HYDROGRAPHIC & GEOPHYSICAL SURVEY REPORT

HKA CABLE ROUTE SURVEY

HERMOSA, CALIFORNIA

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Acronyms and Abbreviations

°	degree(s)
3D	three dimensional
ACSM	American Congress on Surveying and Mapping
ASN	Alcatel-Lucent Submarine Networks
BMH	Beach Manhole
cm	centimeter
COR	Contracting Officer Representative
CRS	Cable Route Survey
CSF	Composite Source File
DB	QINSy database
DCC	Distance Cross Course
eTrac	eTrac Inc.
Fugro	Fugro Singapore Marine Pte Ltd
GLONASS	global navigation satellite system
GNSS	global navigation satellite system
GPS	global positioning system
HKA	Hongkong – America Consortium
Hz	hertz

ID	identification
IHO	International Hydrographic Organization
JSF	java server faces
KP	Kilometer Point
LAT	Lowest Astronomical Tide
m	meter
m/s	meters per second
MAG	Magnetometer
MAR	Marine Advanced Research Inc
MBES	multibeam echosounder system
MLLW	Mean Lower Low Water
NAD83	North American Datum 1983
NGS	National Geodetic Survey
NOAA	National Oceanic and Atmospheric Administration
OPUS	Online Positioning User Service
pdf	Adobe Portable Document Format
POSMV	position and orientation system for marine vessels
PPK	Post Processed Kinematic
QPS	Quality Positioning Systems
RTK	real time kinematic
RPL	Route Point List
SBET	smoothed best estimate of trajectory
SBP	Sub-bottom Profiler
SSS	Sidescan Sonar

THSOA	The Hydrographic Society of America
USM	universal sonar mount
WGS84	World Geodetic System 1984
XTF	Extended Triton Format

EXECUTIVE SUMMARY

Between May 22nd 2018 and May 30th eTrac Inc. completed a topographic, geophysical and bathymetric survey of the Hermosa Longfellow landing site (Beach landing and nearshore) area located nearshore off of Hermosa, California in support of the HKA Cable Route Survey. The survey area consists of a 500 meter cable corridor centered on the planned able route which extends from 2 meters water depth on the shoreward to the 3 nautical mile demarcation line. Also included in the survey area is an additional 500 meter wide area centered on the planned cable route 500 meters past the 3 nautical mile limit to overlap the pacific crossing survey being conducted to the 3nm state limit. This report covers the geophysical and bathymetric survey. A separate report "2018_Hermosa_Topographic_Survey_Report_Final.pdf" details the topographic survey.

1. INTRODUCTION

1.1 Contract and Scope

This report is prepared for Marine Advanced Research Inc. (MAR) a subcontractor to Fugro Singapore Marine PTE LTD (Fugro) for Alcatel-Lucent Submarine Networks (ASN) by eTrac Inc. (eTrac) under the Alcatel HKA Cable Route Survey Inshore California Survey Job Number: P03437, to perform an inshore marine geophysical and bathymetric survey in Hermosa, California. The principle objective of the inshore Marine Cable Route Survey is to confirm or amend the preliminary post Cable Route Study (CRS) route as proposed by ASN, to ascertain a feasible and safe route for cable system design, deployment, survivability, and subsequent maintenance. Another objective of this survey is to assist ASN with decisions regarding cable armoring by identifying all route obstacles and cable hazards and providing information to support cable route and installation engineering.

1.2 Survey Area

The survey area is defined as a polygon using the Route Point List (RPL) for the Hermosa Longfellow Beach Manhole (BMH) landing site. This site is located in Los Angeles, CA on Hermosa Beach. The area includes a topographic survey of the beach area in the vicinity of the BMH (Details of this survey can be found in document "2018_Hermosa_Topographic_Survey_Report_Final.pdf") and a nearshore area bounded by a buffer of 250 meters to either side of the RPL and 500 meters offshore of the 3nm state waters boundary. The landfall point for the inshore geophysical survey work is defined as up to the 3m contour below LAT.

Figure 1 below shows the project area location.

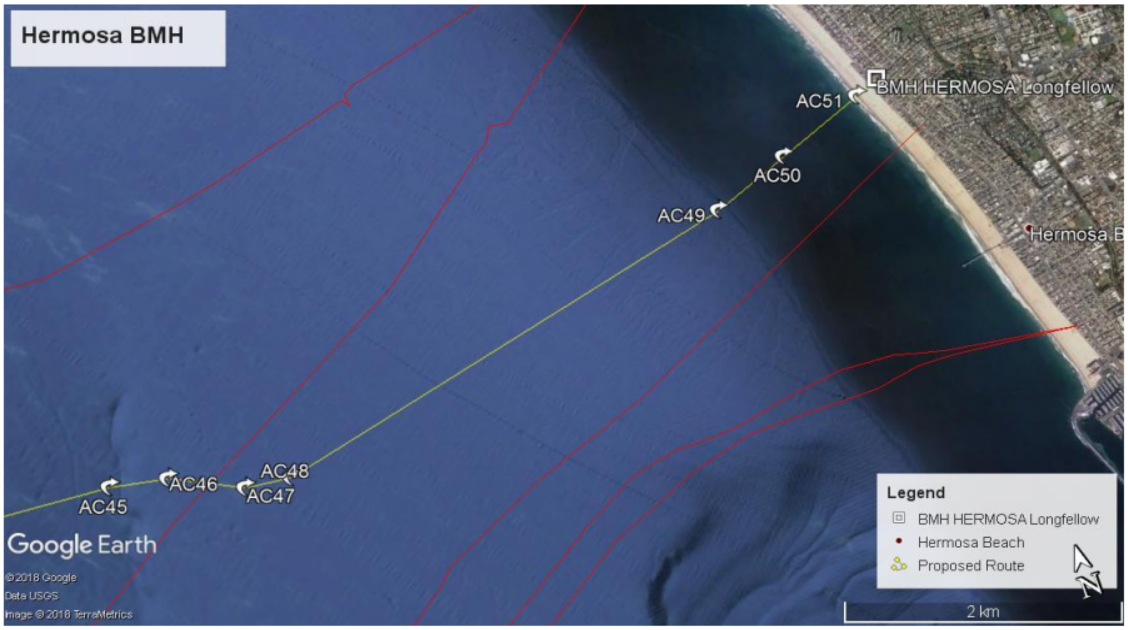


Figure 1: Survey Area Location

1.2.1 Topographic Survey Area

A topographic survey was conducted in a 500 meter wide corridor centered about the BMH HERMOSA Longfellow Avenue Manhole Site (see below Figure 2). The topographic landing survey identified access points and infrastructure in the survey area. Topographic features were located from the concrete boardwalk abutting the beach down to the waterline at low tide. Other permanent features such as utility locations were also mapped within the 500m beach corridor.

Figure 2: Topographic Survey Area

All topographic survey methods, results, and interpretations can be found in document ""2018_Hermosa_Topographic_Survey_Report_Final.pdf" and the plot "2018_Hermosa_Topo_FINAL.pdf".

1.2.1 Nearshore Survey Area

The nearshore survey consists of a polygon bounded by a buffer of 250 meters to either side of the cable alignment and 500 meters offshore of the 3nm state waters boundary (see Figure 3). The nearshore extents of the survey area for all bathymetric and geophysical operations is defined as the 3m contour in reference to LAT. All operations required in the nearshore survey area will support the measurement, study, and investigation of the bathymetry, seabed features, shallow geology, and potential hazards along the cable route.

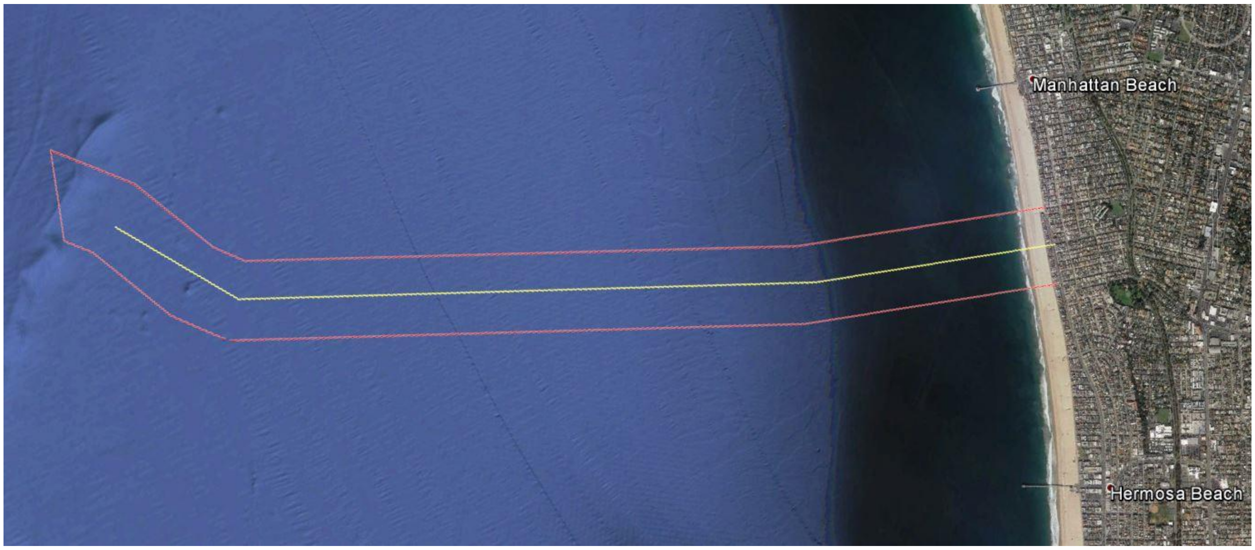


Figure 3: Nearshore Survey Area

The survey area required 100% coverage with 20% overlap for the multibeam echosounder (MBES) and sidescan sonar (SSS) data acquisition to map seabed morphology. Sub-bottom profiler (SBP) data were required to be collected along transects spaced at 80 meter intervals from the cable alignment to determine thickness and nature of the sediments depending on depth. Magnetometer (MAG) data were required to be collected at the offshore cable crossing of the alignment. Sediment grab samples were required to be collected at 500m intervals along the proposed cable alignment.

1.3 Company Overview

eTrac Inc. was established in 2003 as a hydrographic and geophysical surveys, vessel positioning and instrumentation firm. eTrac has several offices along the US West Coast including San Francisco, Seattle and Anchorage. The firm has earned a strong reputation among many sectors of the hydrographic industry, including government agencies and private industry. Its equipment fleet has also grown to include 8 aluminum geophysical survey vessels as well as several ultraportable, shallow water survey craft. eTrac's role has grown over the years to include a strong group of full-time staff as well as several localized vessels to support the work required by the USACE, marine construction, engineering firms and petroleum industry contractors on the West Coast. eTrac is committed to continual re-investment in industry leading equipment and knowledgeable staff to complete multibeam, singlebeam, sidescan, mobile LiDAR, sub-bottom, and water-level surveys required by our clients. Staffed with professionally licensed land surveyors and ACSM/THSOA (American Congress on Surveying and Mapping/The Hydrographic Society of America) certified hydrographers, eTrac's projects are performed at the highest level of quality and detail that the industry demands.

2 OBJECTIVES

eTrac completed a bathymetric and geophysical survey in support of the HKA Cable Route Inshore Survey at BMH Hermosa . The requirement of the project is to provide seafloor bathymetry, sidescan sonar imagery, sub-bottom stratigraphy, and identification of surface and subsurface features.

The objectives of this survey are as follows:

- Identify access points and infrastructure within the topographic survey area
- Determine the stratigraphic and geologic characterization of sediments, soil, and bedrock underlying the nearshore survey area
- Identify and analyze objects and debris larger than 1m x 1m x 1 m using SSS within the nearshore survey area

3 SURVEY CALENDAR AND PERSONEL

The survey began on May 22 2018 with the mobilization of the multibeam and positioning systems. The final day was May 31 2018 when all systems were demobilized from the vessel. The survey activities calendar is below in Table 1.

Table 1: Survey Calendar

Date	Survey Activities
May 20, 2018	RV 505 arrives at Marina Del Ray, CA and R/V 505 Mobilization
May 21, 2018	Complete Mobilization of RV 505. Launch RV 505 and transit to Hermosa.
May 22, 2018	RV 505 Equipment Calibrations, Bar Check, Patch Test. WAM-V equipment Mobilization, Calibrations, Bar Check. Topographic Survey
May 23, 2018	RV 505 Acquire MBES, SBES, and SSS data. WAM-V Patch Test and Acquire MBES
May 24, 2018	RV 505 Acquire MBES, SBES, and SSS data. WAM-V Acquire MBES. Topographic Survey
May 25, 2018	R/V 505 Acquire SBP data and Sediment Samples. Demobilization of WAM-V
May 26, 2018	Standby day for Holiday Weekend
May 27, 2018	Standby day for Holiday Weekend
May 28, 2018	Standby day for Holiday Weekend
May 29, 2018	R/V 505 Acquire Sediment Samples
May 30, 2018	R/V 505 Acquire MAG data. Begin R/V 505 Demobilization
May 31, 2018	R/V 505 Demobilization
June 1, 2018	R/V 505 Demobilization

Personnel assigned to the survey are listed below.

eTrac
Michael Mueller - Project Manager
David Neff - Project Site Manager and Marine Mammal Observer
Nicholas George - Processing Manager
Isadora Kratchman - Report Manager and Hydrographic Processor
Ben Churchwell - Lead Hydrographic Tech and Hydrographic processor
Chris Ham - Lead Hydrographic Tech, Marine Mammal Observer, and Hydrographic processor
Greg Crenshaw - Hydrographic Tech and Hydrographic processor
Gerhard Skerbinek - Vessel Captain and Vessel Transport
Anthony Salas - Vessel Support and Vessel Transport Support
Fugro
Lew Fian Fui – Project Manager, Contracting Officer Representative (COR) for eTrac, sediment sample classification
Christian Iserentant – Inshore Project Manager
ASN
Mark Jonkergouw – Project Manager
Soeren Christensen – Project Manager Marine

4 METHODOLOGY

4.1 Survey Vessels

As detailed in the mobilization report R/V 505 (Figure 4) and the WAV-V 20 (Figure 5) were used for hydrographic survey operations for this project. R/V 505 was also used for all geophysical survey operations for this project.
On R/V 505 a positioning and motion detection system was installed on the vessel with a long antenna base allowing maximum heading accuracy. A multibeam system was mounted with a Universal Sonar Mount (USM). The sediment sampler was deployed and retrieved via the onboard electric winch. The sidescan sonar and sub-bottom system were towed using a sheave with a block and winch off the stern of the vessel. The magnetometer was towed in tandem with the sidescan sonar.

On the WAM-V 20 a positioning and motion detection system was installed on the vessel with a long antenna base allowing maximum heading accuracy. A multibeam system was mounted with a custom sonar mount.

Figure 4: R/V 505

Figure 5: WAM-V 20

4.2 Equipment

Precise positioning and motion systems, high resolution multibeam sonars, a sediment grab sampler, a sidescan sonar system, a CHIRP sub-bottom sonar system, and a magnetometer were installed for this project and are described below.

4.2.1 Positioning System

As detailed in the mobilization report, R/V 505 was positioned and motion accounted for using an Applanix POS Oceanmaster V5 and the WAM-V 20 was positioned and motion accounted for using an Applanix POS Wavemaster V5.

4.2.2 Positioning System

For horizontal positioning R/V 505 was equipped to receive DGPS coast guard corrections from nearby coast guard beacons:
Primary: Point Loma – ID 881 – Freq: 302

DGPS corrections on the R/V 505 were provided by a Hemisphere MBX-4 positioning system receiving corrections from the U.S. Coast Guard beacon located at Point Loma.

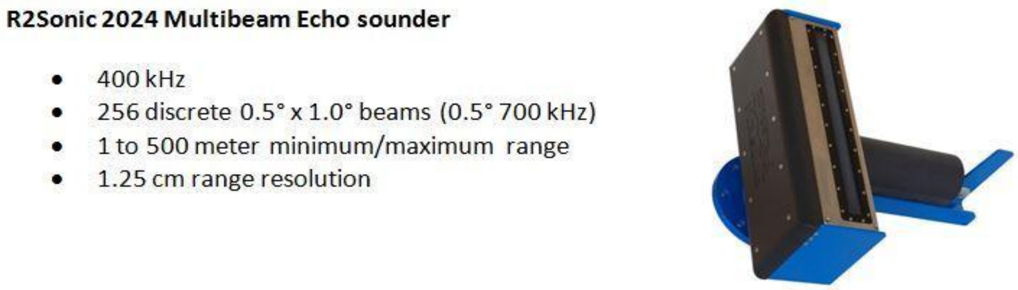
Mobilization details the QC methods for the POS MV Positioning system can be found in Appendix A – Mobilization Report.

4.2.3 Cable Counter

During SSS, SBP, and MAG operations, Towfish cable payout was measured with the Hydrographic Survey Projects, Inc. SCC Smart Sensor. The system is comprised of a sheave block fitted with the SCC sensor and 2 magnets. The sheave block is coupled with the SCC display interface. Cable payout messages were sent via DB9 serial cable to SonarWiz acquisition software.
Further details of this system can be found in the Mobilization Report.

4.2.4 Multibeam Sonar

An R2 Sonic 2024 multibeam system (Figure 6) was used for all bathymetry data acquisition on R/V 505. The system used is capable of running at 400 kHz to get the highest resolution dataset.

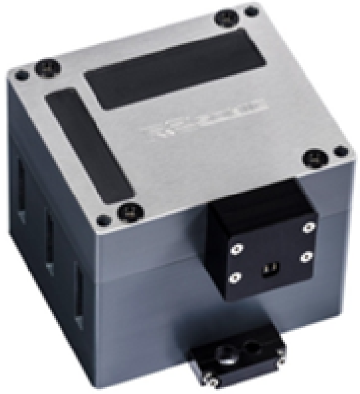


R2Sonic 2024 Multibeam Echo sounder

- 400 kHz
- 256 discrete 0.5° x 1.0° beams (0.5° 700 kHz)
- 1 to 500 meter minimum/maximum range
- 1.25 cm range resolution

Figure 6: R2 Sonic 2024 Multibeam Echosounder System

An R2 Sonic 2020 multibeam system (Figure 7) was used for all bathymetry data acquisition on the WAM-V. The system used is capable of running at 400 kHz to get the highest resolution dataset.

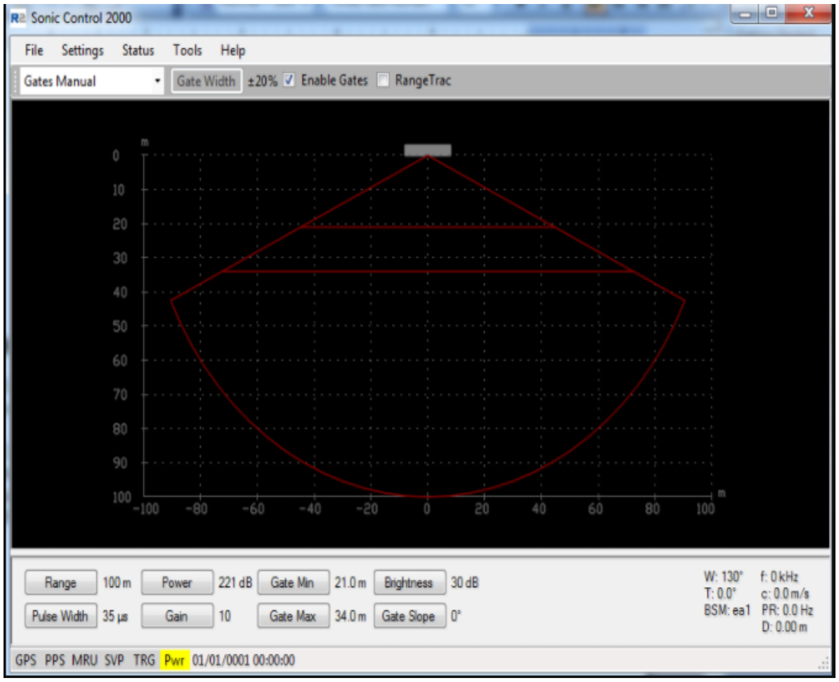


R2 Sonic 2020 Multibeam Echosounder

- 400 kHz
- 256 discrete 2° x 2° beams
- 1 to 120 meter minimum/maximum range
- 1.25 cm range resolution

Figure 7: R2 Sonic 2020 Multibeam Echosounder System

Both the R2Sonic 2024 and R2Sonic 2020 system is controlled using the R2 sonic controller (seen below in Figure 8). The setting changes that can be made include the range, gain, power, pulse width, absorption and saturation. These are monitored and adjusted accordingly. Swath width is also adjusted using the R2 sonic controller.



Range 100 m
Power 221 dB
Gate Min 21.0 m
Brightness 30 dB
Pulse Width 35 µs
Gain 10
Gate Max 34.0 m
Gate Slope 0°
W: 130°
T: 0.0°
BSM: ea1
f: 0 kHz
c: 0.0 m/s
PR: 0.0 Hz
D: 0.00 m
01/01/0001 00:00:00

Figure 8: R2 Sonic Control 2000

Data was logged in QINSy as .DB files containing bathymetry data.

As described in the Mobilization Report, the top center of the IMU was chosen as the reference point and measurements were taken in the x, y, and z direction between the RP and the R2 Sonic Acoustic Center and used to position the system. These offsets were applied in the vessel Database in QINSy and position was calculated and recorded in real-time. The R2Sonic position is displayed in the QINSy shell as a node.

Further details of the calibration and QC methods for multibeam system can be found in the Mobilization Report.

4.2.5 Singlebeam Sonar

R/V 505 was equipped with an Odom EchoTrac CV100 singlebeam echosounder in single channel configuration with a SMSW200-4a transducer. At 200kHz the SMSW200-4a has a 4° beamwidth. CV100 operates at a maximum ping rate of 20Hz and was configured to ping at the optimum rate during the Hermosa mapping effort.

4.2.6 Sound Velocity

As described in the Mobilization Report, sound velocity profiles were obtained on the R/V 505 at pre-planned intervals during all surveys to adjust the computation of MBES, SBES, SSS, SBP, and MAG refraction and ranging of data due to speed of sound variation in the water column. As described in the Mobilization Report, sound velocity profiles from the R/V 505 were applied to the WAM-V 20 MBES data during post processing.

AML Base X2 Sound Velocity Profiler

- Depth Range: up to 500 meters
- Sound Velocity Range: 1375 to 1625 m/s
- Sound Velocity Precision (+/-): 0.006 m/s
- Sound Velocity Accuracy (+/-): 0.025 m/s
- Sound Velocity Resolution: 0.001 m/s
- Pressure Range: Up to 6000 dBar

Figure 9: AML Base X2 Sound Velocity Profiler

An AML Base X 2 Profiler (See Figure 9 for image and details) was used as the sound speed profiler due to its high accuracy time of flight sound speed sensor, which is capable of measuring sound speed in depths up to 500 meters. The AML Base X 2 is capable of transferring data via WiFi. AML SeaCast software was run on the acquisition computer to facilitate the data transfer and profile formatting.

AML Micro X sound Velocity Probe

- Depth Range: up to 500 meters
- Sound Velocity Range: 1375 to 1625 m/s
- Sound Velocity Precision (+/-): 0.006 m/s
- Sound Velocity Accuracy (+/-): 0.025 m/s
- Sound Velocity Resolution: 0.001 m/s

Figure 10: AML Micro X Sound Velocity Probe

During MBES survey on the R/V 505 and the WAM-V an AML Micro X (see Figure 10 for image and details) was utilized by the R2Sonic 2024 for the surface sound speed measurement. The AML Micro X is a time of flight SV sensor and is powered through the R2Sonic topside unit via RS232 serial cable connection. Sound speed measurements (measured in meters per second) are output through the same serial connection at 1Hz.

Details of the sound velocity profiler systems can be found in the Mobilization Report.

4.2.7 Grab Sampler

A WILDCO Ponar grab sediment sampler system was used for all sediment collection(Figure 11). The Ponar grab is a self closing stainless steel grab sampler and has a sample volume of 500 Cubic Inches and measures 9’Wx9’L. Further details of the grab sampler can be found in the Mobilization Report.

