitude;
- Time, in UTC;
- Raw Magnetic Readings for each instrument;
- Sensor Altitude; and
- Survey Line Number/Name.

Each of these components must occupy a single field within the table. For example, easting or longitude data must be within a single column in the data table. This would include a column for an easting amount, or longitude in decimal degrees, not a table with separate columns for degrees and another for decimal minutes.

The information used to create the table of side scan sonar contacts and charting of sonar contacts shall be submitted by the Contractor to the Corps in an ArcGIS readable format [e.g., Microsoft Excel [.xls], Comma separated value [.csv], Text file [.txt], Database [.dbf] or Shapefile [.shp]). The following attributes should be included:

- Side scan sonar contact ID;
- Survey Area / Block;
- Survey line number;
- Sensor altitude;
- Target length (m);
- Target width (m);
- Target height (m);
- Target shadow (m);
- Target description;
- Associated magnetic anomalies;
- NAD 83 coordinates of the target in decimal degrees to 5 decimal places; and
- Original source file name.

Additionally, both raw and processed eXtended Triton Format (.xtf) line files for the survey should be submitted, as well as mosaics. Side scan sonar mosaics of the survey area should be prepared as a geo-referenced Tagged Image Format (.tif) and output as 0.5 m resolution or better. The data used to create the charts illustrating the horizontal and vertical extent of sub-bottom geomorphic features shall be submitted by the Contractor to the Corps in an ArcGIS readable format. All anomalies analyzed as forming a cluster interpreted as a single, potential site shall be given a centroid location referenced to NAD 83, and shall also have an accompanying polygon readable in GIS format outlining the cluster, in addition to the individual anomaly data.

6. **Description of Supplies/Services – Hard Bottom Ground Truthing.** Additionally, the Contractor shall ground truth select sites to confirm the presence or absence of hard bottom resources using a combination of videography and benthic grab sample techniques. The Contractor shall utilize a combination of remotely operated vehicle (ROV) and benthic grab sample techniques to ground truth and confirm the presence and/or absence of hard bottom within the areas previously identified in Phase 1 as potential hard bottom from the multibeam survey data interpretation. Videography with Differential Global Positioning System (DGPS) annotation shall be used at a select number of interpreted potential hard bottom sites (N=10) to confirm the presence or absence of hard bottom features associated with interpreted side scan sonar signature returns. A phase 2 survey plan shall be submitted to the Corps for approval prior to commencement of work. The plan shall discuss the rationale for selection of ground truth sites as well as transect locations within each site. Positioning shall be performed with an accuracy of ± 1-meter, or other system of equivalent accuracy. The distribution of sites shall consider factors such as: (1) the diversity of bottom type (i.e., differences in backscatter return) and (2) diversity of interpreted relief. The videography transect lines shall traverse benthic habitat transitional points identified by multibeam survey data backscatter differences. Real time coordinates shall be clearly visible in the video to determine location along the video transect. Additionally, benthic grab samples (N=2/site; Total = 20), correlated with select transect locations, shall be obtained to assess the sediment characteristics for each site. The sediment samples will be described using visual classifications and the Unified Soil Classification

System. Adjustments to locations may be made based on information gathered in the field and with approval from the Corps.

Additional phase two ground truth sites are a separately priced optional bid item (priced by day) to be exercised by the Contracting Officer, if necessary, to adequately ground truth the diversity of multibeam signature returns in the project area. The video observations and the sediment characterization will be used to provide a rational for back-scatter differences previously identified through multibeam imagery which suggested potential hard bottom.

The correlation of ground truth data to specific multibeam signature returns shall be used to interpolate and refine bottom mapping results within the rest of the project area. All confirmed hard bottom areas from ground truth efforts, as well as interpolated sites, shall be characterized as being of low, moderate, and/or high relief. Hard bottom areas with generally less than 0.5 meters (1.64 feet) protruding above ocean bottom will be characterized as low relief. Hard bottom areas generally protruding between 0.5 to 2 meters (1.64 to 6.57 feet) will be characterized as moderate relief. Hard bottom areas generally protruding more than 2 meters (6.57 feet) above the bottom will be characterized as high relief.

7. **Clearances and/or Permits.** The Contractor shall acquire all clearances and/or permits necessary to obtain the required data. All discussions for access to private or public property or restricted waters or airspace, if applicable, must be included in the required weekly status report with the name(s), address(es), and telephone number(s) of any contacted person(s).