Figure 11: WILDCO Ponar Grab Sampler

4.2.8 Sidescan Sonar

As discussed in the mobilization report, R/V 505 was equipped with an Edgetech Chip 4200 sidescan sonar system with a 701-DL topside interface for surface object detection. The dual frequency sonar operated at frequencies 300kHz and 600 kHz concurrently. The sidescan sonar was towed using a 300m length of armored tow cable. The tow cable was wound onto a custom electric winch mounted to the cabin top of the RV 505 vessel. Electronic control of the winch direction was initiated with a remote control unit handled by the hydrographic surveyor on the deck of the vessel.

Layback of the tow fish was computed in SonarWiz software (caternary and cable incl.) using both physical measurements from the cable (alternating 2 and 3 meter markings) as well as an electronic hall effect sensor-based cable counter on a dedicated sheave. The sheave was suspended from a davit towed from a point on the centerline of the stern of the vessel. Electronic cable payout information was input in real-time via serial data to the acquisition computer and applied in the SonarWiz software.

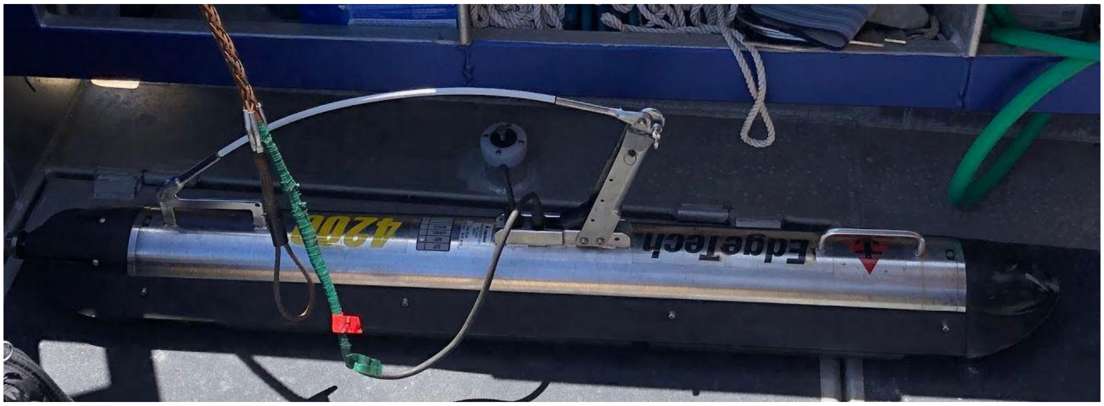


Figure 12: EdgeTech 4200 Sidescan Sonar

4.2.9 Sub-bottom Profiler

As discussed in the Mobilization report, R/V 505 was equipped with an Edgetech Chirp 216S sub-bottom profiler with a 3200X topside to understand the shallow subsurface stratification (up to 30 feet below seabed) and for subsurface object detection.
The Edgetech Chirp 216S (Figure 13) has a frequency modulated pulse and was be set-up to 2-15 kHz with a 20 ms pulse width and Edgetech Pulse ID 25129. The sub-bottom profiler was towed using a fixed layback in the Discover software from the same towpoint used for the sidescan sonar operations. Line navigation during acquisition was handled using QINSy software and the Applanix POSMV. The sub-bottom profiler data was collected using a depth range adjusted by the on-line surveyor. The range varied according to the depth of penetration desired and depth of the seabed in the area being surveyed.

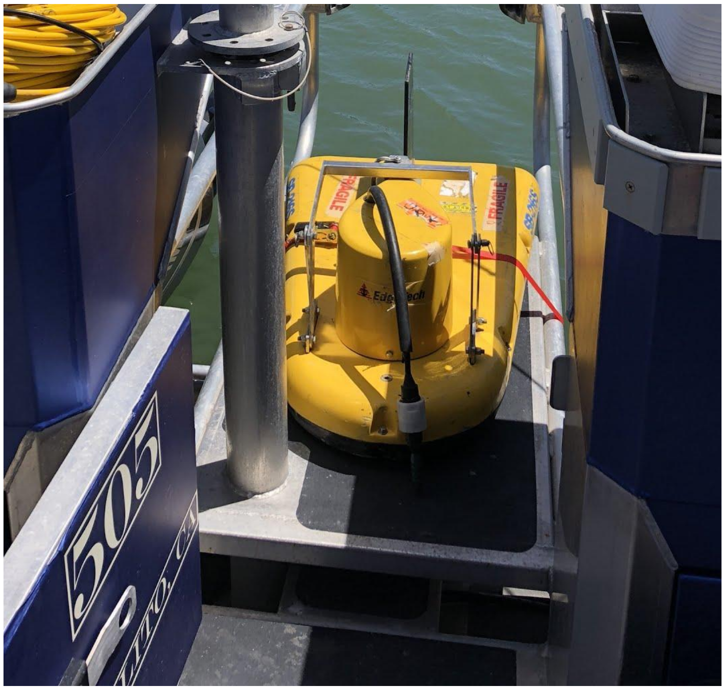


Figure 13: EdgeTech Chirp 2016S

4.2.10 Magnetometer System

As discussed in the mobilization report R/V 505 was mobilized with a Geometrics G-882 cesium marine magnetometer (Figure 14) to detect cable crossings. This system detects ferrous objects below and at the surface of the seabed.

Figure 14: Geometrics G-822 Cesium Magnetometer

The G-882 was towed in tandem (i.e. aft of) the 4200 sidescan sonar towfish. Layback of the magnetometer was computed as an offset of 9meters from the sidescan position computed in the SonarWiz software. SonarWiz was configured to accommodate the serial messages from the 4200 sonar which acts as a pass-through for the information from the 882 magnetometer. The magnetometer data was recorded to the SonarWiz JSF files and extracted in post-processing from SonarWiz as well. Line navigation during acquisition was handled using QINSy software and the Applanix POSMV.

4.3 Data Acquisition

4.3.1 Multibeam Bathymetry

All multibeam data was acquired as outlined. The combined POSMV and R2 Sonic multibeam systems were used to acquire all multibeam bathymetry data. Both the R2Sonic 2024 and R2Sonic 2020 were run at 400 kHz to allow hi-res data. As described in section 4.2.6 of this report, for all multibeam data the sound speed both at the sonar head and through the water column was accounted. An AML micro X and an AML Base X2 were used. During mulitbeam acquisition sound velocity profiles were acquired every 2 – 3 hours and applied in real-time on R/V 505 in QINSy using the echosounder settings utility in the online QINSy shell and in post processing for the WAM-V 20 MBES data. As described in the Mobilization Report, the AML Base X2 sound velocity profile and the AML micro X sound velocity at the head were compared.

As described the Mobilization Report, multibeam data was collected to achieve 100% bottom coverage with 20% overlap for seabed morphology. This achieved coverage is further explained in section 4.4.1 of this report.

4.3.2 Singlebeam Bathymetry

All singlebeam data was acquired as outlined. Singlebeam data was acquired simultaneously with MBES data and was used as a quality control check for the MBES data. The Odom CV100 was run at 20 kHz.

During mulitbeam acquisition sound velocity profiles were acquired every 2 – 3 hours and applied in real-time on R/V 505 in QINSy using the echosounder settings utility in the online QINSy shell.

4.3.3 Sediment Sampling

Sediment grab samples were completed as outlined. The sediment sampler was dropped at each site location and a fix marked of the estimated position the sample was taken. Each sample was retrieved and then placed in a plastic container, labeled and photographed. In field analysis was completed. Each sample was classified by color using a Munsell soil chart and grain size using a Fugro supplied soil classification. Further analysis was completed by Fugro technician Lew Lian Fui. A final simplified ASN client specific surface classification scheme was used for analysis and charting.

4.3.4 Sidescan Sonar

All sidescan sonar data was acquired as outlined. The EdgeTech 4200 was used to acquire all sidescan sonar data. As previously described in the Mobilization Report, the dual frequency sonar operated at frequencies 300kHz and 600 kHz concurrently. The sidescan sonar was towed using a 300m length of armored tow cable. The tow cable was wound onto a custom electric winch mounted to the cabin top of the RV 505 vessel. Electronic control of the winch direction was initiated with a remote control unit handled by the hydrographic surveyor on the deck of the vessel.

Layback of the tow fish was computed in SonarWiz using both physical measurements from the cable (alternating 2 and 3 meter markings) as well as an electronic hall effect sensor-based cable counter on a dedicated sheave. The sheave was suspended from a davit towed from a point on the centerline of the stern of the vessel. Electronic cable payout information was input in real-time via serial data to the acquisition computer and applied in the SonarWiz software.

4.3.5 Sub-bottom System

All sub-bottom sonar data was acquired as outlined. The EdgeTech Chirp 216S was used to acquire all sub-bottom data. As previously described as well as described in the Mobilization Report, the Edgetech Chirp 216S has a frequency modulated pulse and was be set-up to 2-15 kHz with a 20 ms pulse width and Edgetech Pulse ID 25129. The sub-bottom profiler was towed using a fixed layback in the Discover software from the same towpoint used for the sidescan sonar operations. Line navigation during acquisition was handled using QINSy software and the Applanix POSMV. The sub-bottom profiler data was collected using a depth range adjusted by the on-line surveyor. The range varied according to the depth of penetration desired and depth of the seabed in the area being surveyed.

4.3.6 Magnetometer System

In the original project scope, eTrac was instructed to acquire magnetometer data at the offshore cable crossing of the alignment to confirm the locations of the charted cable. The charted cable was not detected at the crossing of the alignment. Fugro provided eTrac with 2 position points of the charted cable received from Alcatel. These 2 points corroborated with the charted cable. Instructed by Fugro representatives, eTrac ran passes perpendicular to the charted cable but was unable to detect the cable. eTrac successfully detected multiple charted cables outside of the survey area as well as a charted steel buoy.

The Geometrics G-882 Cesium system was used to acquire all magnetometer data. As described in the Mobilization Report, the G-882 was towed in tandem (i.e. aft of) the 4200 Sidescan sonar towfish. Layback of the magnetometer was computed as an offset of 9meters from the sidescan position computed in the SonarWiz software. As described above in section B.2.2.1., the caternary and cable payout out values supplied to the software contributed to the computation of the layback value in real-time. Both physical measurements from the cable (alternating 2 and 3 meter markings) as well as an electronic hall effect sensor-based cable counter on a dedicated sheave were used to supply data to the software. SonarWiz was configured to accommodate the serial messages from the 4200 sonar which acts as a pass-through for the information from the 882 magnetometer. The mag data was recorded to the SonarWiz JSF files and extracted in post-processing from SonarWiz as well.

Line navigation during acquisition was handled using QINSy software and the Applanix POSMV.

4.4 Survey Lines

4.4.1 Multibeam

As previously described, multibeam data was collected to achieve 100% bottom coverage with 20% overlap for seabed morphology. Lines were run to ensure the full extents of the boundary were covered with multibeam sounding data. Line spacing was determined by depth. The density (soundings per node) or a 1x1 meter grid ranges from at least 1 sounding per node to over 40 soundings per node with a mean sounding density of 8 soundings per node.

4.4.2 Sediment Samples

Sediment grab samples were collected at 500m intervals along the proposed cable alignment. The 500m spacing was based around a gas plume that was observed in the MBES data collected on the first day of MBES survey operations. A sediment grab sample was taken at the gas plume location and further samples were taken in 500m increments along the cable alignment in either direction from the sample taken at the plume.

4.4.3 Sidescan Sonar

As previously described, sidescan sonar data was collected to achieve 100% bottom coverage with 20% overlap for seabed morphology and object detection of any object larger than 1m by 1m by 1m. Lines were run to ensure the full extents of the boundary were covered with multibeam sounding data. Line spacing was determined by depth. All lines were run a set speed between 2-4 knots to maintain data density while maintaining the system flying above the seafloor.

4.4.4 Sub-bottom

As previously described, sub-bottom profiler files were collected along transects spaced at 80 meter intervals from the cable alignment to determine thickness and nature of the sediments. 6 cross lines were also collected perpendicular to the cable alignment. Two extra transects were assigned during collection, +380 and +480 meters from the cable alignment. 1 line was also collected for layback calibration. This spacing, assigned cross lines and extra lines resulted in 11 survey lines running parallel to the alignment, 6 survey lines running across the alignment, and 1 survey line for layback calibration. All lines were run at a set speed between 4-5 knots to maintain data density.

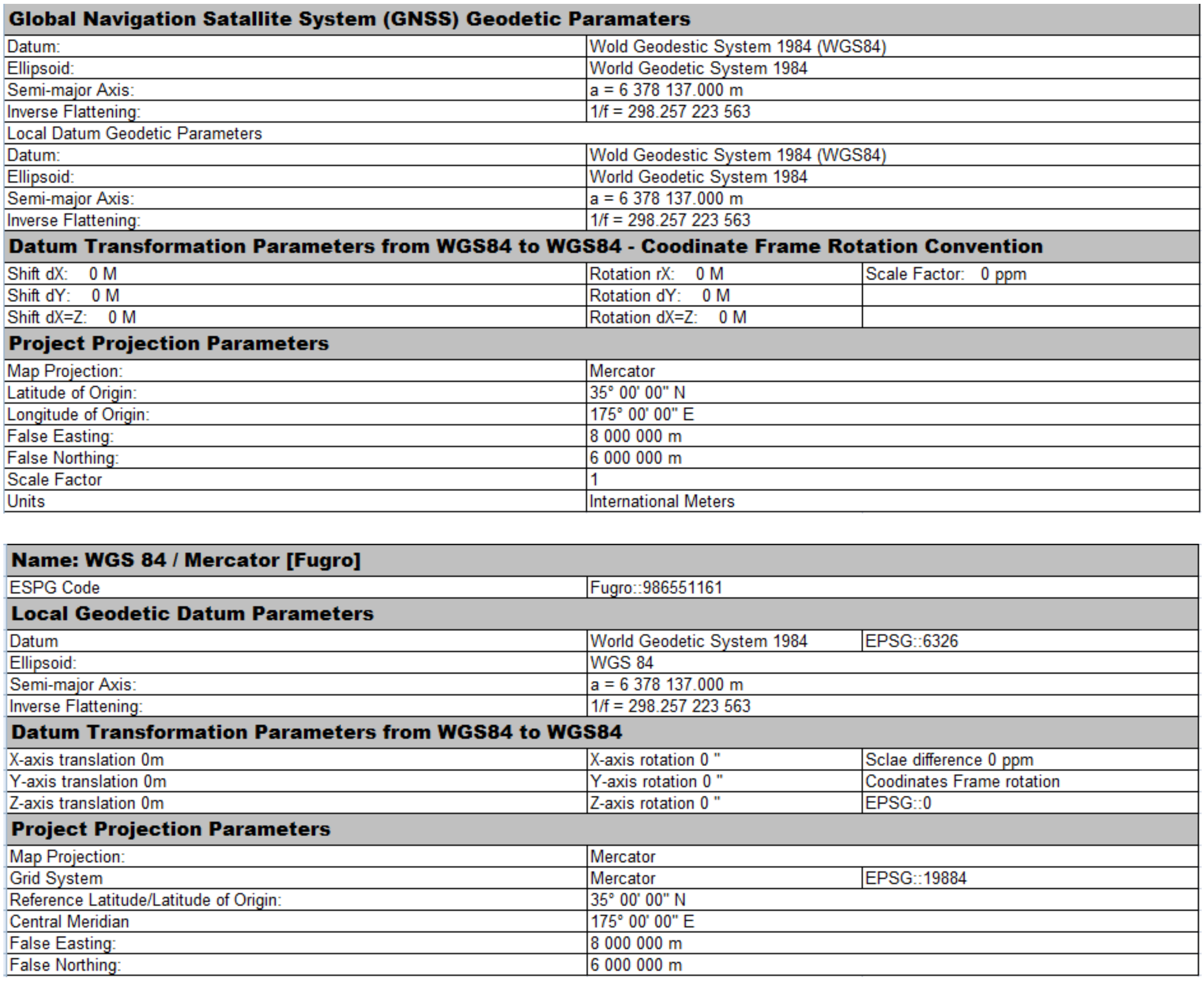
4.4.5 Magnetometer

As previously described, eTrac was instructed to collect magnetometer data at the offshore cable crossing of the alignment. 6 lines were run perpendicular to the charted cable in 175 meter increments. The charted cable was not detected at the crossing of the alignment. eTrac ran 2 lines over charted cables outside of our survey area with successful detection. 4 lines were also run over a charted steel buoy with successful detection. All lines were run at a set speed of 2-4 knots so that the system flew at the same offset length behind the vessel throughout the survey.

4.5 Geodesy

4.5.1 Project Coordinates

The project coordinates used for the survey were a custom Mercator projection supplied by Fugro. The units employed were in meters. The geodesy parameters can be found below as well in the mobilization report. The parameters were confirmed on June 1st 2018 with reference to two test points in Fugro Starfix.



Global Navigation Satallite System (GNSS) Geodetic Paramaters		
Datum:	Wold Geodestic System 1984 (WGS84)	
Ellipsoid:	World Geodetic System 1984	
Semi-major Axis:	a = 6 378 137.000 m	
Inverse Flattening:	1/f = 298.257 223 563	
Local Datum Geodetic Parameters		
Datum:	Wold Geodestic System 1984 (WGS84)	
Ellipsoid:	World Geodetic System 1984	
Semi-major Axis:	a = 6 378 137.000 m	
Inverse Flattening:	1/f = 298.257 223 563	
Datum Transformation Parameters from WGS84 to WGS84 - Coodinate Frame Rotation Convention		
Shift dX: 0 M	Rotation rX: 0 M	Scale Factor: 0 ppm
Shift dY: 0 M	Rotation dY: 0 M	
Shift dX=Z: 0 M	Rotation dX=Z: 0 M	
Project Projection Parameters		
Map Projection:	Mercator	
Latitude of Origin:	35° 00' 00" N	
Longitude of Origin:	175° 00' 00" E	
False Easting:	8 000 000 m	
False Northing:	6 000 000 m	
Scale Factor	1	
Units	International Meters	

Name: WGS 84 / Mercator [Fugro]		
ESPG Code	Fugro::986551161	
Local Geodetic Datum Parameters		
Datum	World Geodetic System 1984	EPSG::6326
Ellipsoid:	WGS 84	
Semi-major Axis:	a = 6 378 137.000 m	
Inverse Flattening:	1/f = 298.257 223 563	
Datum Transformation Parameters from WGS84 to WGS84		
X-axis translation 0m	X-axis rotation 0 "	Sclae difference 0 ppm
Y-axis translation 0m	Y-axis rotation 0 "	Coodinates Frame rotation
Z-axis translation 0m	Z-axis rotation 0 "	EPSG::0
Project Projection Parameters		
Map Projection:	Mercator	
Grid System	Mercator	EPSG::19884
Reference Latitude/Latitude of Origin:	35° 00' 00" N	
Central Meridian	175° 00' 00" E	
False Easting:	8 000 000 m	
False Northing:	6 000 000 m	

Figure 15: Geodesy Parameters as used for the project

It should be noted that these parameters differ from those in document “P03437 - HKA - Inshore Survey in CA - 14 May 2018.pdf” Internal kick off meeting which employs a scale factor at the standard parallel.

4.5.2 Vertical Datum

Survey data was vertically referenced to LAT. MLLW tide data were downloaded from the local (Santa Monica Pier) NOAA tide station. These data were applied to the data sets and a fixed 0.59 meter offset was applied to the MLLW data to correct it to the desired LAT vertical datum. The 0.59m value was supplied by Fugro project representatives on May 22nd 2018.

4.5.3 Horizontal and Vertical Control

During acquisition R/V 505 received DGPS corrections via an MBX4 Beacon and supplied position and orientation updates to the software through a network connection. The corrections supplied by the MBX4 were monitored during data acquisition to ensure differential signal was maintained throughout the survey.

4.6 Acquisition and Safety

All data was collected from May 22rd 2018 to May 30th 2018. Data was collected in a safe and efficient manner. All personnel involved with the project are OSHA certified. All personnel completed a Project Safety Orientation and Vessel Safety Briefing before being operations. At the start of the day and before any activity change a full toolbox talk was completed. The main risk involved was deploying and retrieving the towed survey instruments (SSS, SBP, and MAG). Two people were always on deck during these operations and retrieval and it was always done at periods during which ample time could be allowed for the process to be done in a safe manner.

4.7 Processing and Software

4.7.1 Multibeam Data

All multibeam data acquisition was completed in QPS QINSy hydrographic data acquisition and navigation software package. All position data was logged for a PPK solution. Changes in the sound speed environment were monitored and appropriate actions in terms of further measuring of the water column sound speed were taken.

All multibeam data was processed in QPS Qimera software. A post processed kinematic solution; smooth best estimate of trajectory (SBET) for the horizontal position of the vessel was created in Applanix POSPAC software and applied in Qimera to replace all online navigation and motion. Tidal data from NOAA tide station 9410840 Santa Monica was used to reduce the data to datum MLLW. The data was further reduced to LAT using the given offset of 0.59m. Additional checks and processing of sound velocity was completed in the software. Data was cleaned and analyzed on a 1mx1m dynamic surface (grid) in Qimera. Data was cleaned using slice sections and 3D point cloud views. Spurious sounds were deemed to be those which did not agree with the general surface and points which were not detected by two lines. In addition plumes of noise that can be recognized as sonar disturbance due to their shape were cleaned.

4.7.2 Singlebeam Data

All singlebeam data acquisition was completed in QPS QINSy hydrographic data acquisition and navigation software package. Changes in the sound speed environment were monitored and appropriate actions in terms of further measuring of the water column sound speed were taken.
All singlebeam data was processed in QPS QINSy processing manager software. Acquired QPDS files were cleaned of spurious soundings in the software. The same tide applied to the multibeam data was used. Additional checks and processing of sound velocity was completed in the software. Singlebeam data was used as a quality control check for our multibeam data.

4.7.3 Sidescan Sonar Data

All sidescan data was processed in SonarWiz software. Data was corrected for layback based on the noted cable out and a caternary factor. Overlapping lines and targets were compared to quality control the layback adjustments made. Position data was filtered in order to account for GNSS errors or "jumps". Data was then bottom tracked, slant range corrected and a coverage mosaic created.
Each lines was analyze to generate targets and to attribute targets with measurements (length, width and description). Heights were analyzed using the object shadow from the sidescan imagery. The program logs JSF files as the raw data files and are processed through SonarWiz to generate CSF files.

4.7.4 Chirp Sub-bottom Data

Chirp JSF data was imported into SonarWiz. Navigation was filtered using a spline smoothing filter to account for GNSS positioning errors and represented the estimated course of the fish with layback. Gain adjustments were applied in order to enhance the data to identify changes in amplitude through the profiles. Data was then bottom tracked to determine the consistent range from the sonar to the seabed. Layback calibration was completed and quality controlled against features in the multibeam data.
Using the multibeam gridded data, the sub-bottom, bottom tracked data was aligned to the seabed. This processing step reduces the need for direct heave compensation of the sub-bottom data as the multibeam data is corrected for all motion artifacts. In addition, all depths below the seabed after aligning with the seabed are brought down to the LAT vertical datum so that any subsurface feature depth is absolute (related to LAT) as well as relative to the seabed.

Subsurface seismic units were identified and digitized in the chirp data using SonarWiz. Data was analyzed for parabolas in order to identify buried targets. Various time varying gain settings were used to enhance subsurface features. Contacts were picked by looking for parabolas and disturbance. Cross line intersections were viewed to confirm subsurface horizons, sediment facies and features on multiple lines. With no bore sampling data available a standard sound velocity of 1500m/s through the subsurface material was employed.

4.7.5 Magnetometer Data

Magnetometer JSF data was imported into SonarWiz. The position was cleaned and interpolated to eliminate position jumps. Magnetometer data profiles were analyzed for dipole wave forms. The profiles were analyzed in reference to the plan view map showing the cable locations. This analysis allowed the determination of whether the cable could be detected. A test object of known ferrous material was surveyed. This was used to confirm the ability of the sensor to detect ferrous objects. In addition the lines confirmed layback calculations and allowed the calibration of the system to determine correct Tesla ranges that could be observed over a cable.