8. **Quality Control.** If work is found to be in error, incomplete, illegible or unsatisfactory after assignment is completed, the Contractor shall be liable for all cost in connection with correcting such errors. Corrective work may be performed by Government personnel or Contractor personnel at the discretion of the Contracting Officer. In any event, the Contractor shall be responsible for all costs incurred for correction of such errors, including salaries, automotive expenses, equipment rental, supervision, and any other costs in connection therewith. All data and deliverables shall be reviewed for the following:

    - Required coverage of the project limits
    - Capture of all required features
    - Required accuracies
    - Required horizontal and vertical datum
    - Adherence to the task order requirements

9. **AT/OPSEC.** Pre-screen candidates using E-Verify program. The Contractor must pre-screen candidates using the E-Verify program (https://www.e-verify.gov/) to meet the established employment eligibility requirements. The Vendor mush ensure that the Candidate has two valid forms of Government-issued identification prior to enrollment to ensure the correct information is entered into the E-Verify system. An initial list of verified/eligible Candidates must be provided to the COR no later than 3 business days after task order award date. When contracts are with individuals, if applicable, the individuals shall be required to complete a Form I-9, Employment Eligibility Verification, with the designated Government representative. This form will be provided to the Contracting Officer and shall be part of the official contract file.

10. **Safety.** The U.S. Army Corps of Engineers Safety and Health Requirements Manual, EM 385-1-1, is available online at:

    https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_385-1-1.pdf

    The Contractor shall be responsible for maintaining a safe and healthy work environment for all employees at all times. This includes reasonable provisions for proper lighting, seating, and shelter from weather, and access to accommodations for adequate rest, food, and water. The Contractor

shall provide all personnel and equipment necessary for safe and effective completion of all archaeological and related services as detailed in this Description of Services. In addition, the following terms shall be met:

a. *Safety and Activity Hazard Analysis Plan.* In consultation with the COR, the Contractor shall determine the need for a Safety and Hazard Analysis Plan. This plan shall be required if the work environment or the work itself if found to be atypical of the work normally performed under this contract, and if that work presents hazards not normally encountered and accounted for as a routine part of task orders issued pursuant to the basic contract. When consultation determines that a Safety and Hazard Analysis Plan is required, the Contractor shall adhere to applicable sections of EM 385-1-1, "Safety and Health Requirements Manual," Appendix A, and the activity hazard analysis shall identify potential hazards that are specific to the work being conducted under this Description of Services. Requirements for the activity hazard analysis are presented in EM 385-1-1 at Section 19, *Floating Plant and Marine Activities*. All employees shall be made aware of these hazards and the appropriate preventative, remedial, and first aid measures. The Contractor's proposed Safety and Hazard Analysis Plan shall be submitted not later than 10 working days after receipt of notification of award. The Plan must include a tentative fieldwork schedule.

b. *Survey Vessel.* The survey vessel shall be supplied by the Contractor and shall be of sufficient size to contain all required survey and safety equipment, and provide temporary shelter to the field crew. The survey vessel shall meet all relevant U.S. Coast Guard safety criteria for the crew size, equipment, and tasks being performed. The survey vessel shall have available a litter, emergency oxygen, first aid supplies, personal floatation devices, marine VHF radio, and cellular telephone.

c. *CPR and First Aid.* All field crew personnel shall have current and valid certification in CPR and First Aid.

11. **Required Deliverables**. The Contractor shall be required to deliver post-processed XYZ multibeam bathymetric data, shapefiles, a survey plan, metadata records, ROV videography data, benthic grab samples, weekly status reports, safety and health plan, accident prevention plan, draft final written report, and a final written report/data submissions to the Contracting Officer's Representative (COR) and NCOSA/NCSHPO, where applicable.

XYZ Multibeam Bathymetric Data. The Contractor shall deliver multibeam data in XYZ format. The datasets shall meet USACE surveying standards and shall be post-processed to correct for tidal variations.

Side Scan Mosaic Raster Data Sets. The Contractor shall deliver Georeferenced Mosaics of the Raster Data sets from the Side Scan Survey. The Raster Data sets shall depict the backscatter information used to map the potential hard bottom areas in the project area. The Raster Data Sets shall be in a format compatible with ESRI ArcView/ArcInfo Version 10.6.