5 RESULTS

5.1 Multibeam

100% multibeam coverage with 20% overlap was achieved through the entire survey area. Multibeam data was collected over the 500m wide corridor centered about the HKA Cable RPL to the BMH Hermosa landing site. Depths ranged from approximately 1m LAT on the landward end (KP 1066.60000) to 99m LAT on the seaward extents (KP 1060.20000) of the survey area. Additional coverage was run at the deeper end of the corridor near the elbow. The purpose was to provide possible alternative routes due to observed gas seeps near the elbow. The additional wing lines expanded the multibeam coverage to approximately 1000 meters in width at the seaward end of the corridor.

The average density was eight (8) soundings per node and a maximum of forty (40) soundings in a grid cell was achieved in parts of the survey area. Spurious soundings were identified where two soundings from different passes were not in agreement. All position data was successfully collected and applied in processing. Data was successfully aligned to the LAT vertical datum using a continuous tide file and offset to LAT. MBES depth coverage through the entire survey corridor is displayed in the image below in Figure 16.

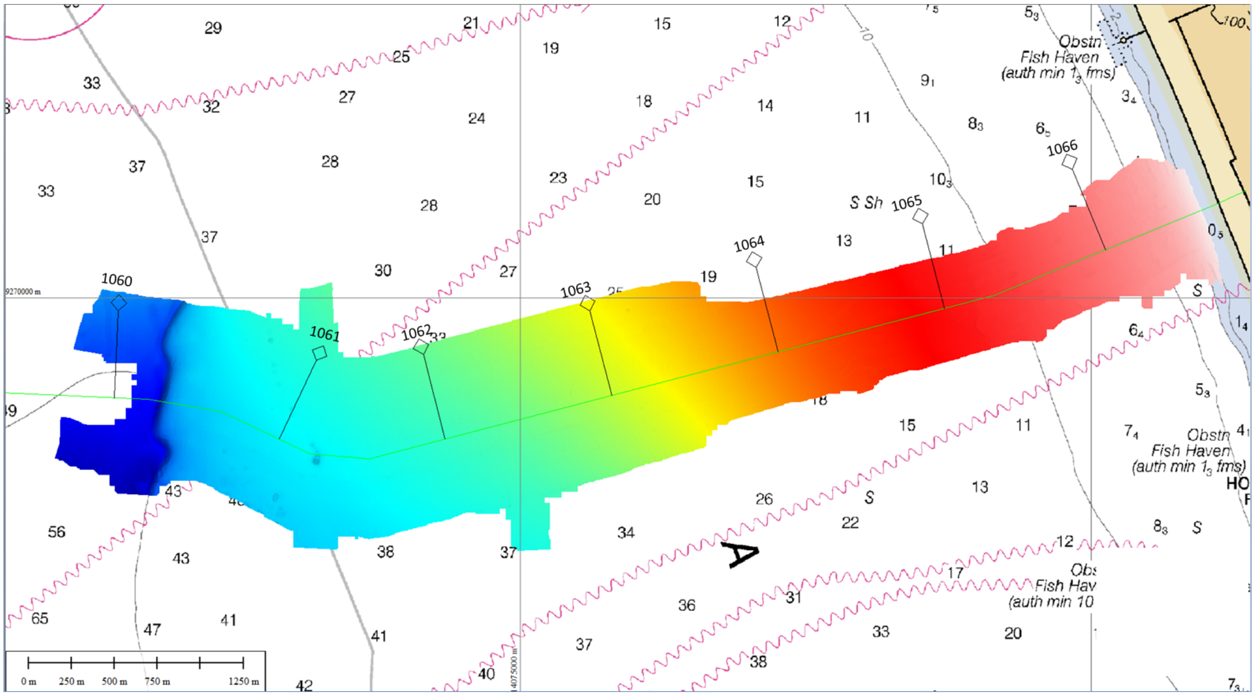


Figure 16: Multibeam Coverage

5.2 Sediment Samples

All twelve (12) sediment samples were successful and sufficient material was collect in each to allow analysis. The completed bottom sample locations are displayed in the image below.

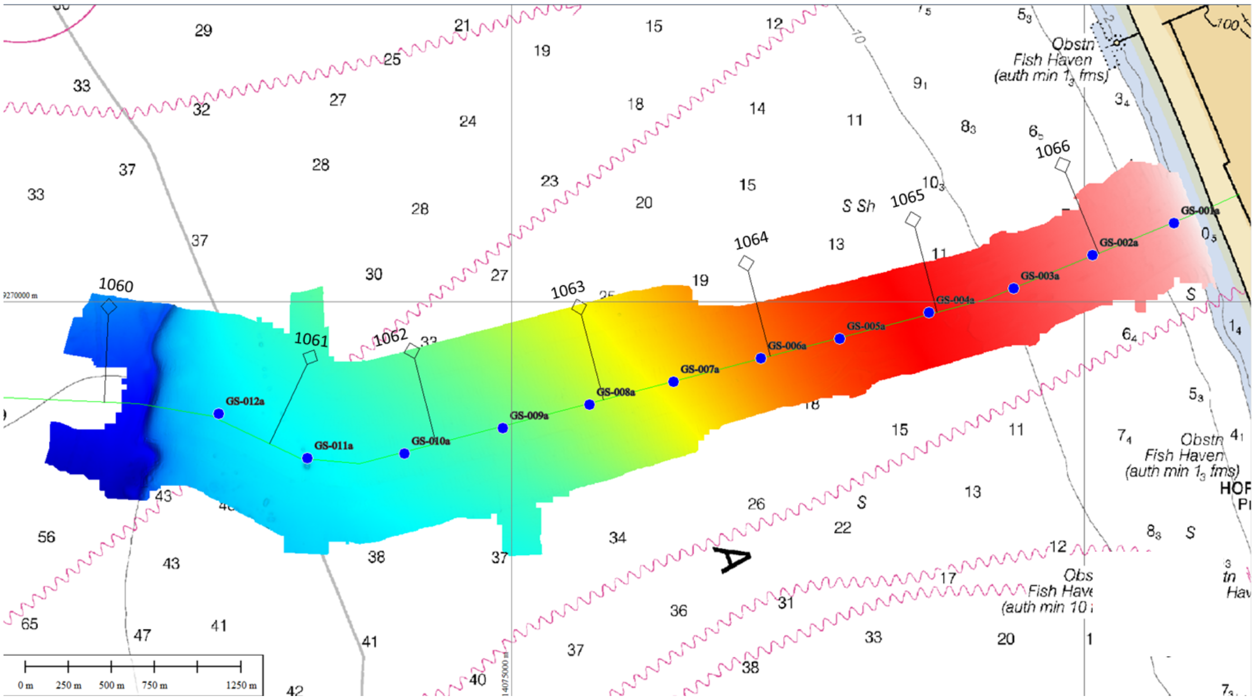
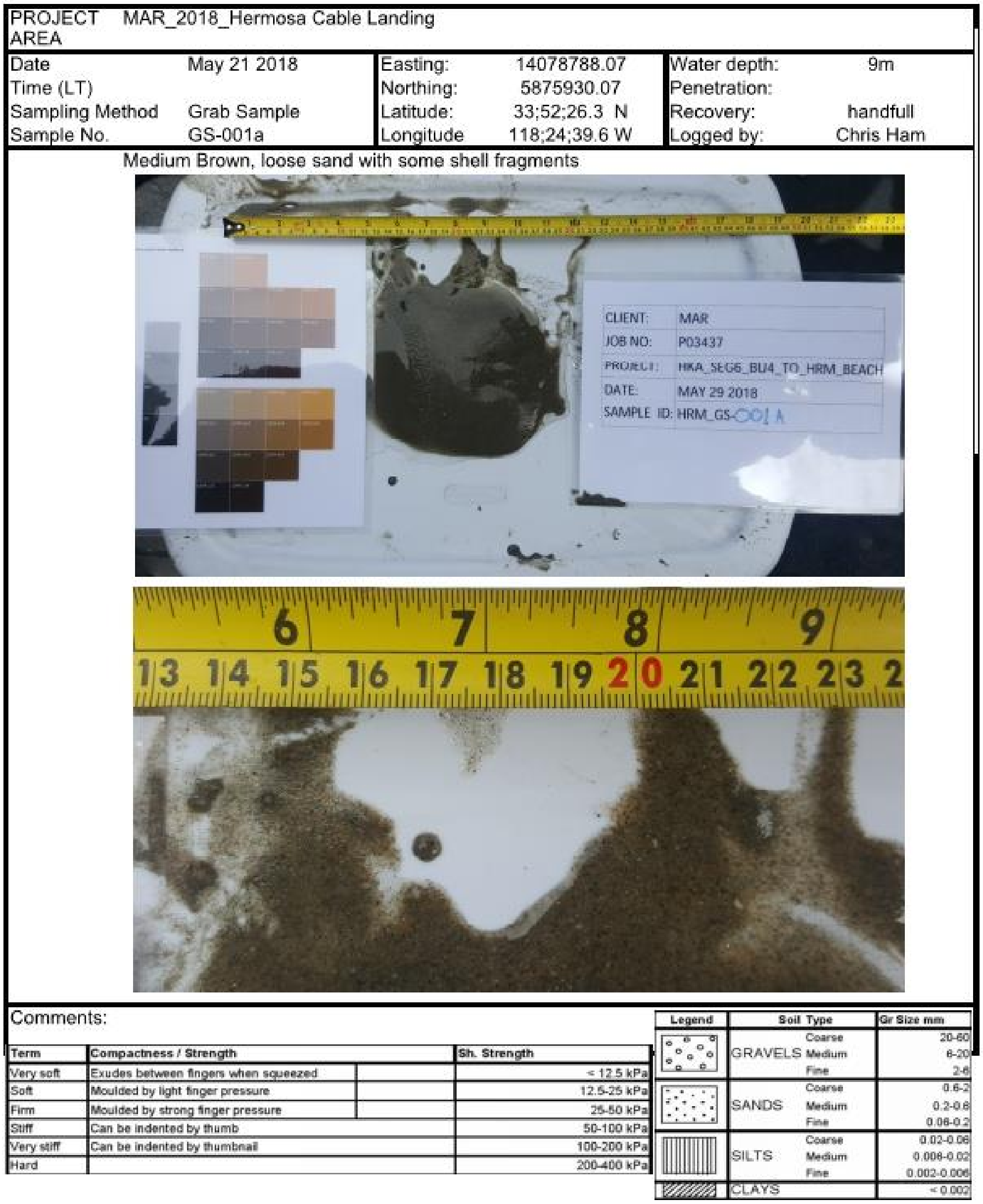


Figure 17: Sediment Grab Sample Locations

Analysis was completed in the field with both color and grain size able to be determined.

An example of a logged sample can be found below in Figure 18.



PROJECT AREA	MAR_2018_Hermosa Cable Landing

Date	May 21 2018	Easting:	14078788.07	Water depth:	9m
Time (LT)		Northing:	5875930.07	Penetration:	
Sampling Method	Grab Sample	Latitude:	33;52;26.3 N	Recovery:	handfull
Sample No.	GS-001a	Longitude	118;24;39.6 W	Logged by:	Chris Ham

Medium Brown, loose sand with some shell fragments

CLIENT:	MAR
JOB NO:	P03437
PROJECT:	HKA_SEG6_BU4_TO_HRM_BEACH
DATE:	MAY 29 2018
SAMPLE ID:	HRM_GS-001 A

Comments:

Term	Compactness / Strength	Sh. Strength
Very soft	Exudes between fingers when squeezed	< 12.5 kPa
Soft	Moulded by light finger pressure	12.5-25 kPa
Firm	Moulded by strong finger pressure	25-50 kPa
Stiff	Can be indented by thumb	50-100 kPa
Very stiff	Can be indented by thumbnail	100-200 kPa
Hard		200-400 kPa

Legend	Soil Type		Gr Size mm
⁘	GRAVELS	Coarse	20-60
		Medium	6-20
		Fine	2-6
⁚	SANDS	Coarse	0.6-2
		Medium	0.2-0.6
		Fine	0.06-0.2
▥	SILTS	Coarse	0.02-0.06
		Medium	0.006-0.02
		Fine	0.002-0.006
▨	CLAYS		< 0.002

Figure 18 Example of a logged soil sample in the site

The table below (Table 2) shows the results of the sediment sample recovery.

Table 2: Sediment Sample Recovery

Sediment Sample Recovery				
		Fugro Custom Projection		
ID	Sediment Sample Recovery	Easting	Northing	KP
1	loose sand with shells	14078788.07	9270445.02	1066.47358
2	clayey sand with shells	14078320.46	9270262.62	1065.97109
3	clayey sand with shells	14077871.72	9270074.14	1065.48376
4	coarse sand with shells	14077385.05	9269934.31	1064.97572
5	coarse sand with shells	14076877.60	9269788.39	1064.44719
6	sandy silt/clay	14076426.52	9269675.91	1063.98173
7	sandy silt/clay	14075925.52	9269542.16	1063.46253
8	sandy silt/clay	14075445.45	9269411.46	1062.96438
9	sandy silt/clay	14074952.48	9269274.67	1062.45219
10	sandy silt/clay	14074385.60	9269131.80	1061.86686
11	sandy silt/clay	14073831.77	9269104.45	1061.30522
12	sandy silt/clay	14073326.99	9269356.74	1060.73715

Surface classification was determined through Sidescan Sonar and sediment sample analysis. Sediment samples were used to ground truth data. An ASN client specific simplified classification scheme was used for analysis and charting. This grouped all sand types in to a Sand classification and all silt/clay types into Silt/Clay.

5.3 Sidescan Sonar

100% sidescan sonar coverage with 20% overlap was achieved through the entire survey area. Sidescan data was run simultaneously with MBES. Sidescan data was collected over the 500m wide corridor centered about the HKA Cable RPL to the BMH Hermosa landing site. Depths ranged from approximately 1m LAT on the landward end to 99m LAT on the seaward extents of the survey area. Additional coverage was run at the deeper end of the corridor near the elbow. The purpose was to provide possible alternative routes due to observed gas seeps near the elbow. The additional wing lines expanded the SSS coverage to approximately 1000 meters in width at the seaward end of the corridor.
As described in the Mobilization report, lines were run for layback calibration. The layback calculation was performed using the position of the towpoint sheave as the starting point. Layback of the tow fish was computed in SonarWiz software (caternary and cable incl.) using both physical measurements from the cable (alternating 2 and 3 meter markings) as well as an electronic hall effect sensor-based cable

counter on a dedicated sheave. Electronic cable payout information was input in real-time via serial data to the acquisition computer and applied in the SonarWiz software. Layback calibration allowed for the position of the sidescan sonar to be accurate and consistent throughout the entire survey. All data was successfully QCed against the multibeam data.

The data density and coverage of sidescan sonar data allowed for the creation of a continues mosaic. Objects as small as 1x1x1m were able to be detected in the sidescan data.   A sidescan sonar mosaic across the entire survey area is shown below in Figure 19.

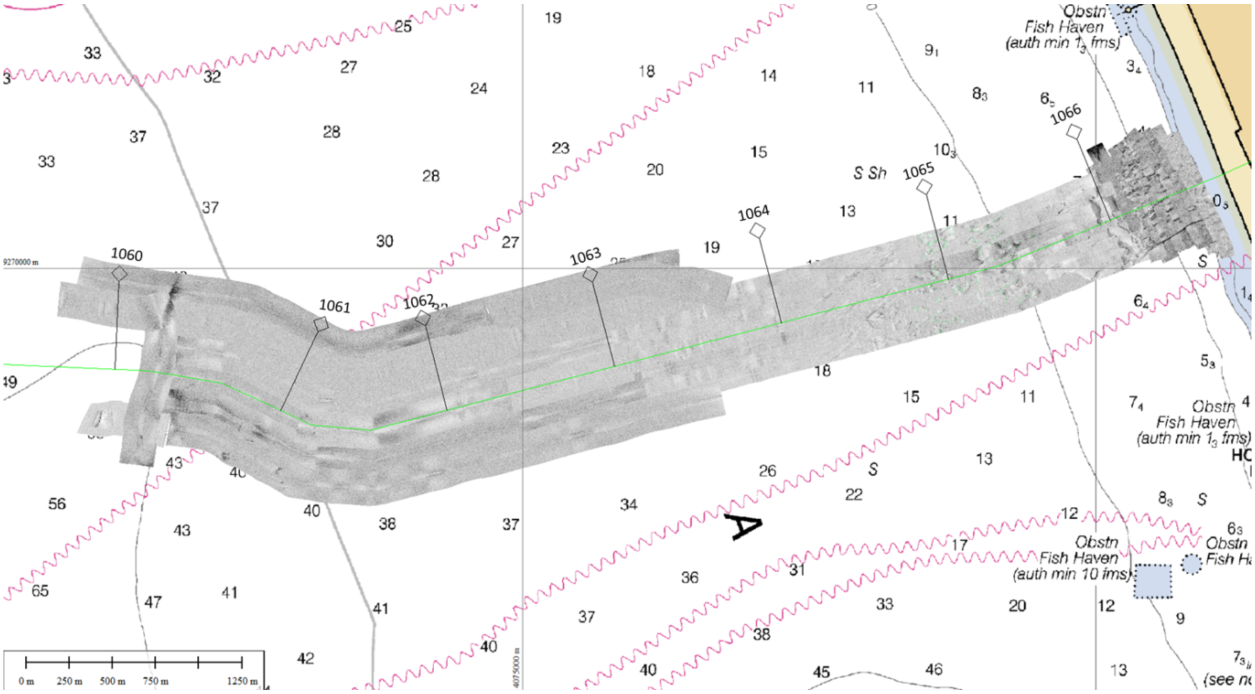


Figure 19 Sidescan data within the Hermosa survey area

5.4 Sub-bottom

100% of planned survey lines were run. Twenty-two (22) sub-bottom lines were acquired along 18 planned lines. The lines covered the entire survey area. 80m spaced lines were run parallel to the Route Plan Line, with two (2) 100m spaced lines and Six (6) cross lines at equal spacing where run perpendicular to the RPL. The sub-bottom line coverage is shown below in Figure 20 with the survey area displayed as a white polygon and the bathymetry grid in background.

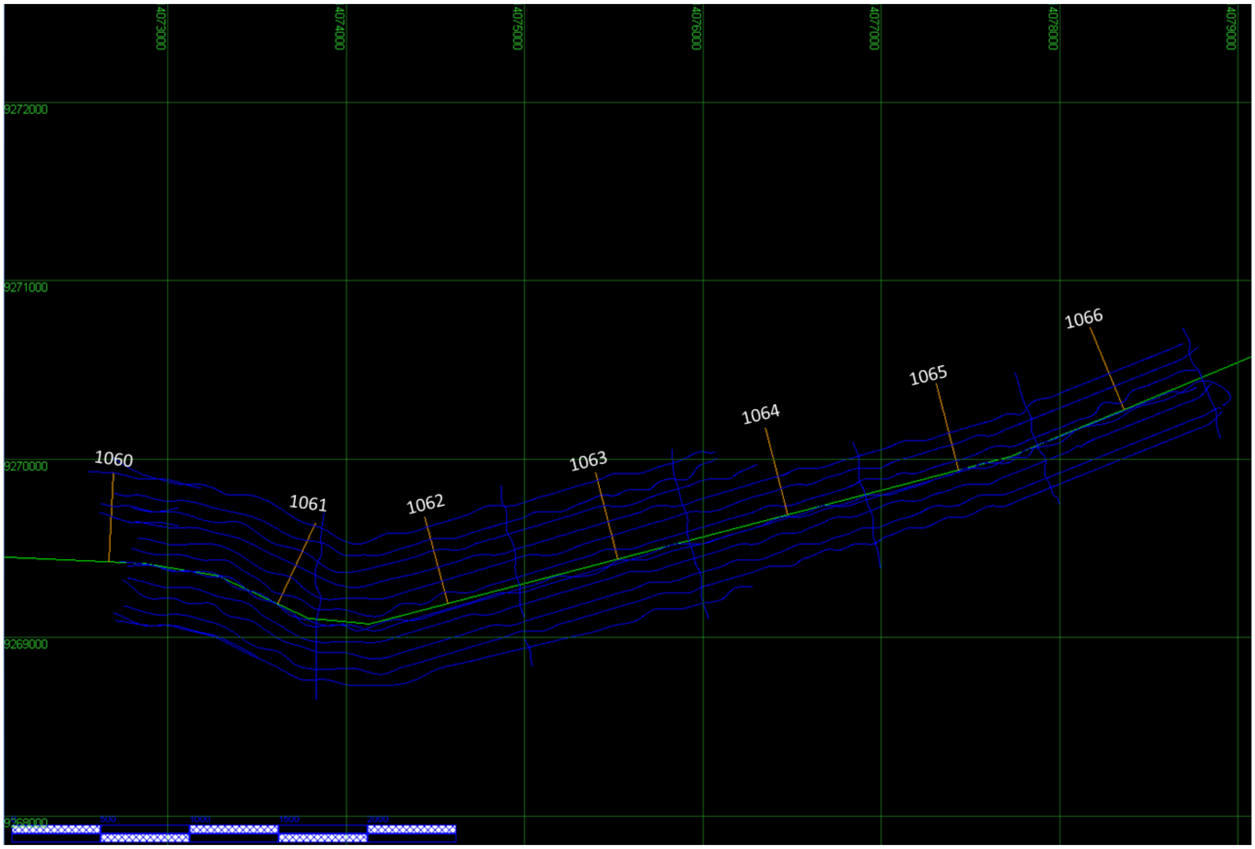


Figure 20: Sub-Bottom Acquired Lines

As described in the mobilization report, the sub-bottom profiler was towed using a fixed layback in the Discover software from the same tow point used for the sidescan sonar operations. The data was of good quality with no data gaps. Data was correctly aligned to datum successfully using the bathymetry grid from the multibeam data to reduce the data to absolute depth below LAT. Layback processing accurately positioned the fish and thus, the data. Surface detection data was cross checked against the multibeam data (see mobilization report for details).

The CHIRP frequency of 2-15 kHz, with a maximum ping rate of 10Hz of the system allowed for shallow subsurface stratification. The sample range for the system was adjusted along the planned lines to account for the differing seabed depths. At the request of the Fugro COR, the range for the system was set to at least 60m below the detected seabed. Full resolution penetration of up to 25m below the seabed was achieved (some penetration beyond could have been interpreted beyond any bottom multiple but was considered out of the required depth of interest for this project. Stratification layers were evident and sediment facies were identifiable across the data. The cross line data corroborated with the along track profiles both in terms of position and identified subsea strata. Nine (9) types of subsurface facies were identified across the survey area. These were able to be digitized consistently across adjacent lines. Several subsurface isolated features were identified in the data. The signal return from the features did not produce a parabola analogous with the detection of subsurface hard objects, but a clear change in amplitude of return was noted at these points.

Figure 21 below shows an example of subsurface sediment facies identified in Chirp sub-bottom data.

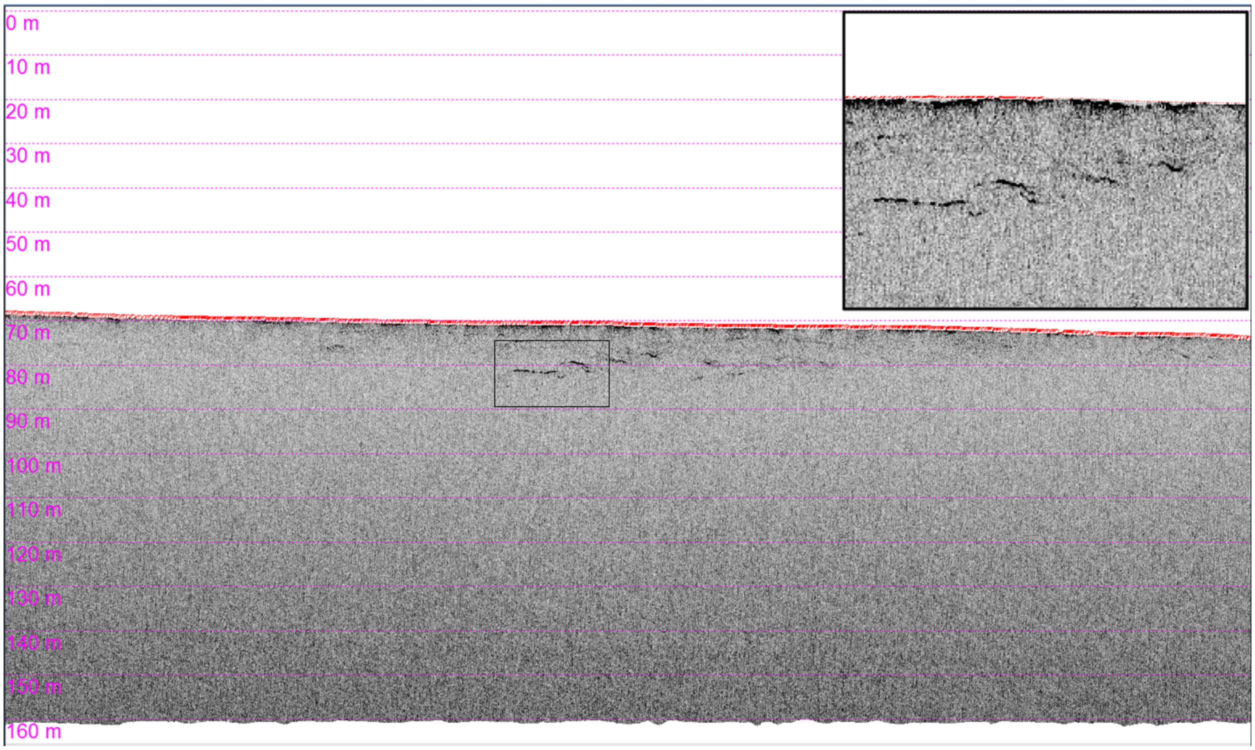


Figure 21: Subsurface Sediment Facies in Sub-bottom Data

Figure 22 below shows an isolated feature in the Chirp Sub-bottom data.

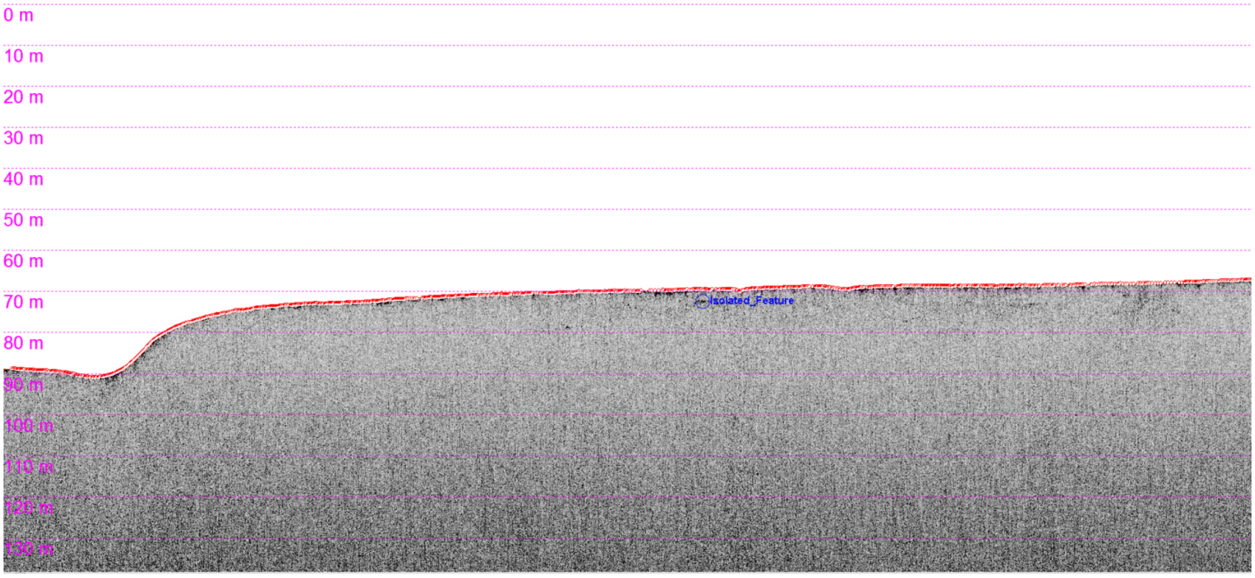


Figure 22: Isolated Feature Found in Sub-bottom Data

5.5 Magnetometer

100% of planned survey lines were run. Twelve (12) magnetometer lines were run to complete detection of the cable including four (4) test lines at a steel buoy and two (2) lines over charted cabled outside of the assigned cable crossing.
As described in the mobilization report, layback of the magnetometer was computed as an offset of 9 meters from the sidescan position computed in the SonarWiz software. The measured offset and layback calibration of the SSS allowed the position of the gradiometer system to be accurate and consistent throughout the entire survey.

Figure 23 below shows the magnetometer lines completed in the survey area.

No ferrous returns were found in the survey area. The Magnetometer was unable to detect the cable at the cable crossing. Ferrous returns were found during the test lines at the steel buoy and during the lines over charted cables outside of the cable crossing.

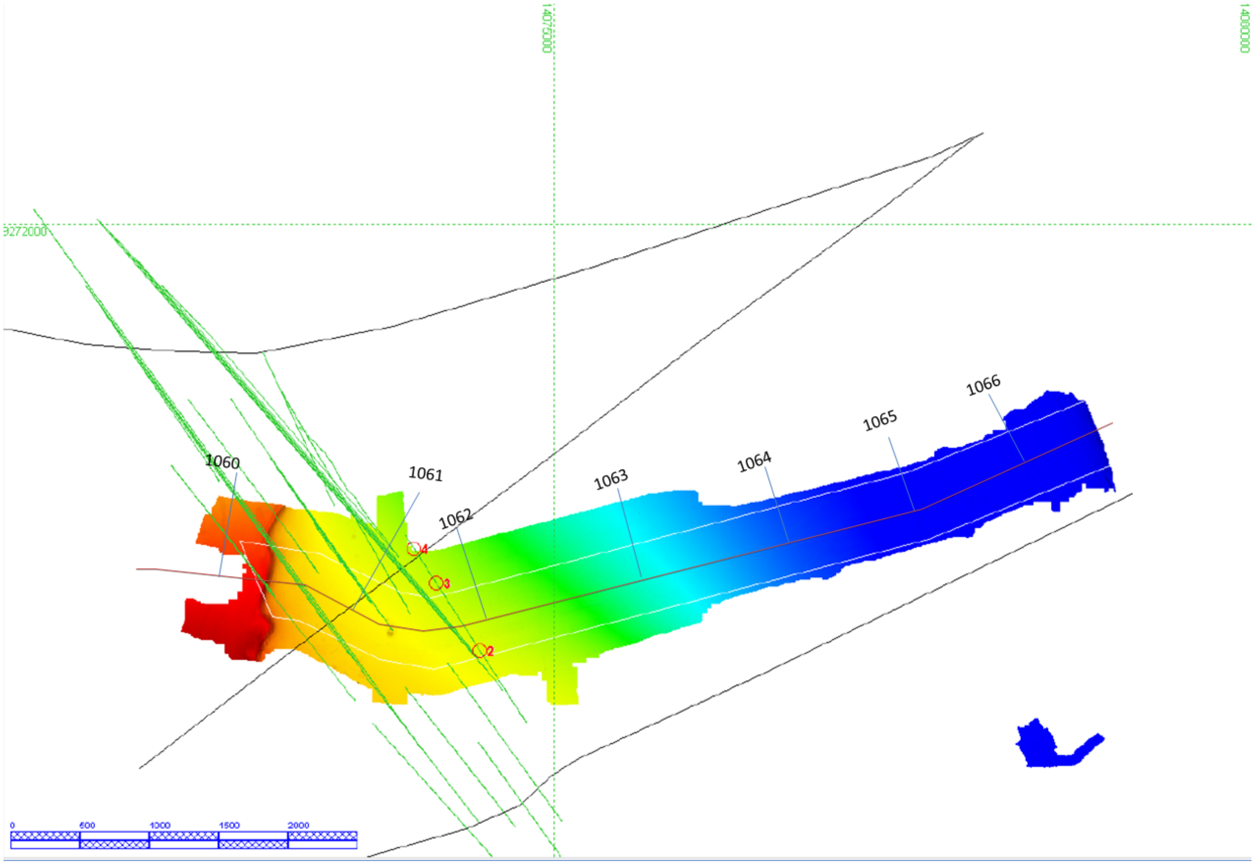
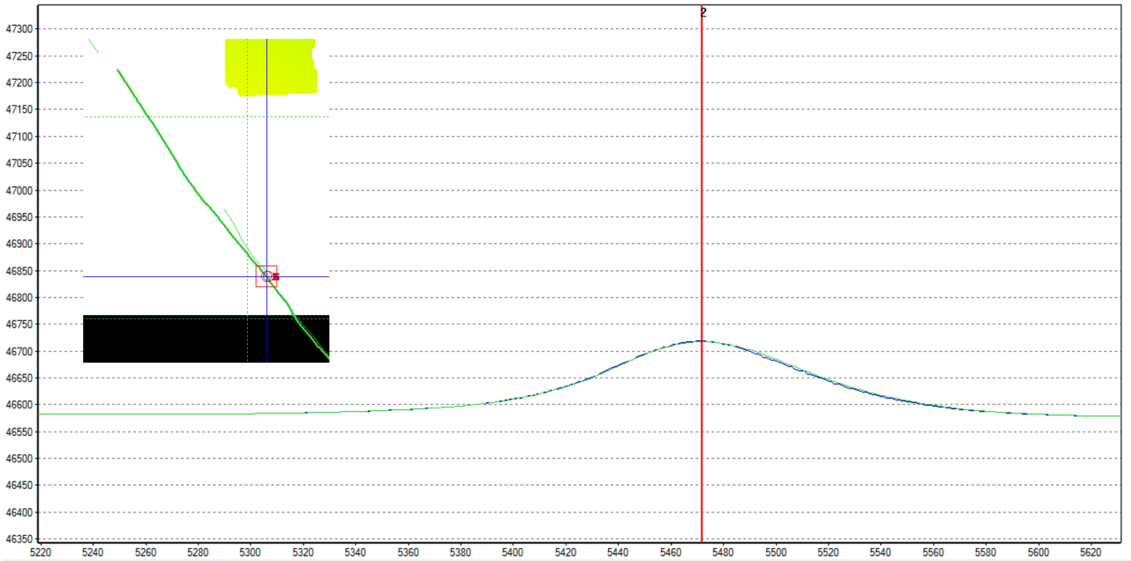


Figure 23: Magnetometer Lines Run

The positioning and detection of the ferrous object was accurate and consistent. Two object were detected in the same position on two passes. The detection of the test object along one magnetometer line is shown below in Figure 24.



[redacted]

Figure 24: Magnetometer Profile over a Test Object Showing Detection

Data across the cables showed no obvious return aside from the ambient magnetism of the survey area. The point in the profile, the magnetometer crosses a charted cable route is shown below in Figure 25.

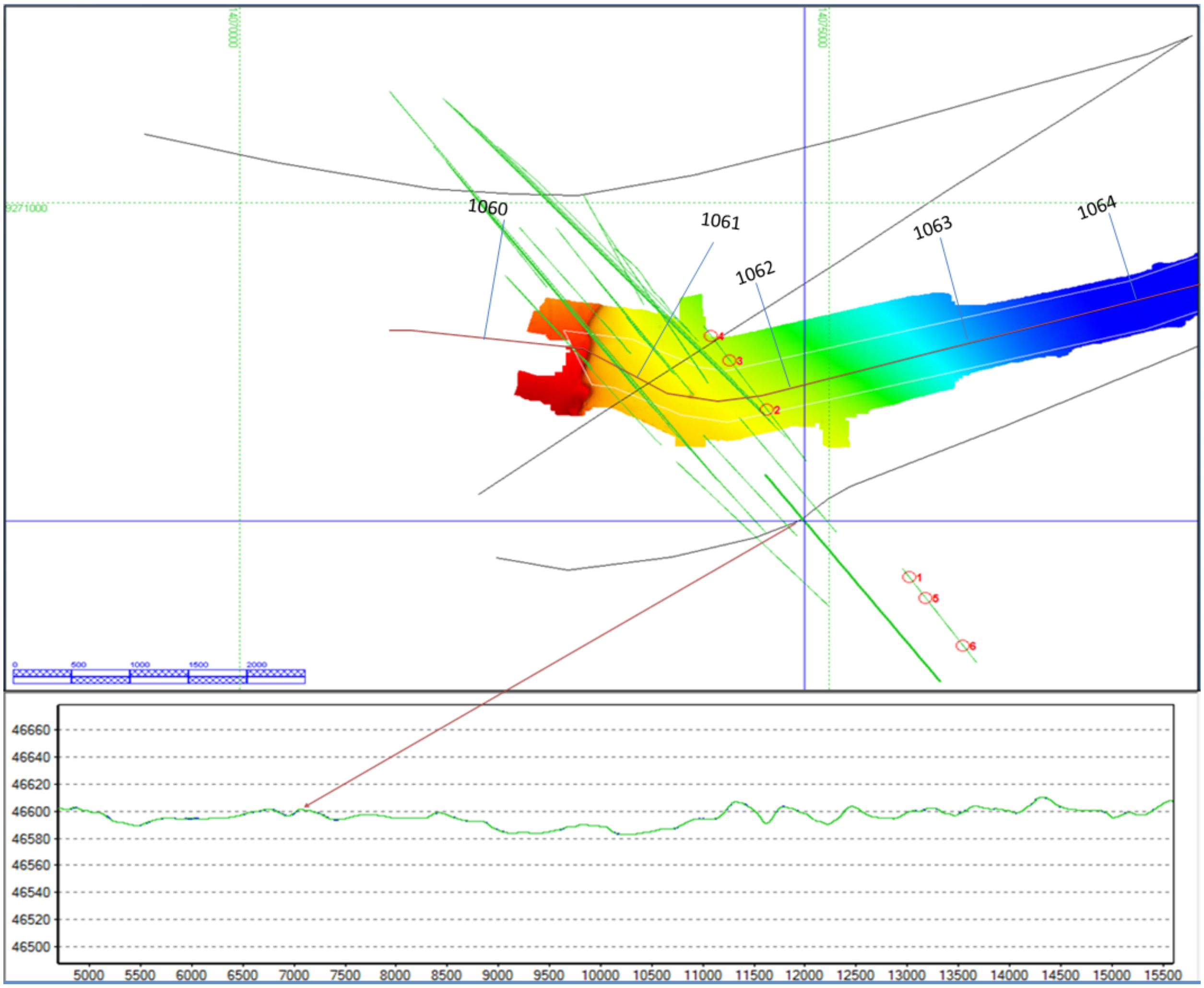


Figure 25: Profile of Magnetometer Data over the Charted Cable Route with no Return

5.6 Overview

Surface objects and debris larger 1m x 1m in size were detected. Subsurface stratification and sediment facies were identified and located. Each sediment layer was classified and differentiated for each other. Sediment classification was also determined by sediment grab samples acquired every 500m along the center alignment of the survey area. Subsurface isolated features were identified in the sub-bottom sonar data. There was no ferrous return detected in the magnetometer data at the charted cable crossing.

6 ANALYSIS

This section will describe the As Surveyed positions of surface and subsurface objects and the classification of sediment layers and areas and. Surface and subsurface objects were categorized based on object type. The location of each feature in the analysis sections below are referenced to Kilometer point (KP) and Distance Cross Course (DCC) based on the RPL from the client file "S6_RPL_5K.dwg".

6.1 Bathymetry

The bathymetry in the area ranges from 0m below LAT at shore to a maximum depth of 98m offshore. The bathymetry undulates downward from shore to offshore. The slope is an average of 0.8° and consistently between 0.5 and 1° aside from between KP1066.50 to 1060.50 with only a slight change between KP1064.00 and KP1063.00 where the slope flattens slightly from KP1064.00 to 1064.40 to less than 0.5° and becomes steeper to 1.5° between KP1064.40 to1063.00 before returning to the consistent shallow slopes at 1063.00 towards offshore. An overview of the bathymetry is shown below in Figure 26.

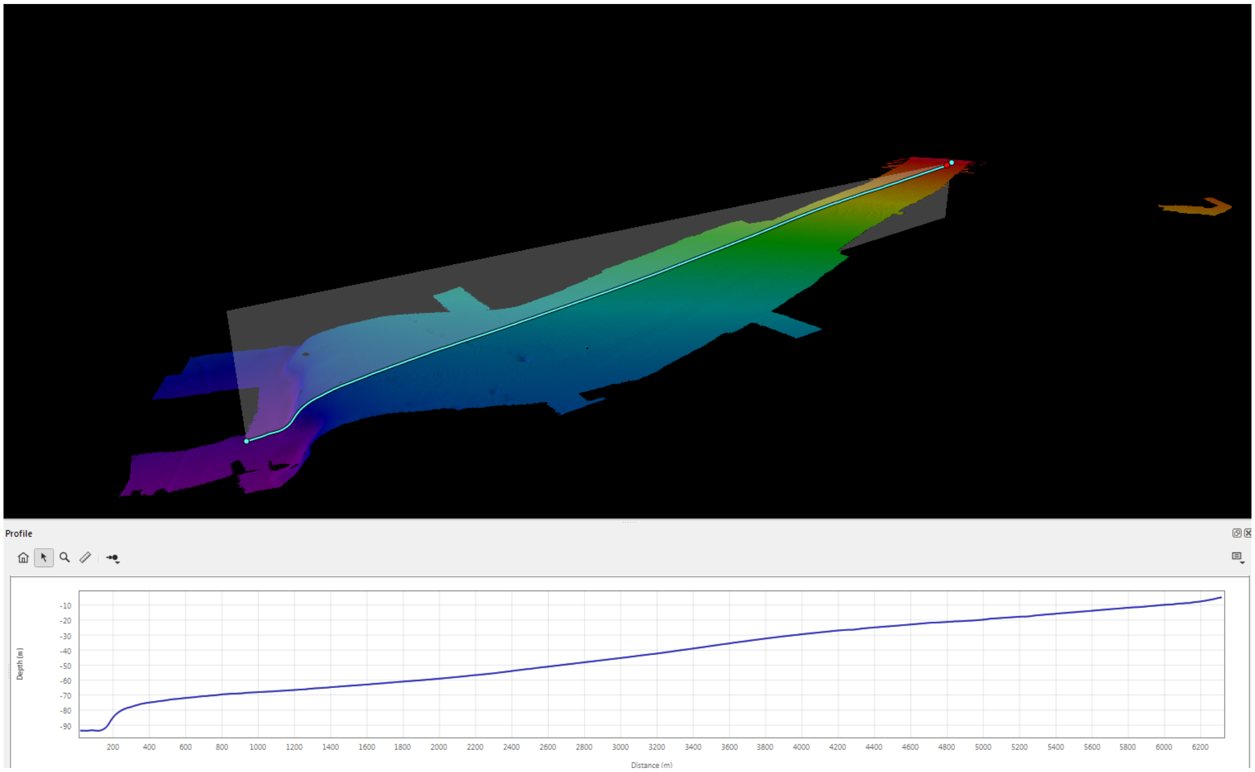


Figure 26 Overview of the bathymetry across the survey area with profile (vertical exaggeration x 6)

At KP 1060.3 a large shelf was observed at the western end of the survey area (see Figure 27 below). The toe of slope appears to intersect the RPL alignment around 33°51’53.30”N, 118°28’31.14”W (14072916.58E 9269441.854N ; KP 1060.32424). Depths drop from approximately 78m down to approximately 92m over a 100m range (approximately 14% grade slope).

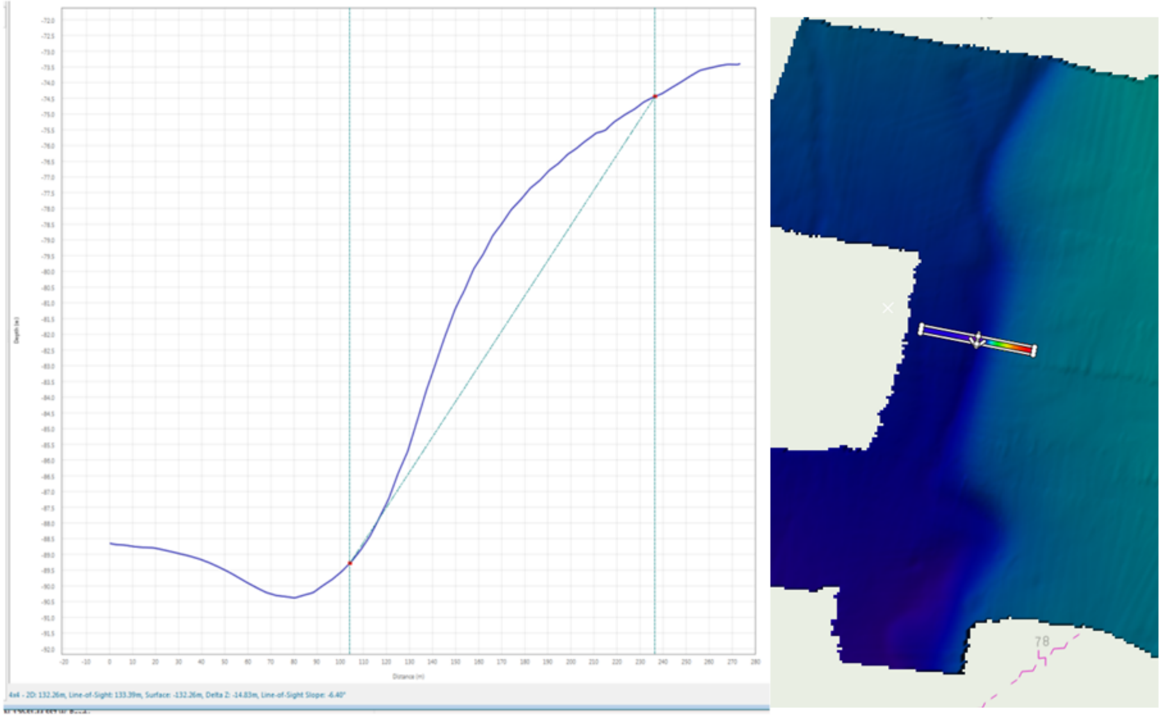


Figure 27: Shelf Observed in MBES Data

5.1 Surface Classification

This section details the classification of the surface sediment. Two types of sediment classification were used for analysis. The more details Fugro classification and the simplified ASN classification. Shore line is composed of loose sand and contains sand waves that parallel the shore caused by shore action. These types of sand waves seem to dissipate when a depth of approximately 5m is reached (KP 1066.50000). The bottom makeup remains loose sand. Long narrow areas of sand waves are observed running from shore. These run to approximately 11m (KP 1066.15700) and are between the shoreline and the GS-002a sediment sample location (KP1065.97109). These long narrow areas of sand waves are within an area of loose sand.
Between the locations of sediment sample GS-001a (KP 1066.47358) and GS-002a (KP 1065.97109), there is a change in bottom type. It is derived that this is sand since there is a hard return and it between an area of loose sand, and clayey sand.

Sediment samples GS-002a (KP 1065.97109) and GS-003a (1065.48376) returned clayey sand. Within this area, there are locations that contain short sand waves of a different texture that what was previously seen (KP 1065.66000 to KP 1065.19000). The clayey sand transitions to unconsolidated gravelly with coarse sand and shell fragments at an approximate depth of 20m (KP 1065.18000). Based on the sidescan imagery, it appears that there are pockets of sandy silt-clay within this region.

At a depth of approximately 22m (KP1064.93800) the gravelly silt transitions to sandy silt/clay. Within the sandy silt/clay area, there are strips of coarse sand ripples that run NE to the SW (KP 1064.93800 to KP 164.13200). Sediment sample GS-005a (1064.44719) was retrieved from one of the coarse sand areas, these ripples be clearly seen in the sidescan data.

At a depth of approximately 32m (KP 164.13200), these coarse sandy strips cease, and a completely homogeneous area of sandy silt/clay begins, and continues west past the edge of the survey area. Sediment samples SG-006a through SG-012a (See

Table 2 for KP) all returned olive green sandy silt/clay. Striation features, boulders, pockmarks, and erosion features were all identified using the multibeam surface.