Shapefiles. The Contractor shall deliver Polygon Shapefiles defining the areas of confirmed hard bottom features and associated relief classification within the project area based on ground truth efforts as well as areas of interpolated hard bottom areas that were mapped based on similar backscatter characteristics to ground truthed areas. The Shapefiles shall be in a format compatible with ESRI ArcCatalog/ArcGIS/ArcMap Version 10.6.

Survey Plan. The Contractor shall describe proposed survey methodology such that required data and contract goals are achieved. The survey plan shall be provided to the COR.

Metadata Records. A North American Profile of ISO 19115 2003 compliant metadata record for each spatial data deliverable and/or feature class shall be created so that they are compatible with ESRI ArcCatalog/ArcGIS/ArcMap Version 10.6. Appropriate information shall be entered in all required fields. The Contractor shall attach the appropriate metadata record to each feature class using ArcCatalog so that no importing or formatting of the metadata record is required by the Government. The metadata shall be Spatial Data Standards for Facilities Infrastructure and Environment (SDSFIE) compliant.

ROV Videography Data. All ROV videography ground truth data shall be provided electronically (or by DVD hardcopy) in a format playable in Windows Media Player and shall be organized and labeled by site location.

Benthic Grab Samples. All benthic grab samples shall be provided in sealed containers and labeled by sample location and sediment classification.

Weekly Status Reports. The Contractor is required to submit a weekly status report, beginning one week from the task order award date, until all deliverables are received and accepted by the Government. The status report shall itemize each scope item with percent of work complete and an estimated data of completion. The report shall also include the number and type of field crews working, a description of any problems, and/or delays encountered, and any photographs of the site and/or significant site features and/or specialized data collection activities.

Safety and Health Plan. The Contractor shall submit a safety and health plan to the COR describing how survey and health will be addressed during required work.

Accident Prevention Plan. The Contractor shall submit an accident prevention plan to the COR describing how the accidents will be reduced/prevented/addressed during required work.

Draft/Final Written Report and Data Submissions. The Contractor shall submit draft / final written reports and data submissions as are described above in this SOW.

12. **Project Points of Contact**

The Corps' points of contact are provided below:

Technical Manager and Contracting Officer's Representative
Mr. Justin Bashaw (CESAW-ECP-PE)
U.S. Army Corps of Engineers
69 Darlington Ave.
Wilmington, NC 28403
Phone: (910) 251-4581
Email: Justin.P.Bashaw@usace.army.mil

Contracting Officer
Ms. Ros Shoemaker (CESAW-CT)
U.S. Army Corps of Engineers
69 Darlington Ave.
Wilmington, NC 28403
Phone: (910) 251-4436
Email: Rosalind.M.Shoemaker@usace.army.mil

13. **Payment / Request for Proposal.** The Contractor's offer shall include all provisions for weather delays, equipment repair and adjustment, holidays, etc. Payments shall be made on a monthly basis upon receipt and acceptance by the Contracting Officer's Representative of a monthly progress letter and invoice. Invoices shall not be processed unless a progress letter has been provided that

indicates in detail the progress of work during the billing period. Payment of partial or final invoices may be withheld until all deliverables are received and accepted by the Wilmington District.

Contract Line Item Number (CLIN)

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE
0001	Hydrographic / Cultural Resources Survey, Hardbottom Ground Truthing	1	LS	$_____
OPTION 0002	Additional Phase 2 Hydrographic Survey day(s) NTE 3 days	1	Survey day	$_____

While the proposed contract has lump sum unit prices, to facilitate discussions and determine a fair and reasonable price proposal, the cost proposal should include a subtotal for each of the following specific tasks identified in the scope of work:

Task 1 Hydrographic Survey – Phase I – Multibeam Survey
Task 2 Hydrographic Survey – Phase II – Draft/Final Written Report
Task 3 Cultural Resources Survey – Phase I – Archival/Background Research
Task 4 Cultural Resources Survey – Phase II – Field Work
Task 5 Cultural Resources Survey – Phase III – Remote Sensing Data Analysis
Task 6 Cultural Resources Survey – Phase IV – Survey Report and Data Submissions
Task 7 Hard Bottom Ground Truthing

13. **Ownership.** All Contractor submittals including digital files, compact disks, hard-copy products, and source data acquired for this project, and related materials, including that furnished by the Government, shall become the property of the Government and shall not be issued, distributed, or published by the Contractor without permission from the Contracting Officer.