Surface classification of the eastern, central, and western sections of the survey are shown below in Figure 28, Figure 29 and Figure 30. Sediment sample classification is displayed on top the SSS imagery in Figure 31, Figure 32, and Figure 33 below.

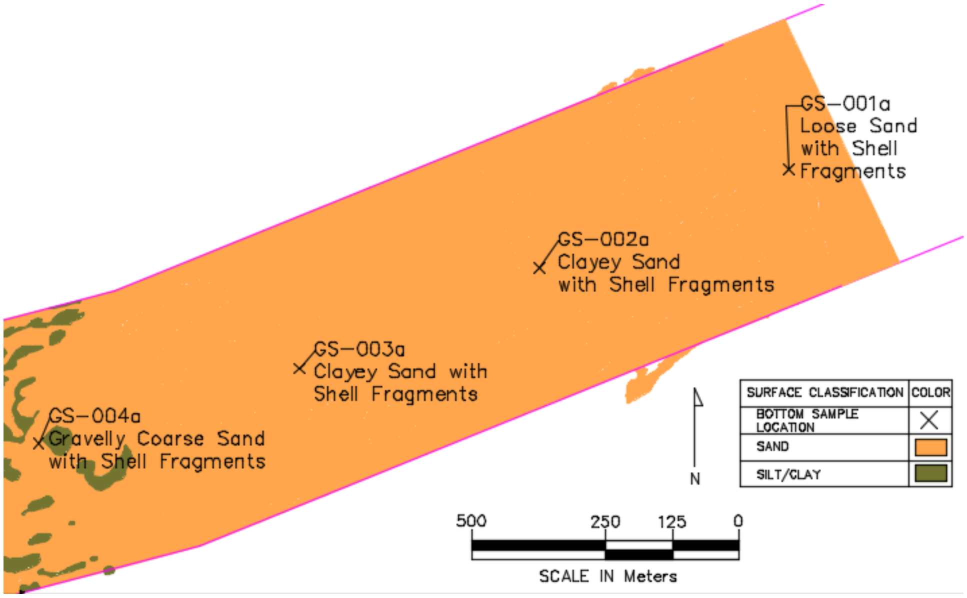


Figure 28: Surface Classification - East Side of Survey Area to Shoreline

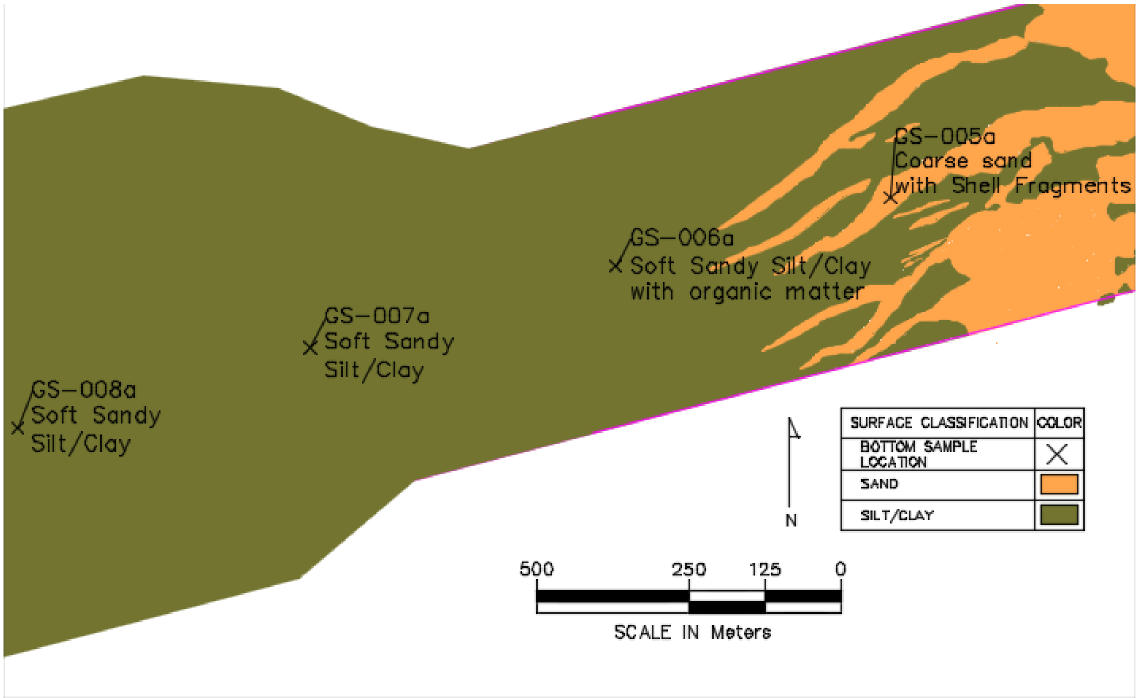


Figure 29: Surface Classification - Central Survey Area

Figure 30: Surface Classification - West Side of Survey Area

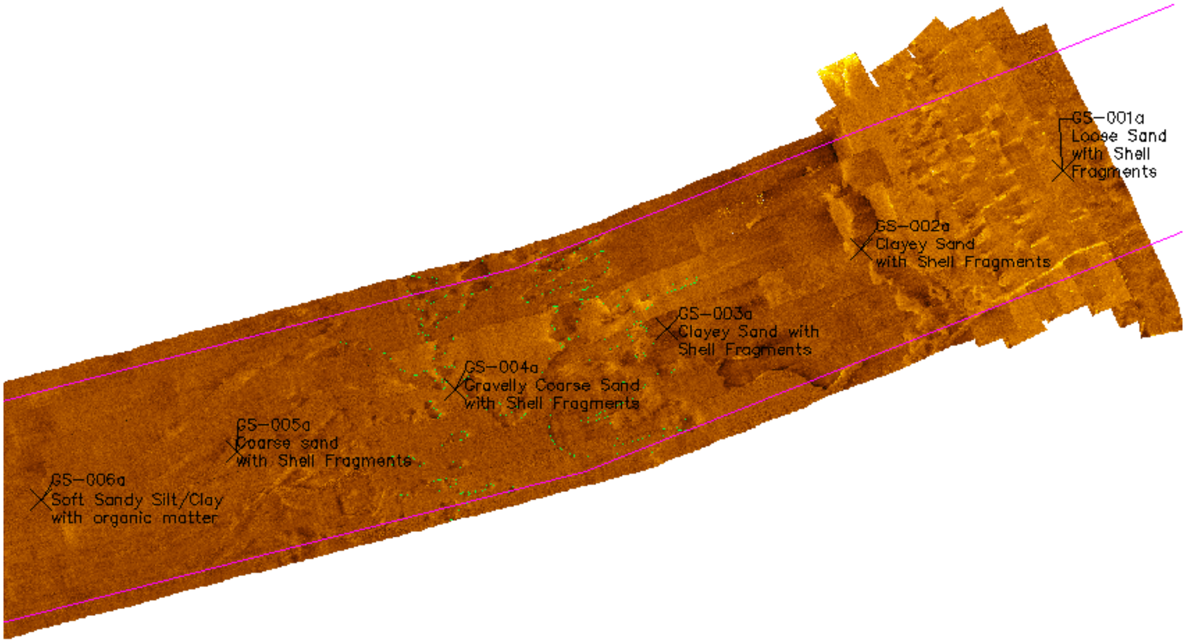


Figure 31: Sediment Sample Classification with SSS Imagery - East Side of Survey Area to Shoreline

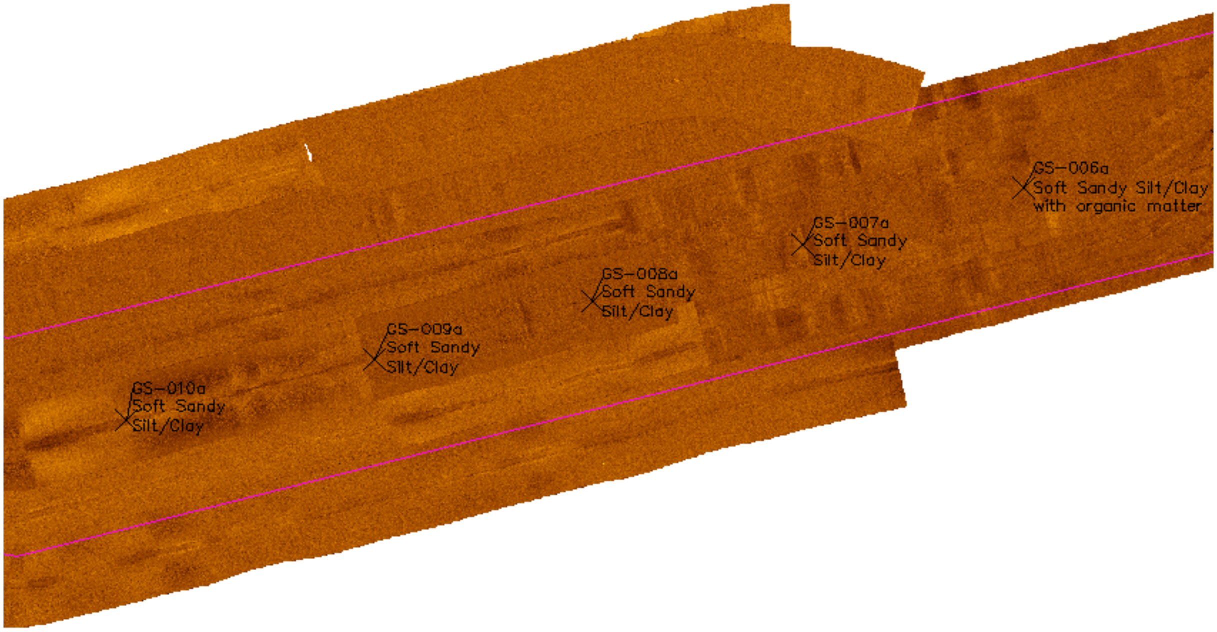


Figure 32: Sediment Sample Classification with SSS Imagery - Central Survey Area

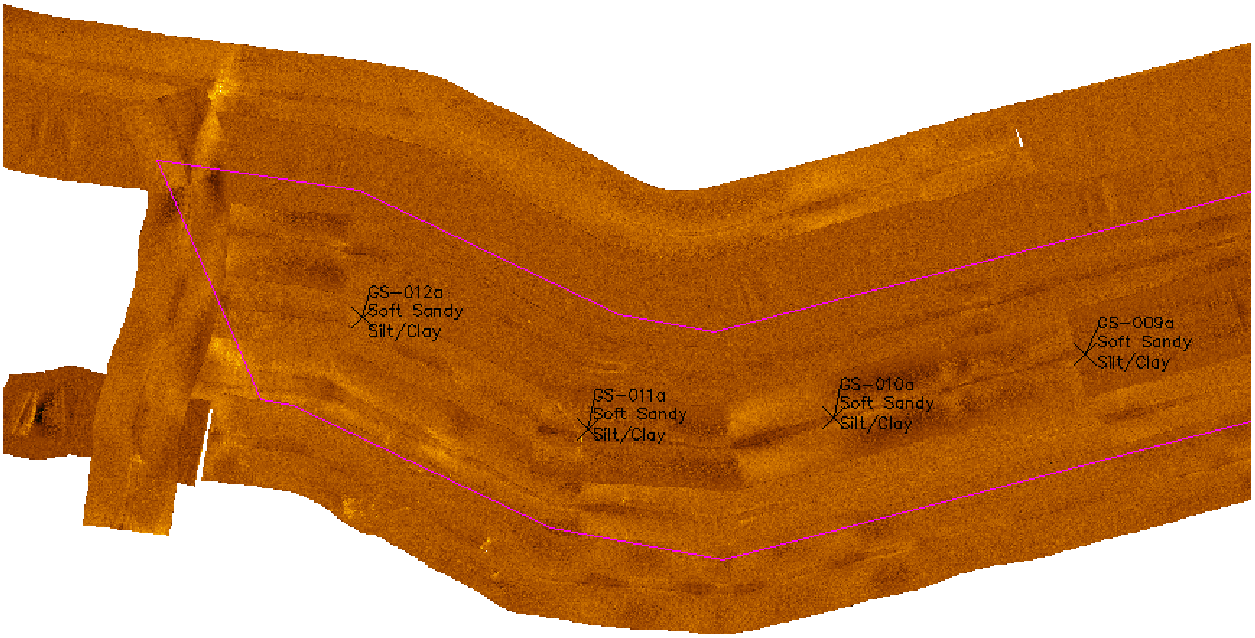


Figure 33: Sediment Sample Classification with SSS Imagery - West Side of Survey Area

5.2 Surface Objects

Using SSS, the survey area was analyzed for surface features larger than 1mx1m1m within the given survey area limits. Thirteen (13) objects with a strong return were found in the survey area. All 13 objects were classified as debris with 1 of the debris objects subcategorized as a cluster of identifiable 20”+ tires (object 012) and another identified as possible exposed pipe (object 007). A detailed list of all objects is below in Table 3.

Table 3: Sidescan Sonar Contacts

Object ID	Coordinates (Easting, Northing)		Coordinates (Latitude, Longitude)		KP	DCC	Max Dimensions LxWxH (meters)	Classification	Description	Line Name
OBJECT-001	14073429.73	9269017.59	33;51.6557066 N	118;28.1817259 W	1060.97481	234.01	4.5x2.9x0.38	Debris	Unknown rectangular object with a strong return	Line 0041_WL
OBJECT-002	14073624.50	9268776.26	33;51.5233789 N	118;28.0537115 W	1061.25406	369.51	10.3x15.1x0.33	Debris	Unknown Objects in a cluster. LxW measured as the cluster and H measured from most prominent shadow	Line 0041_WL
OBJECT-003	14075636.03	9269926.62	33;52.1541210 N	118;26.7316147 W	1063.27937	-442.06	7.34x3.39x1.37	Debris	Unknown Object with a strong return	Line-0045_WL
OBJECT-004	14075499.47	9269949.46	33;52.1666434 N	118;26.8213701 W	1063.15286	-498.67	2.14x0.92x0.73	Debris	Unknown Object with a strong return	Line-0045_WL
OBJECT-005	14076017.45	9269714.89	33;52.0380354 N	118;26.4809229 W	1063.59530	-140.81	1.08x1.48x0.0	Debris	Unknown Object with a strong return	Line-0003
OBJECT-006	14076972.82	9269671.65	33;52.0143278 N	118;25.8529970 W	1064.50989	142.48	1.46x1.64x0.29	Debris	Unknown Object with a strong return	Line-0004
OBJECT-007	14076275.13	9269541.28	33;51.9428479 N	118;26.3115603 W	1063.80100	92.29	12.22x0.81x0.24	Debris	Unknown linear feature more than likely a pipe	Line-0006
OBJECT-008	14075676.11	9269356.26	33;51.8414026 N	118;26.7052717 W	1063.17387	119.91	2.07x1.34x0.39	Debris	Unknown Object with a strong return	Line-0006
OBJECT-009	14077643.65	9269876.55	33;52.1266693 N	118;25.4120878 W	1065.21163	113.78	3.67x0.92x0.55	Debris	Unknown Object with a strong return	Line-0015
OBJECT-010	14078256.94	9270029.72	33;52.2106469 N	118;25.0089972 W	1065.82360	189.78	2.11x1.48x0.41	Debris	Unknown Object with a strong return	Line-0017
OBJECT-011	14077919.19	9270219.48	33;52.3146836 N	118;25.2309865 W	1065.58309	-114.17	3.79x2.49x0.38	Debris	Unknown Object with a strong return	Line-0018
OBJECT-012	14077822.04	9270034.23	33;52.2131196 N	118;25.2948393 W	1065.42256	20.18	3.74x1.50x0.12	Tire Debris	20+ tires in a cluster	Line-0013
OBJECT-013	14073813.17	9268954.02	33;51.6208498 N	118;27.9297064 W	1061.29996	149.22	9.22x4.49x1.36	Debris	Unknown Object with a strong return	Line-0009

Examples of the debris objects found in the sidescan sonar imagery are shown below in Figure 34, Figure 35, and Figure 36.

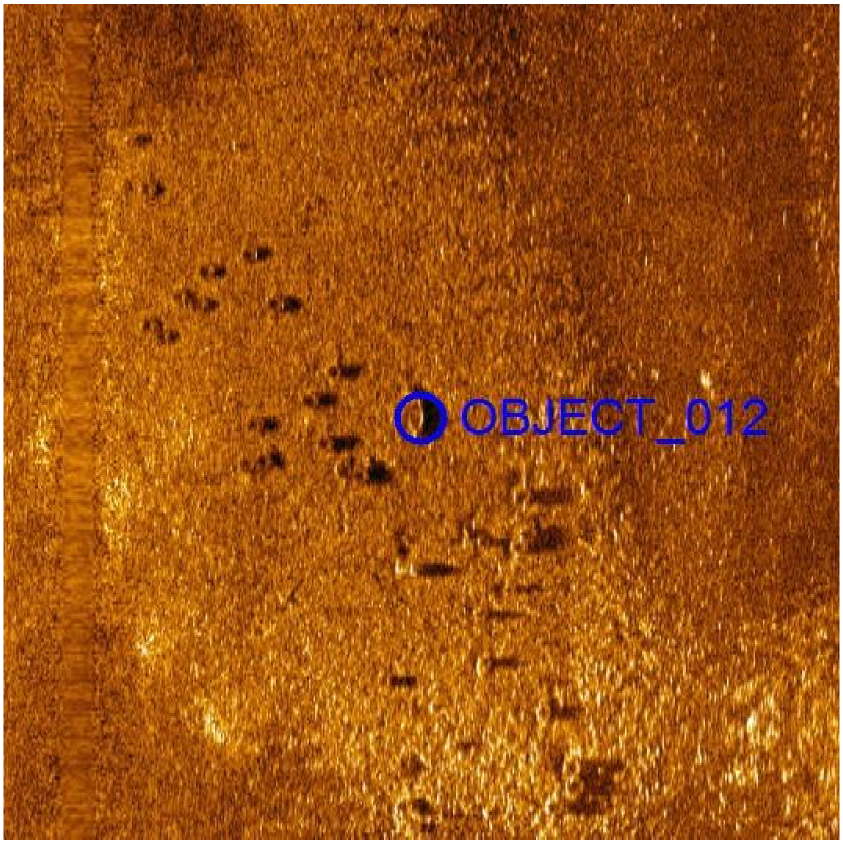


Figure 34: Cluster of Tires Found in SSS Imagery

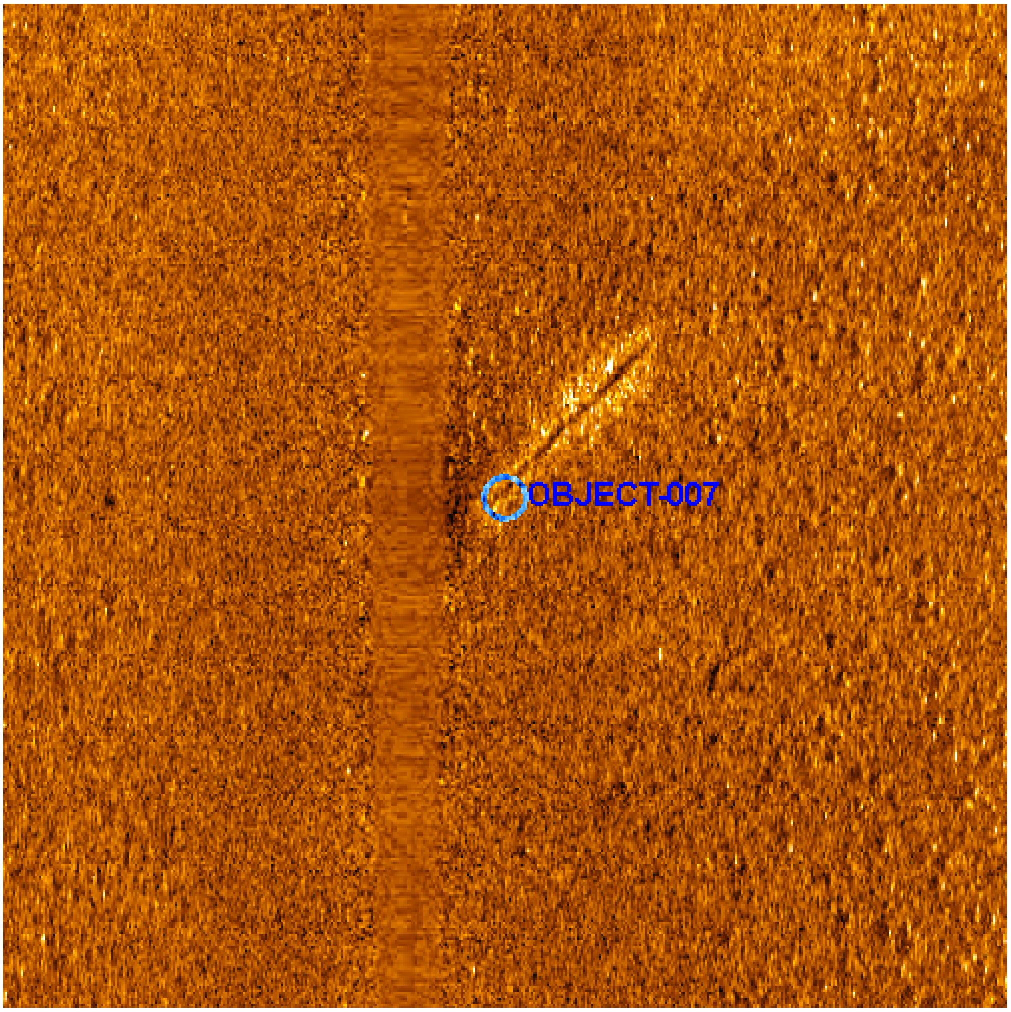


Figure 35: Unknown Linear Feature (possibly a pipe) Found in SSS Imagery

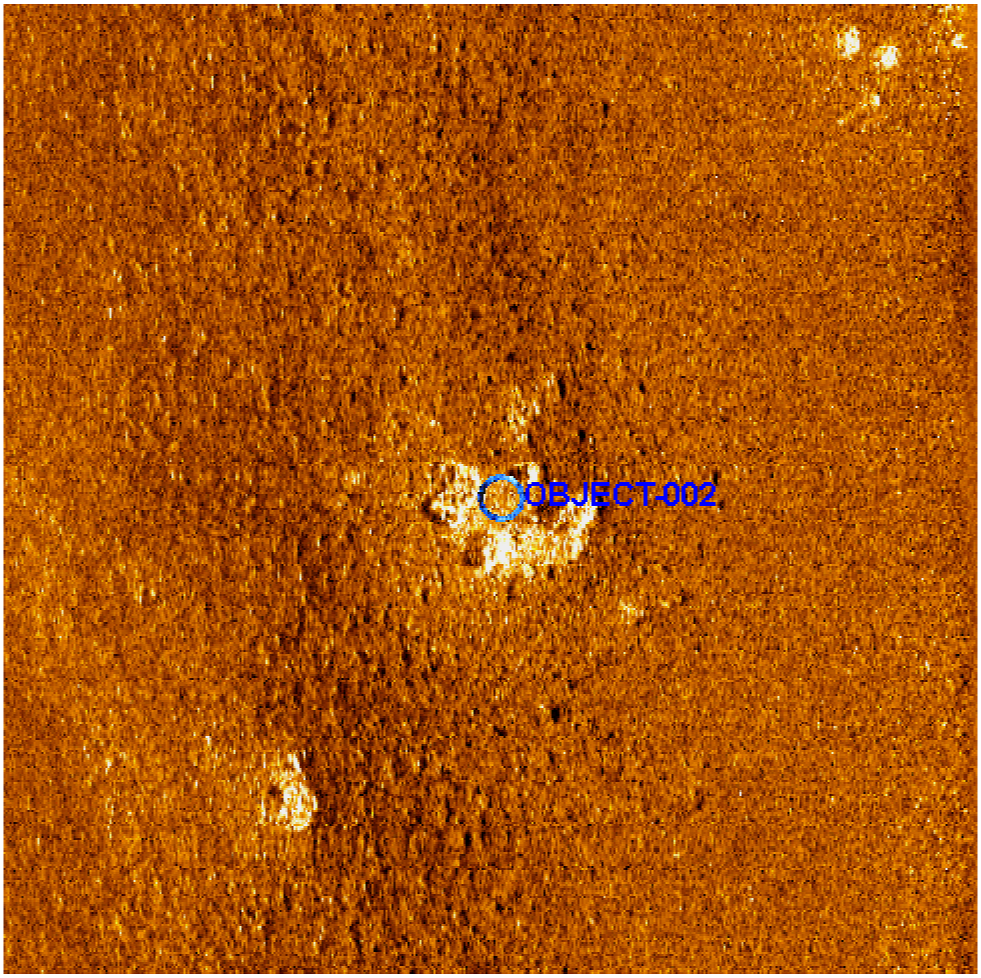


Figure 36: Cluster of Debris with High Intensity Return Found in SSS Imagery

5.3 Surface Geologic Features

Four (4) different classes of geologic features were found within the sidescan sonar data. Firstly, a gas seep with associated pock marks was found during data collection in the field. The seep was clear in the multibeam, sidescan sonar as well as the sub-bottom chirp. Secondly, four different areas of sand ripples were distinguished throughout the survey area. Thirdly, troughs and finally, deposit features were identified at the surface in the survey area. These surface geological features are described below. Figure 37 shows the location of the surface geological features.

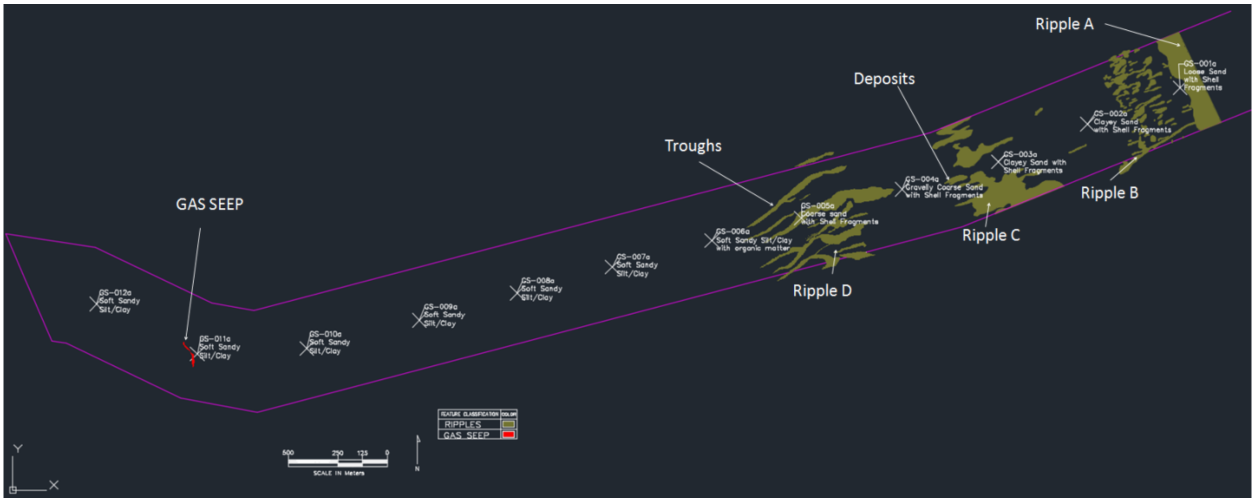


Figure 37: Surface Geological Features across the survey area

The most notable surface features observed in the survey area were gas seeps. The largest of which is located at 33°51’41.03”N 118°27’55.20”W (14073827.94E 9269068.886N ; KP 1061.30454 DCC 33.49). The seep was highly evident in the water column of the sonar interface. Below in Figure 38 is a detailed image of the seep including the rejected data thought to be venting gas.

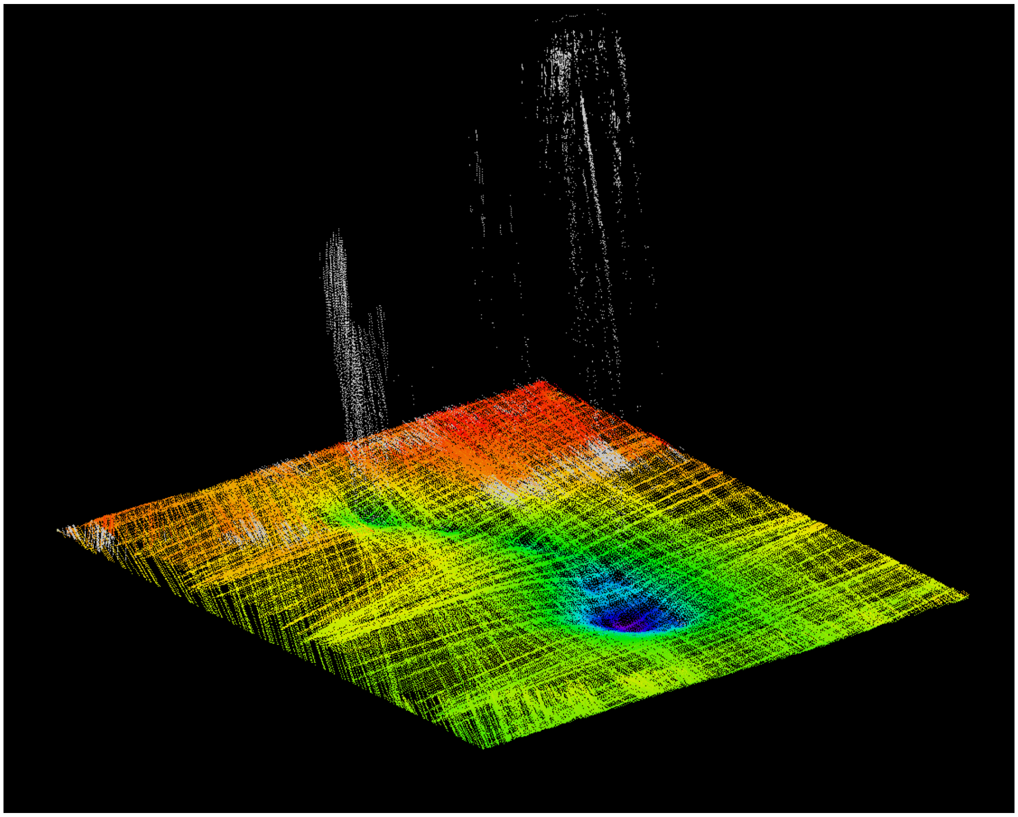


Figure 38: Gas Seep Found in MBES Data

Using the MBES data other depressions in the vicinity of the gas seep were found in line with each other to the northwest, shown below in Figure 39. These depressions look similar to the seep but no noise was observed in the multibeam data which would indicate gas seeping.

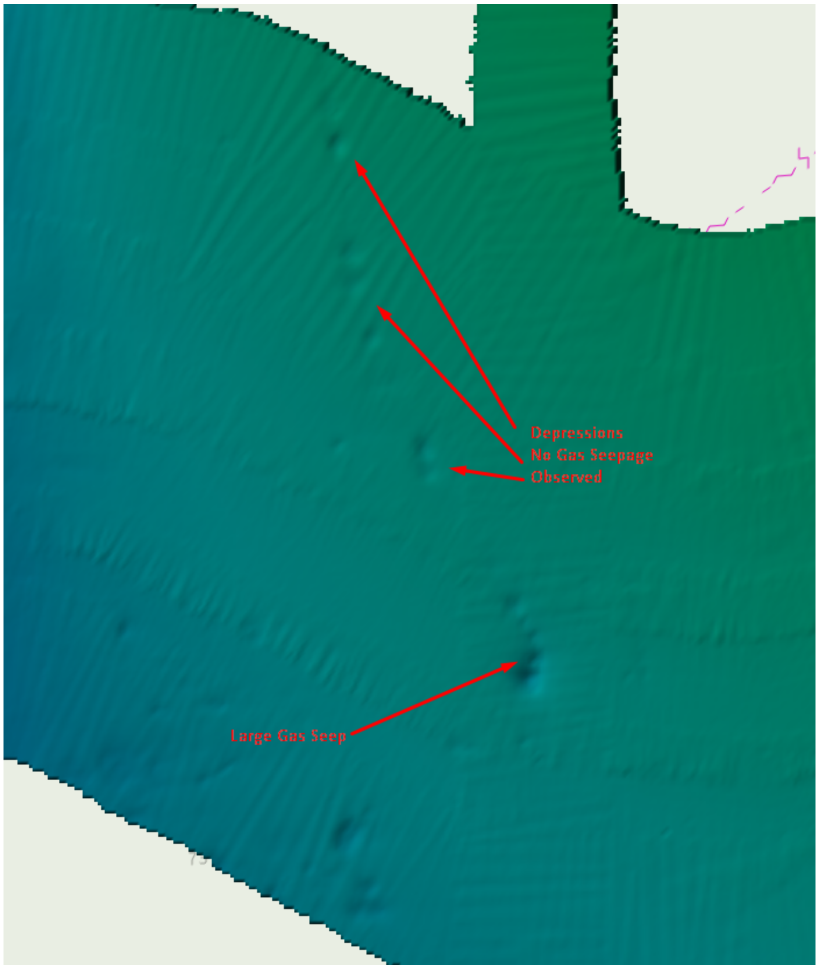


Figure 39: Depressions Found In line with Gas Seep in MBES Data

The seep is visible in the sidescan data and was detected in each pass that covered the area of the seep. The seafloor has been categorized as soft sandy silt-clay and is located offshore at a depth of 71m. Pockmarks were observed in the multibeam data but were not as evident in the sidescan sonar imagery. With pockmarks and the conjunction of the known gas seep, it is noted that the area is hydraulically active and could have buried gas pockets. Pockmarks and gas seeps are common in “soft” areas of seabed which agrees with the sediment classification in this area, categorized as soft sandy silt clay. The seep itself has a high intensity return and the seepage is evident in the water column. The seep is visible in the images below where the water column has not bottom tracked out of the data.

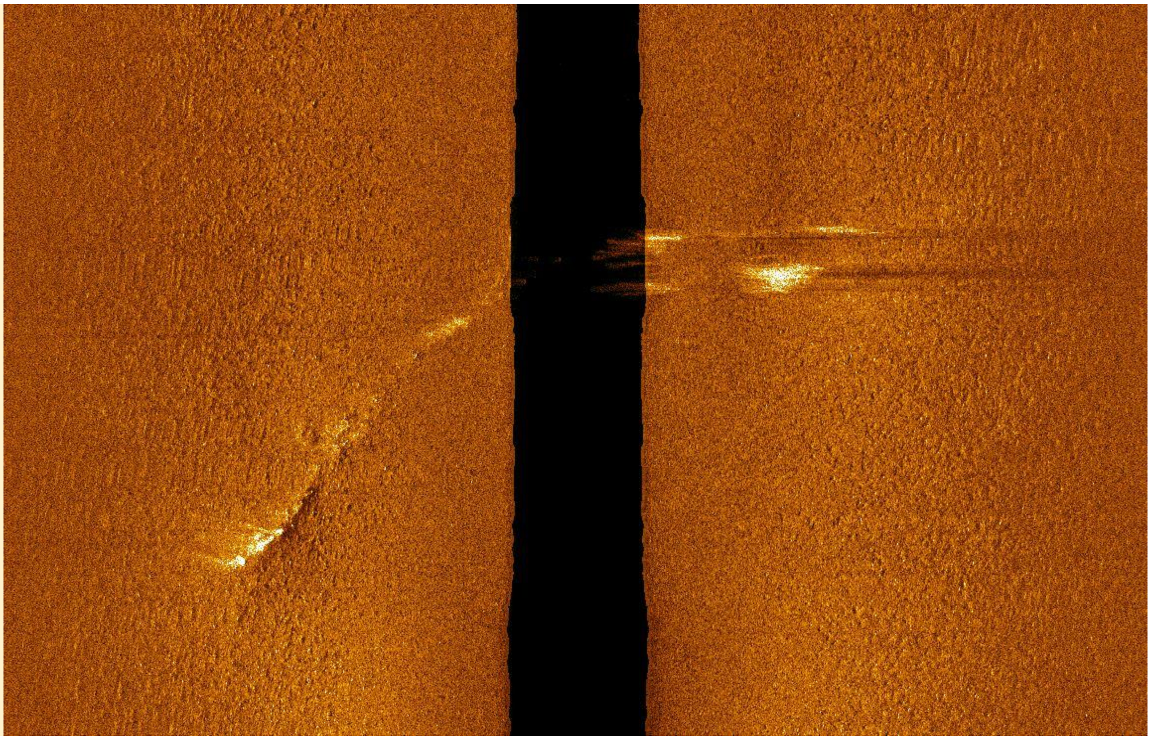


Figure 40: Gas Seep Visible in SSS Imagery (Data Line Collected E-W)

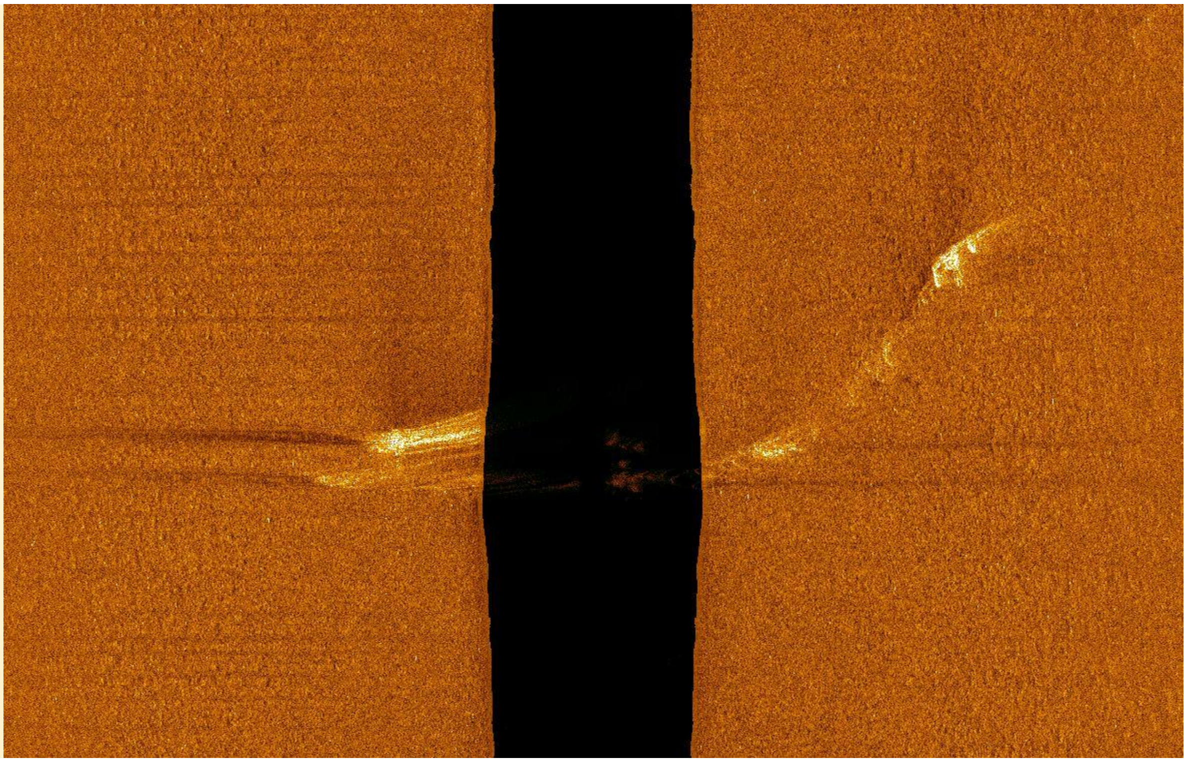


Figure 41: Gas Seep Visible in SSS Imagery (Data Line Collected W-E)

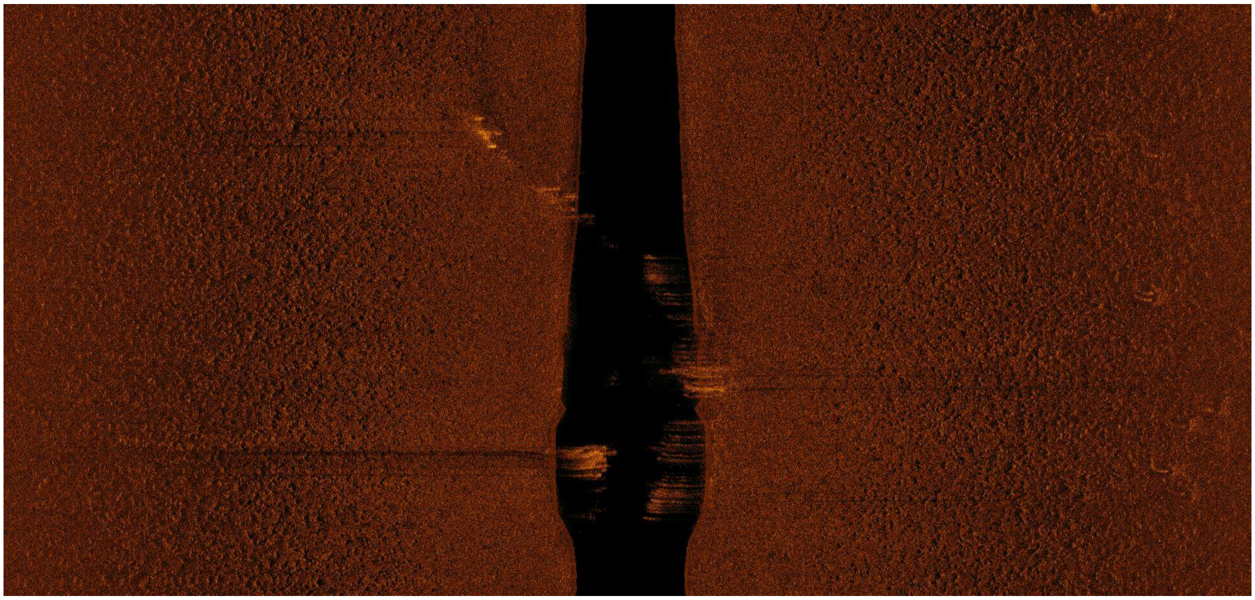


Figure 42: Gas Seep in SSS Imagery (Data Line Collected N-S)

Area of sand ripples, classified as such, as opposed to sandwaves due to their small height and wavelength. Four areas of sand ripples were identified.

The first area of sand ripples (Ripple A) is located closest to the shoreline (shoreline to KP 1066.50000). This area has the shoalest depths within the survey area. The seafloor sediment is this area has been classified as “loose sand”. These ripples are categorized as undulatory and their shape is more lobate than sinuous. The ripples have a maximum height of 0.3m and a wavelength of less than 1m but on average between 0.5m and 0.8m. These ripples are characteristic for shallow water depths on the seaward slope of beaches created by backwash in high energy environments.

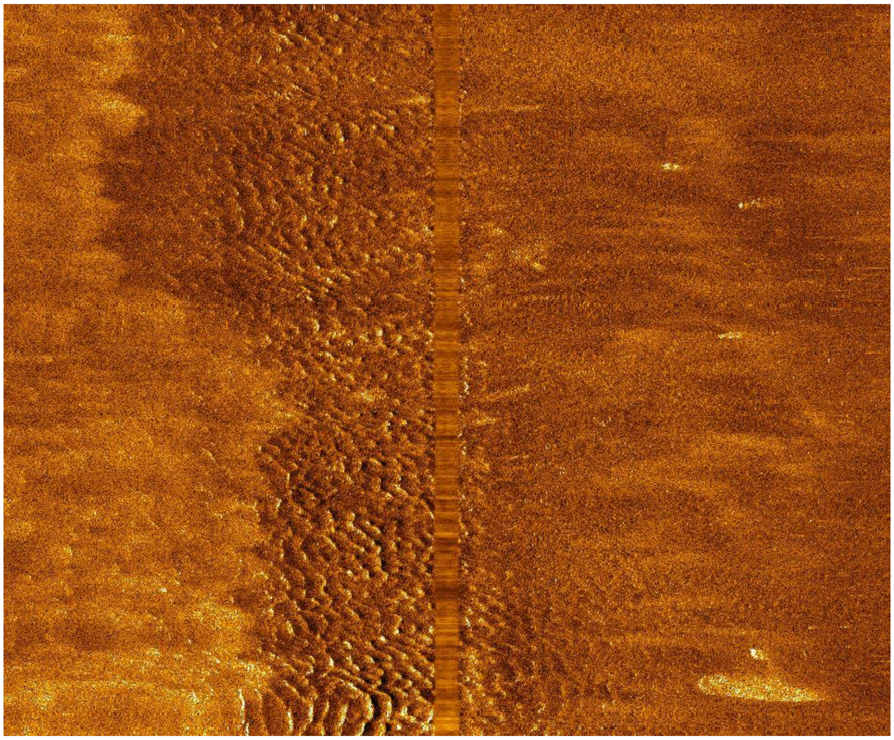


Figure 43: Undulatory Sand ripples - Ripple C

The second area (Ripple B) of sand ripples also occurs in shallow waters, in depths less than 11m (KP 1066.50000 to KP 1066.15700). These sand ripples occur in streaks and run through the inshore undulatory ripples described above. These ripples have a smaller wavelength that varies from 0.2 to 0.5m and a slightly smaller height of between 0.1 and 0.2m.

The streaks of these sand formations are created from high energy currents creating small channel like features running perpendicular to the shoreline. These ripples are categorized as sinuous in shape and mark a transition into an area with less energy from waves and currents. In the area covered by Ripple B features, the seafloor has been classified as “loose sand”, “sand”, and “clayey sand” however, the ripples are predominantly located within the sand and loose sand areas. The streaks of ripples not continue past the depth contour of 11m (KP 1066.15700). These sinuous sand features have a higher intensity return than the undulatory shoreline ripples (Ripple A). Examples of sidescan sonar imagery of these sinuous ripples are shown in Figure 44, and Figure 45 below.