14. **Quality Control.** If work is found to be in error, incomplete, illegible or unsatisfactory after assignment is completed, the Contractor shall be liable for all cost in connection with correcting such errors. Corrective work may be performed by Government personnel or Contractor personnel at the discretion of the Contracting Officer. In any event, the Contractor shall be responsible for all costs incurred for correction of such errors, including salaries, transportation expenses, equipment rental, supervision, and any other costs in connection therewith.

15. **Government Provided Data**. The Government will provide survey boundary polygons (i.e., polygon featured in Figure 1) to the Contractor in ESRI shapefile format.

16. **Schedules**. The tasks contained in this Description of Services shall be completed according to the Table 1 schedule. Adjustments to the schedule must be previously approved by the Contracting Officer. The work shall proceed in a continuous stepwise manner until complete.

Table 1
Schedule

	Estimated Schedule Calendar Days After Award
Kick-off Meeting	5
Submit Draft Work / Safety and Activity Hazard Analysis Plan for COR review	10
Submit Final Work / Safety and Activity Hazard Analysis Plan	15
Begin Field Work / Assessment	30
Complete Field Work	60
Submit Executive Summary	74
Submit Draft Report	94
Submit Final Report	135

Figure 1. Survey Limits.

Attachment 1

North Carolina State Historic Preservation Office Letter
ER-20-1245

October 25, 2021

North Carolina Department of Natural and Cultural Resources
State Historic Preservation Office
Ramona M. Bartos, Administrator

Governor Roy Cooper
Secretary D. Reid Wilson

Office of Archives and History
Deputy Secretary, Darin J. Waters, Ph.D.

October 25, 2021

Teresa R. Young
Biologist, USACE Wilmington District
69 Darlington Ave.
Wilmington, NC 28403
910-251-4725 (office)
teresa.r.young@usace.army.mil

RE: Coastal Storm Risk Management (CSRM) plan, Town of Wrightsville Beach, New Hanover County, ER 20-1245

Dear Ms. Young:

Thank you for your October 6, 2021, submission concerning the above-referenced project. We have reviewed the project and offer the following comments.

While it is unlikely that any archaeological sites will be impacted by the beach renourishment on shore, to our knowledge the chosen offshore borrow area has not been surveyed.

Due to its proximity to Masonboro inlet which has seen historic maritime traffic, as well as the nine recorded archaeological shipwreck sites within the area stated on our last letter, we request that a comprehensive maritime survey be conducted of the chosen offshore borrow area.

The purpose of this survey is to identify archaeological sites and make recommendations regarding their eligibility status in terms of the NRHP. This work should be conducted by an experienced archaeologist that meets the Secretary of the Interior professional qualifications standards. A list of archaeological consultants who have conducted or expressed an interest in contract work in North Carolina is available at https://archaeology.ncdcr.gov/archaeological-consultant-list. The archaeologists listed, or any other experienced archaeologist, may be contacted to conduct the recommended survey. ***Please note that our office requests consultation with the Office of State Archaeology Review Archaeologist to discuss appropriate field methodologies prior to the archaeological field investigation***.

One paper copy and one digital copy (PDF) of all resulting archaeological reports, as well as a digital copy (PDF) of the North Carolina Site Form for each site recorded, should be forwarded to the Office of State Archaeology (OSA) through this office, for review and comment as soon as they are available and in advance of any construction or ground disturbance activities. OSA's Archaeological Standards and Guidelines for Background Research, Field Methodologies, Technical Reports, and Curation can be found online at: https://files.nc.gov/dncr-arch/OSA_Guidelines_Dec2017.pdf.

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We have determined that the project as proposed will not have an effect on any historic structures.

The above comments are made pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified at 36 CFR Part 800.

Thank you for your cooperation and consideration. If you have questions concerning the above comments, please contact Renee Gledhill-Earley, environmental review coordinator, at 919-814-6579 or environmental.review@ncdcr.gov. In all future communication concerning this project, please cite the above-referenced tracking number.

Sincerely,

Renee Gledhill-Earley

for Ramona Bartos, Deputy
State Historic Preservation Officer

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The following have been deleted:
SCOPE OF WORK

(End of Summary of Changes)