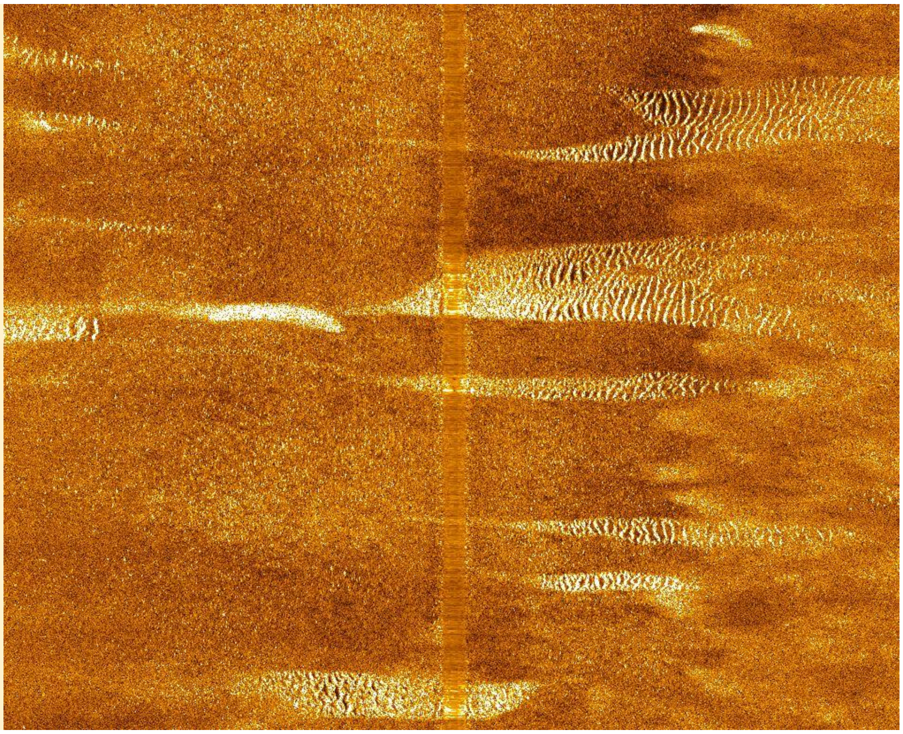


Figure 44: Streaks of Sinuous Sand Ripples - Ripple B (Example 1)

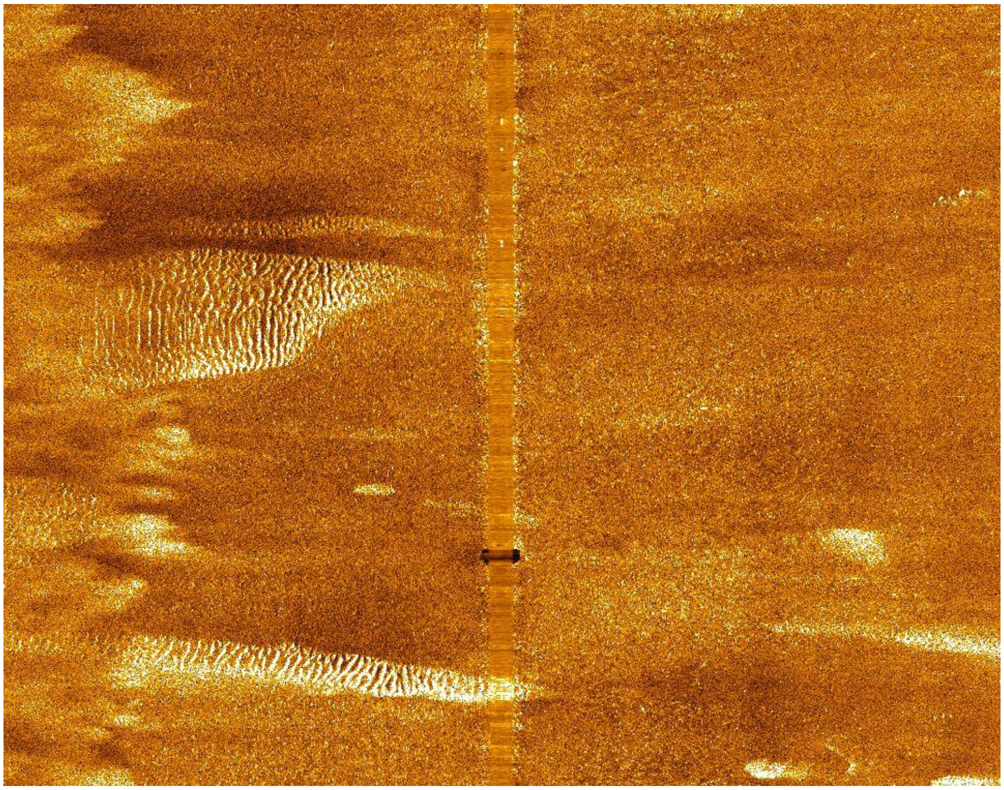


Figure 45: Streaks of Sinuous Sand Ripples - Ripple B (Example 2)

An area of ripples (Ripple C) occurs at a depth range of approximately 15m to 20m in an area where the seafloor has been categorized as “clayey sand” (KP 1065.66000 to KP 1065.19000). These ripples are within between the deposit features described below. The ripples are in a transitional zone between clayey sand and gravelly coarse sand where mounds of soft sandy silt-clay begin to appear. The ripples are straight and sinuous which is indicative of a low energy environment. They have small wavelengths of between 0.3 and 0.4m and heights less than 0.2m.

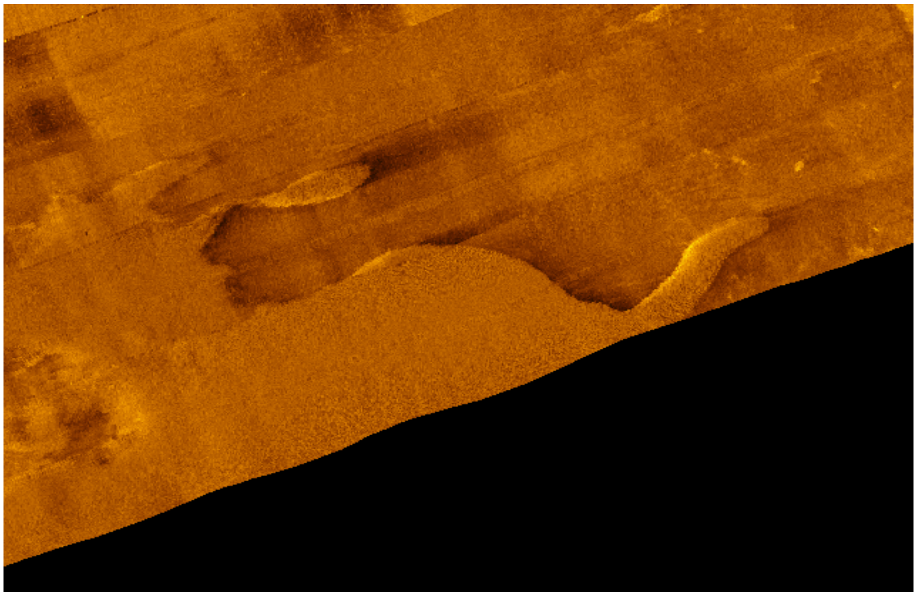


Figure 46: Ripple C area in Low Relief Depressions (Example 1)

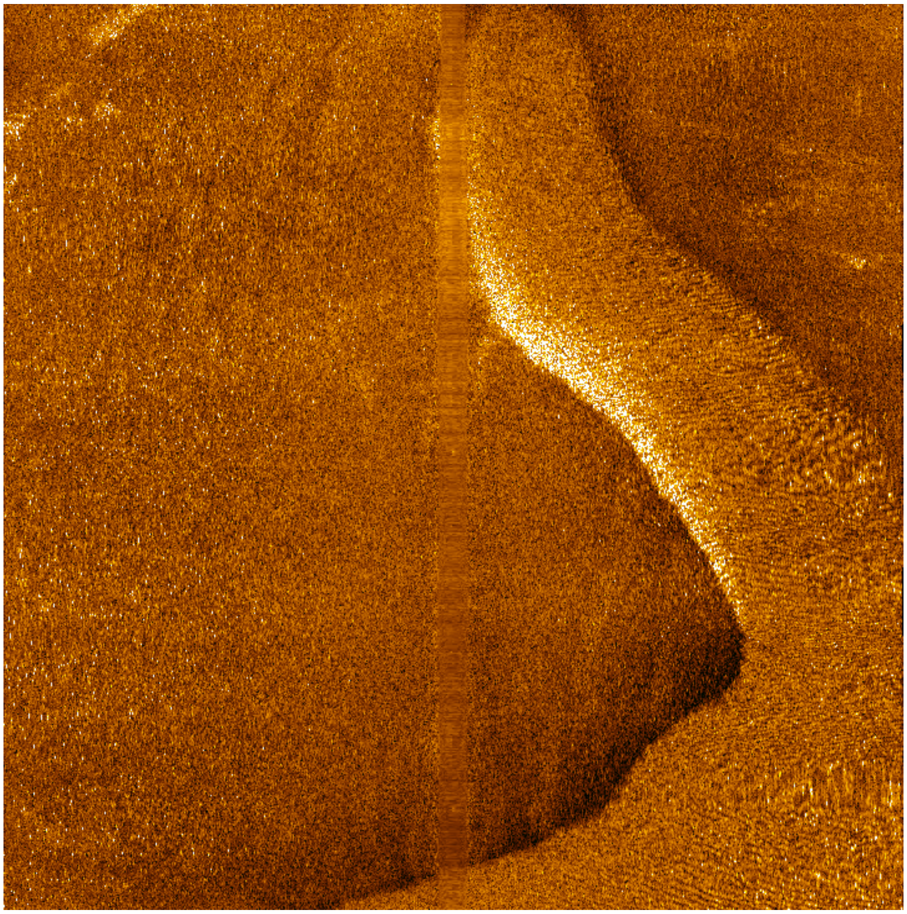


Figure 47: Ripple C in Low Relief Depressions (Example 2)

The forth area of Ripples (Ripple D) occurs in an area where the seafloor has been categorized as “soft sandy silt clay” and has large “streaks” of “coarse sand” (KP 1064.93800 to KP 164.13200). These streaks of sand are channel depressions that are 0.5m deep and described below. This area is also a transition zone moving to soft sandy silt-clay which begins at a depth of approximately 22m (KP 1064.93800). These ripples are undulating, sinuous, and asymmetrical. They are very similar to the “streaks” of the ripples located in the area of Ripple B close to shore. These ripples have a similar intensity return but are larger in size, indicating a higher velocity in the area. The high velocity is likely due to currents given the offshore position of these ripples, far from the high energy environment of the nearshore zone. The ripples cease at an approximate depth of 32m (KP 104.13200) where the seafloor has transitioned into soft sandy silt-clay. An example of these ripples within a depression are shown in Figure 48, Figure 49, and Figure 50 with cross-section A to A’ indicated.

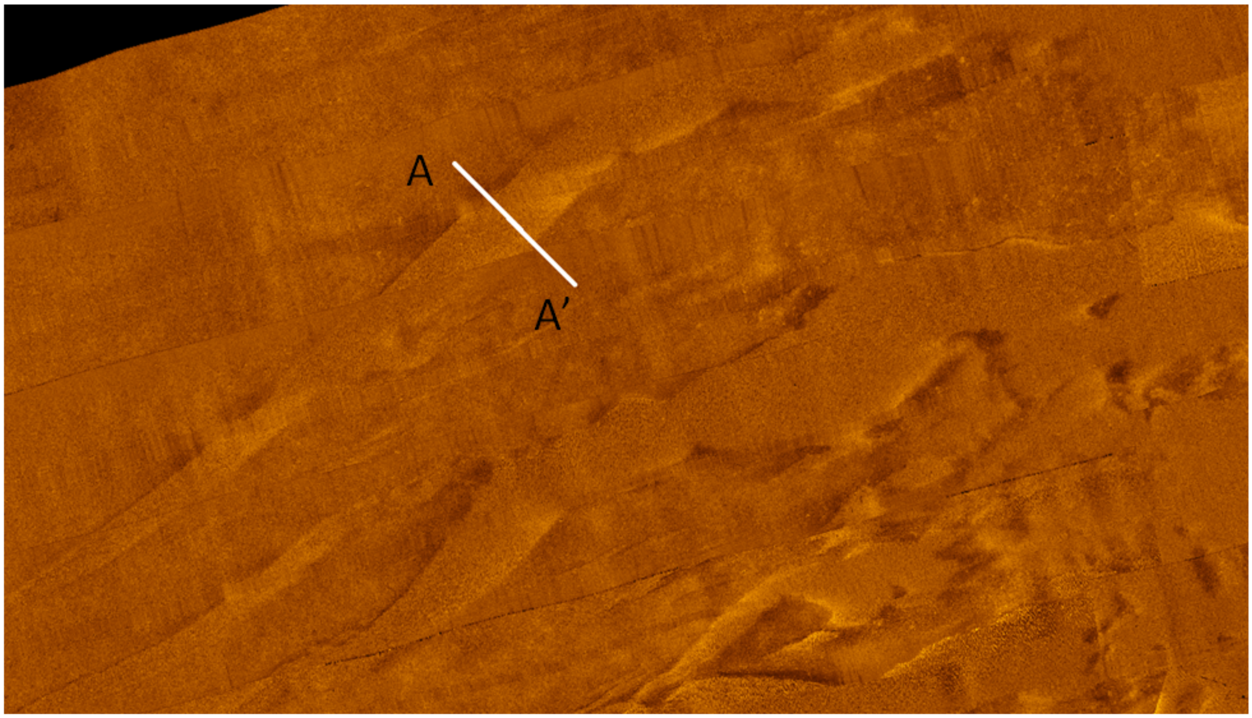


Figure 48: Overview of SSS Imagery of sand ripples (Ripple A) in Channel Depression with Cross-section A to A′ indicated

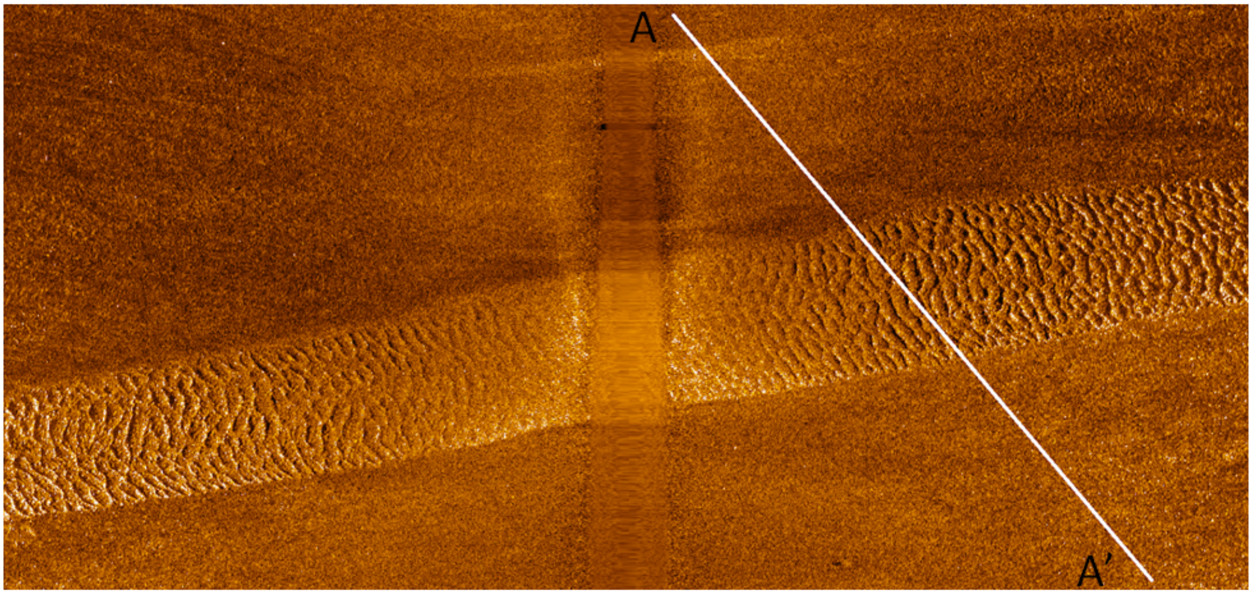


Figure 49: Zoomed in SSS Imagery of Sand ripples (Ripple A) in Channel Depression with Crossection A to A′ indicated

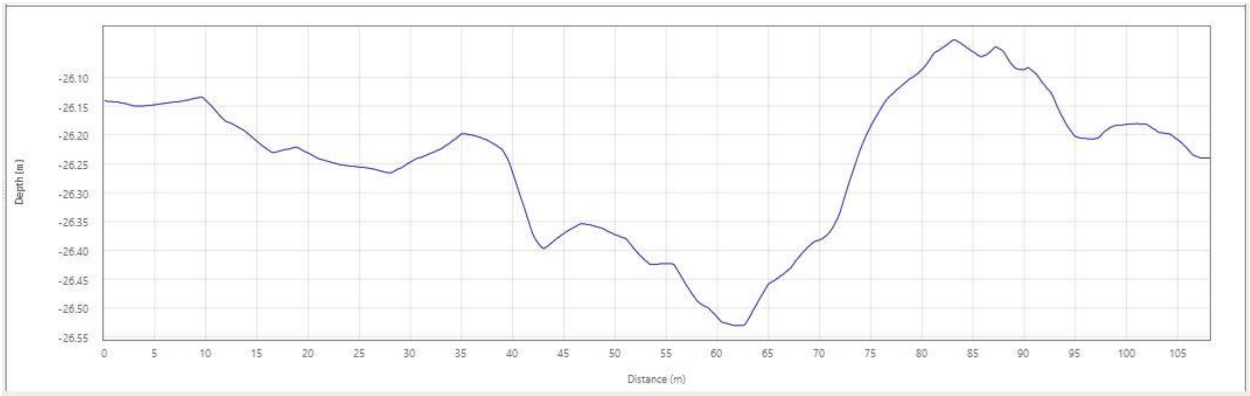


Figure 50 Cross-section A to A' of ripples in Trough of a Depression

In the area of transition between clayey sand and gravelly coarse sand at KP 1064 mounded deposits of soft sandy silt-clay begin to appear. These mounded features are rounded, and have some formation uniformity perpendicular to the shore. The features are up to 20m wide and 1m above the adjacent seabed. Between the deposit features sand ripples, ripple C are located. These features are only within this area at depths of 30m and shown below in Figure 51 and Figure 52.

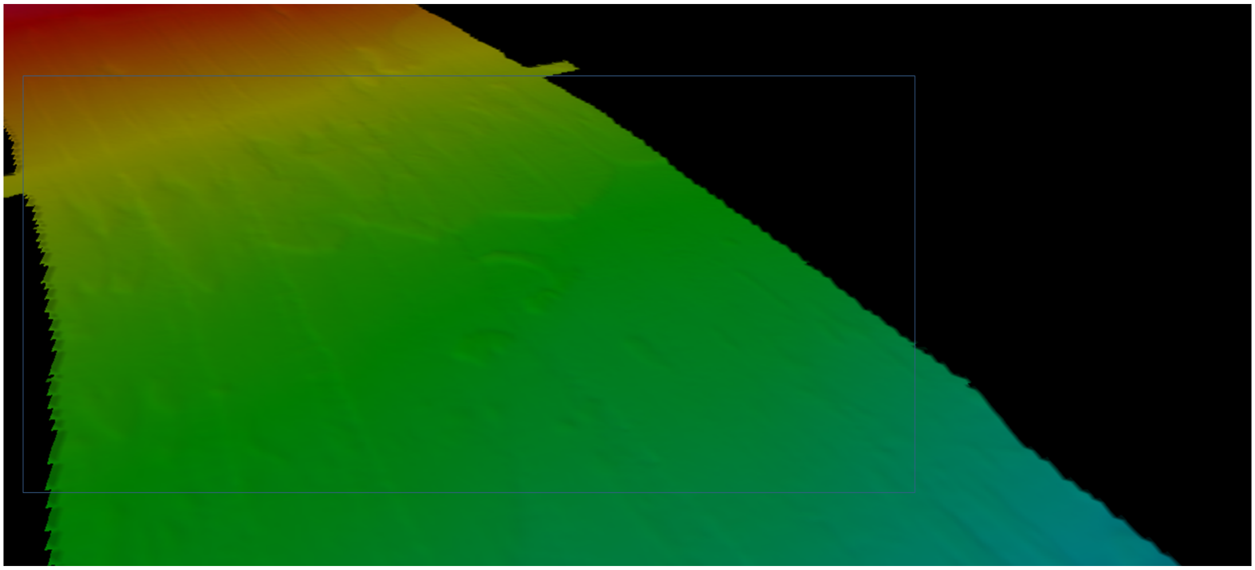


Figure 51 Deposit features

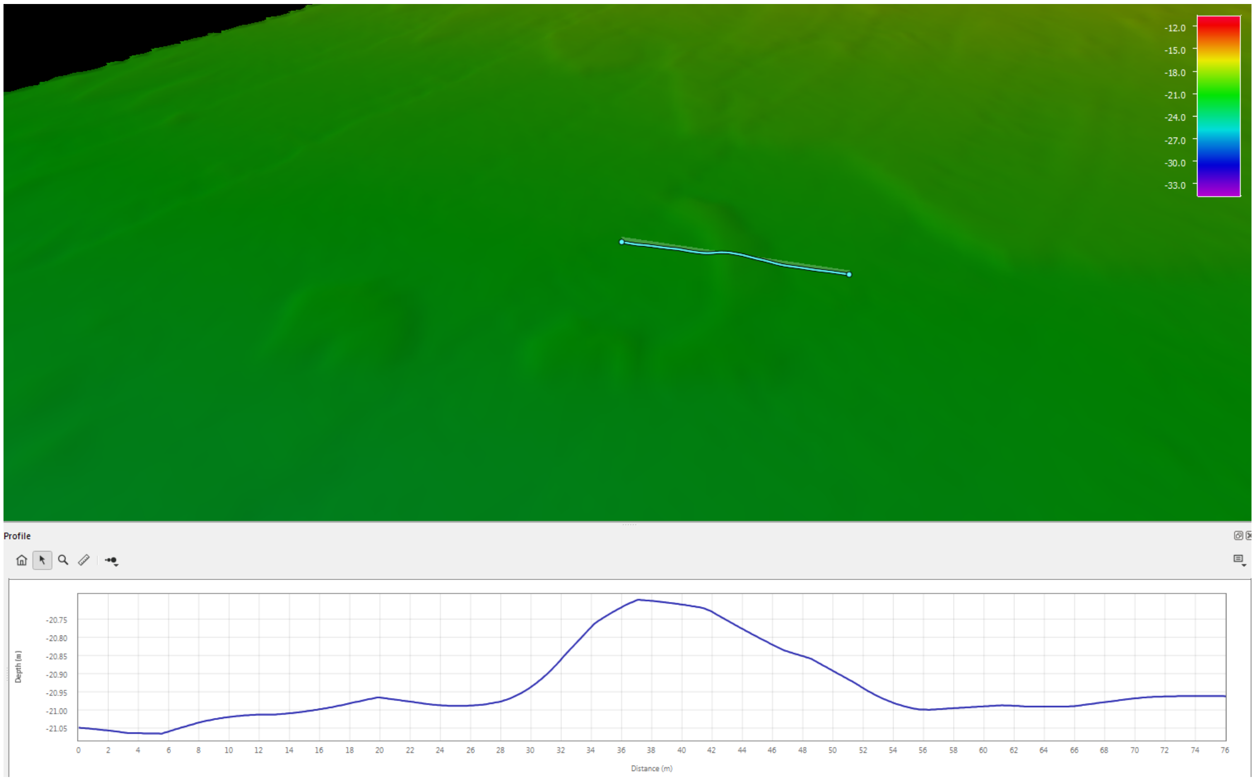


Figure 52 Profile over deposit feature showing dimensions

400m offshore from the deposit features between KP1063.8 and 1063 are a series of troughs. These are perpendicular to the shore line and up to 600m long. Widths of the features range from 40m to 60m. The troughs are found at 30m depth and within them are sand ripple deposits (Ripple D). The trough features as imaged in the multibeam echosounder data are shown below in Figure 53 and Figure 54.

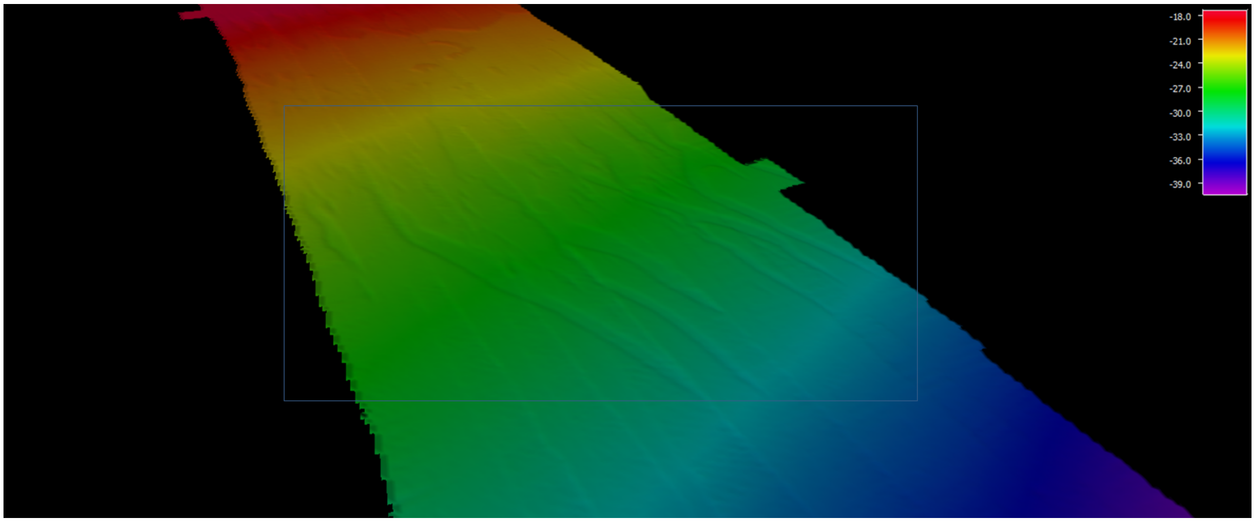


Figure 53 Trough features

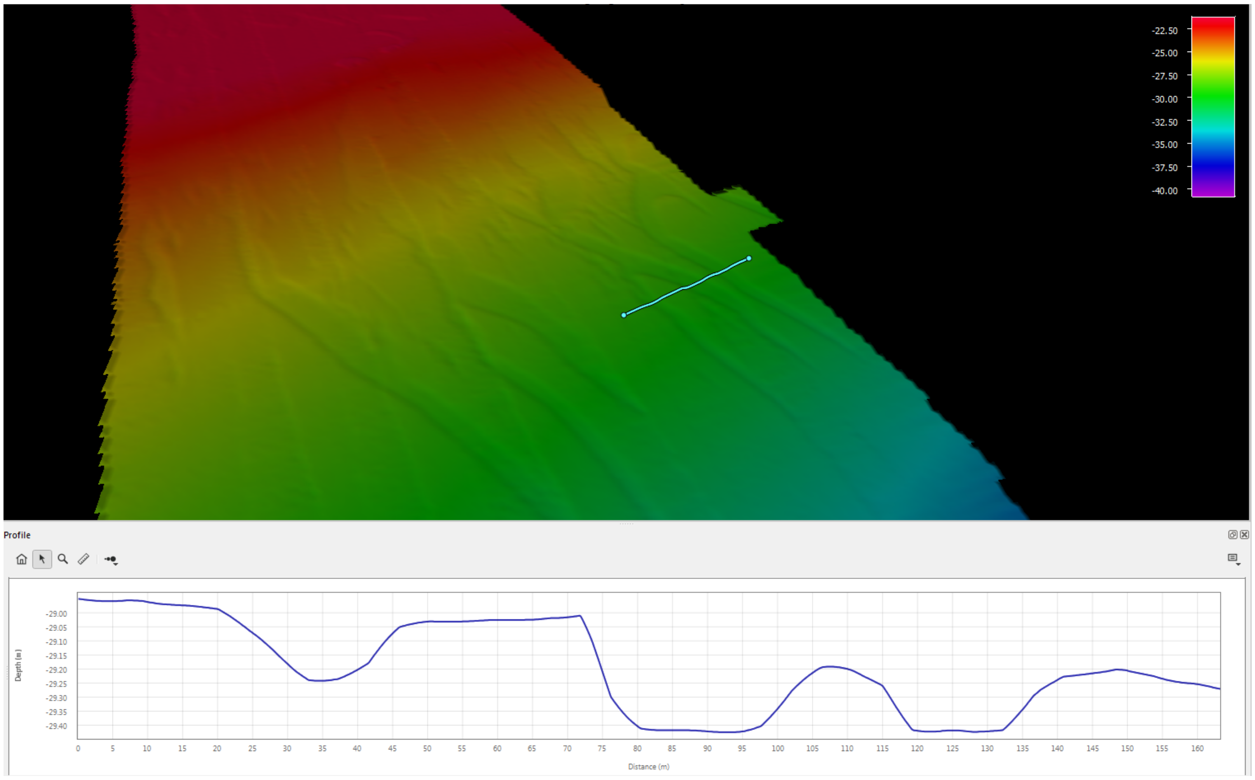


Figure 54 Profile across trough features showing dimensions

5.4 Subsurface Geological Interpretation

Nine (9) subsurface sediment facies were identified in the CHIRP sub-bottom data. These are located across sub-bottom profiles allowing areas of subsurface facies to be determined. The extents of these facies are shown below in Figure 55.

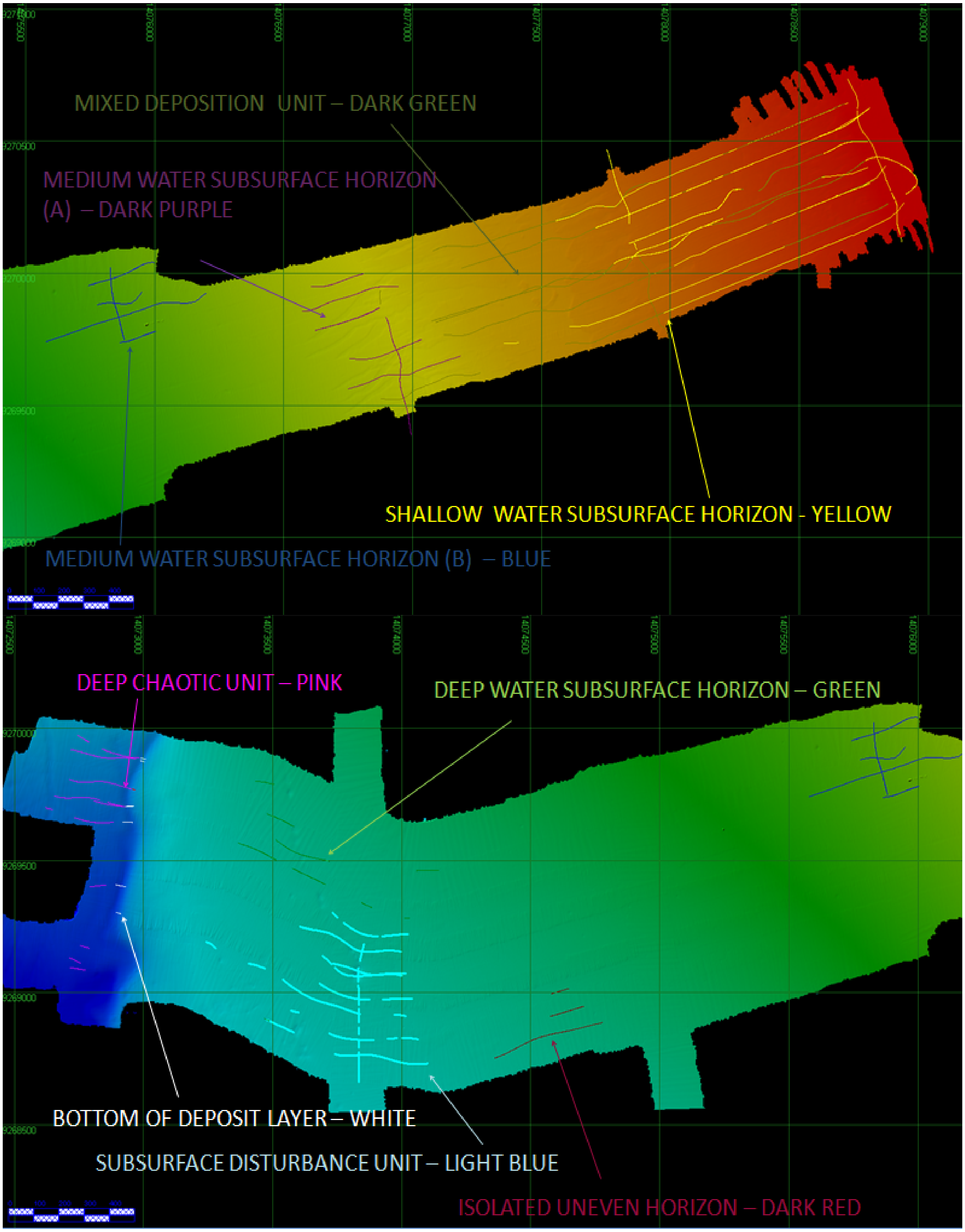


Figure 55: Subsurface Facies Identified Across the Survey Area

No core sample information was obtained or could be found within the survey area. Therefore, no attempt has been made to classify the sub-surface soil types. The surface sediment type is identified for each unit which can be assumed to be the sediment type from the surface to the first horizon.

Single, subsurface horizons suggesting a change in deposited, sediment from the surface were identified across the area. These horizons were identified across adjacent profiles to determine contiguous areas with subsurface change. The subsurface horizons were categorized based on the water depth at which they were identified. Four (4) categories of horizon were created; shallow water subsurface horizon (horizon found in the shallow water depths from 0-20m), two medium water depth horizons (located in water depths of 25-50m) were identified and divided as (A) and (B). A final deep water depth horizon was identified (below depths of 65m).

These horizons are observed at different depths below the seabed. The shallow water horizon is near the seabed surface at depths below the seabed averaging between 1 and 3m. The subsurface horizon medium water (A) is at similar depths below the surface at 1 to 3m. Depths below the surface for medium water unit (B) were between 4 and 6m. The subsurface horizon in deep water is at similar depths below the seabed. Examples of these horizons are shown below in Figure 56, Figure 57, Figure 58, and Figure 59.

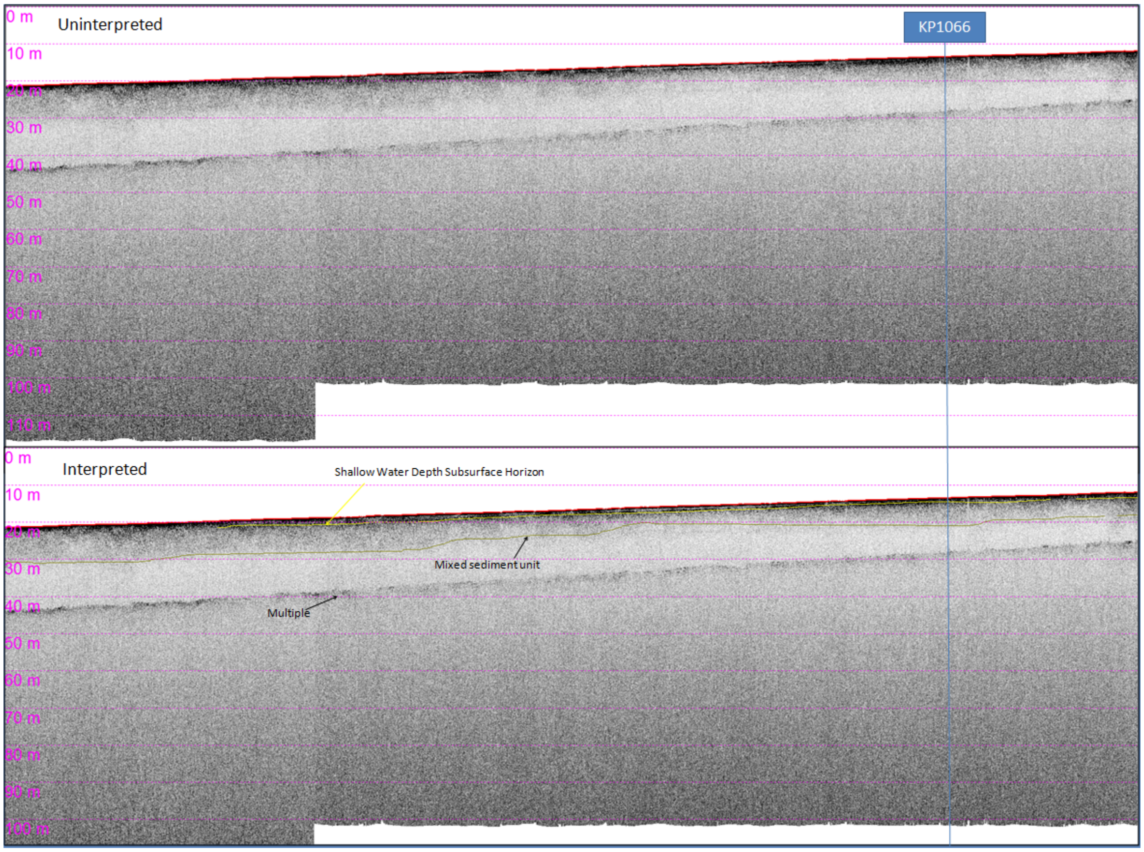


Figure 56: Example of Shallow Water Subsurface Horizon

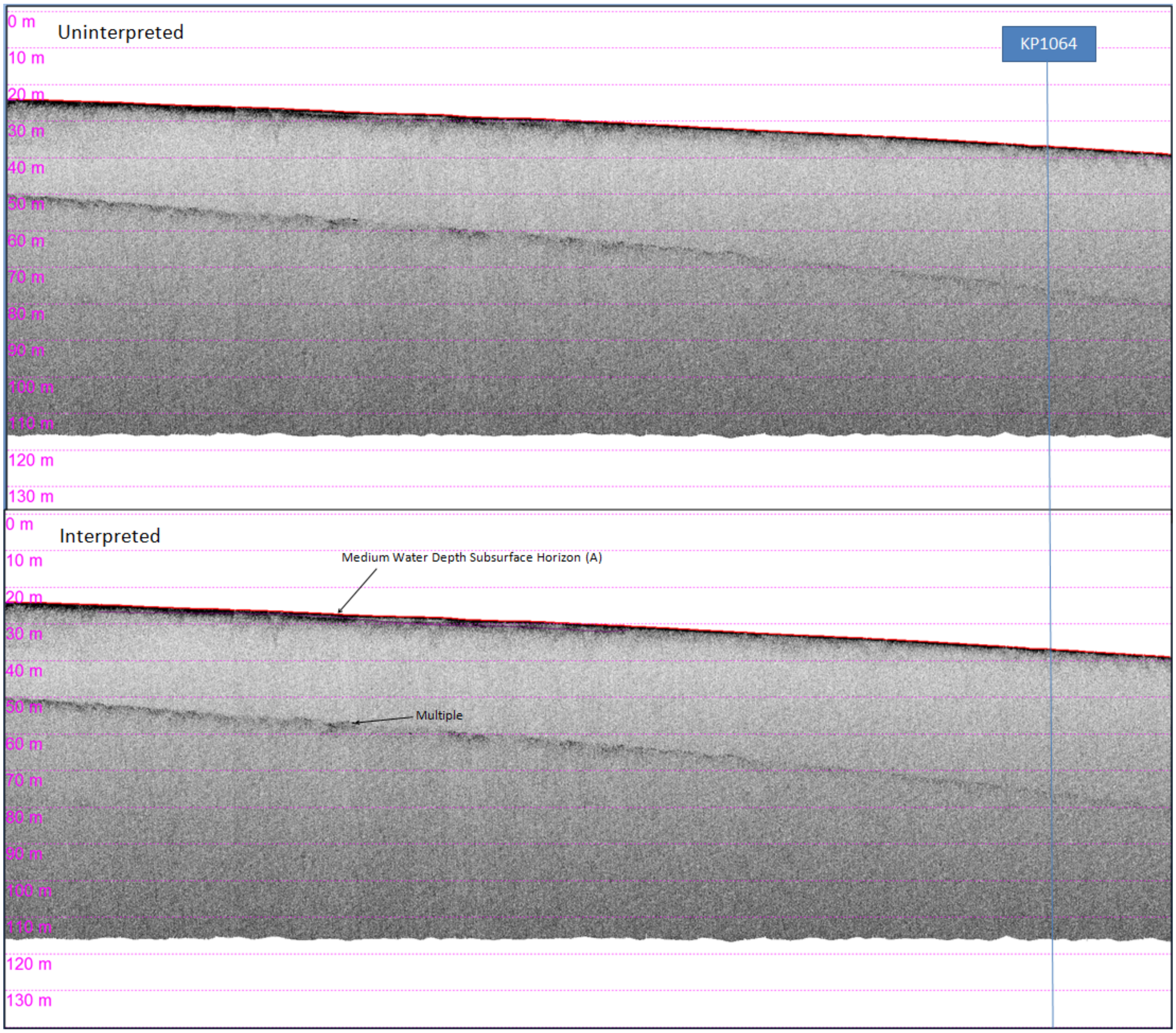


Figure 57: Example of Medium Water Depth Horizon (A) Subsurface Horizon

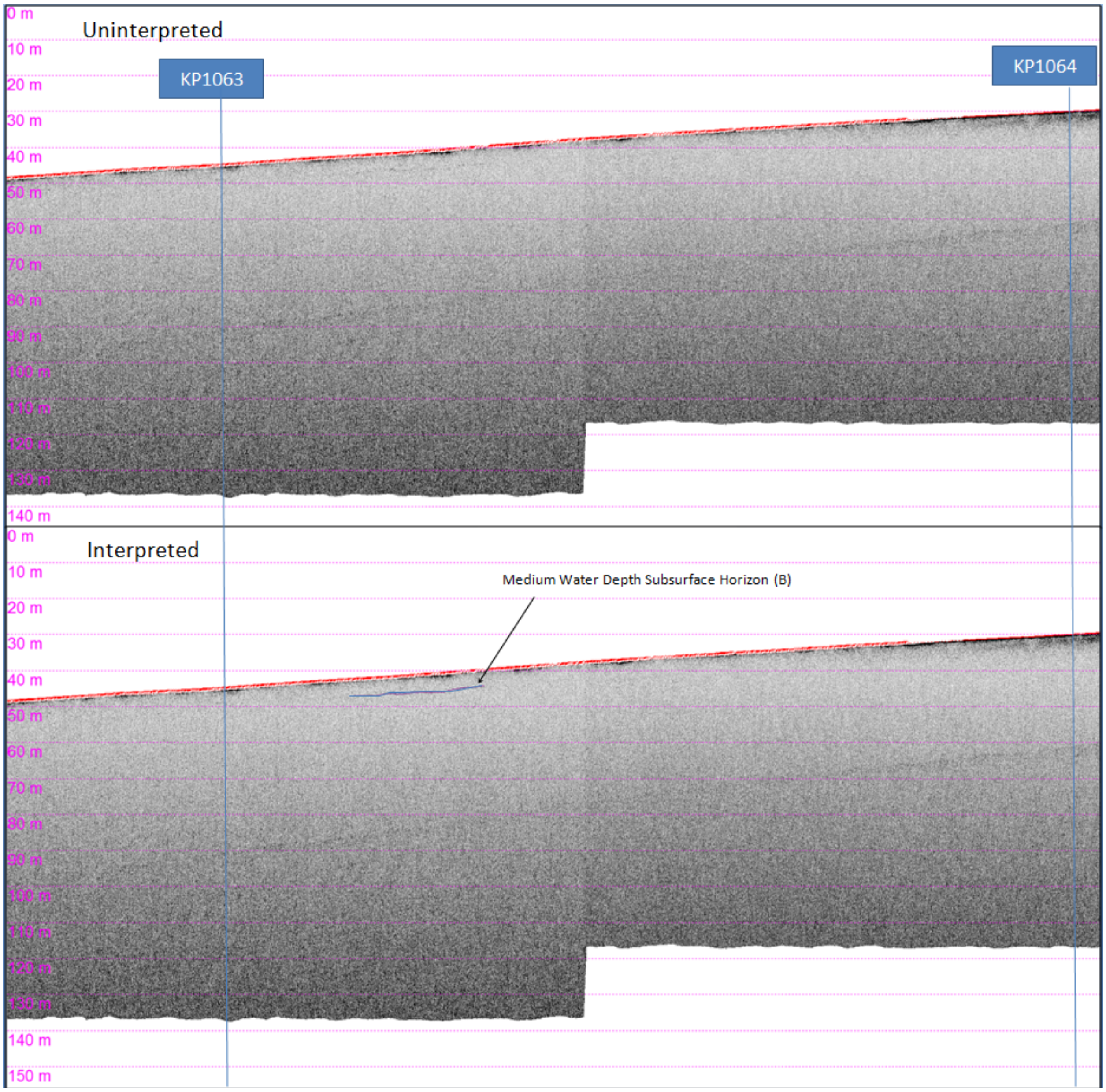


Figure 58: Example of Medium Water Depth Horizon (B) Subsurface Horizon

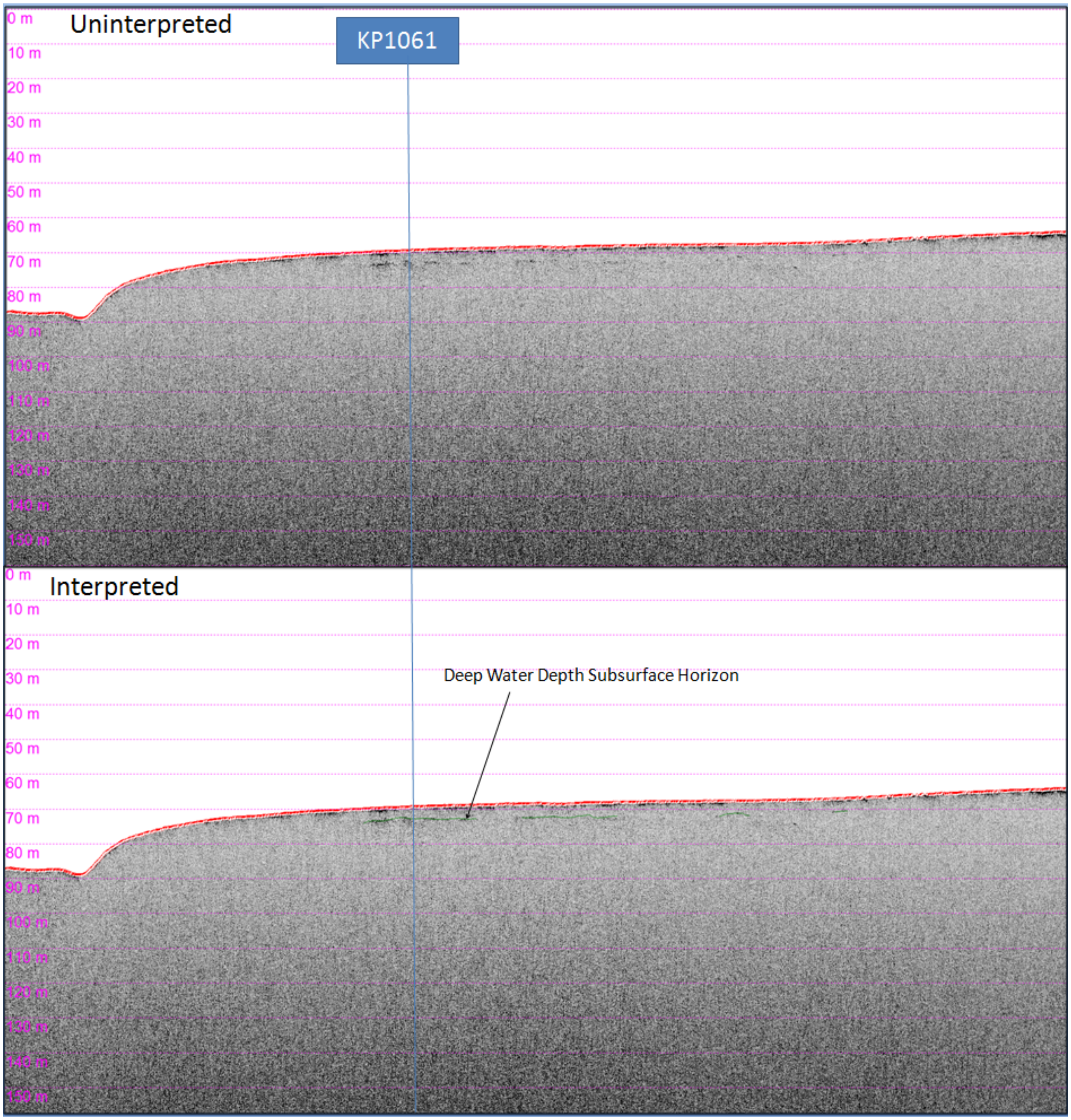


Figure 59: Example of Deep Water Depth Subsurface Horizon

Based on the surface transition from sand, coarse sand to silt clay, the different depth of the horizon below the seabed and the lack of any correlation to the surface sediment types, these horizons are deemed to different rather than one related horizon. The horizons are considered the vertical extents of different sediment units separating the surface sediment unit above the horizon from sediment below.

The surface sediment above the shallow water horizon is consistently clayey sand. Above the medium water depth horizon (A) are deposits made of gravelly, coarse sand with shell. The medium water depth horizon (B) is located in a separate area from (A) in an area where the surface sediment is consistently soft sand, silt/clay. The deep water subsurface horizon divides the surface sediment of soft, sand silt/clay from a subsurface sediment unit.

In the shallow area of the survey from 0 to 25m a facies below the first horizon is a consistent deeper return which suggests a deposition unit which is non linear but mixed. There is then some change nearer the bottom of the unit which has not been detected directly with a change in amplitude, rather a dissipation of the return. Below is an example of a profile across this sediment unit.

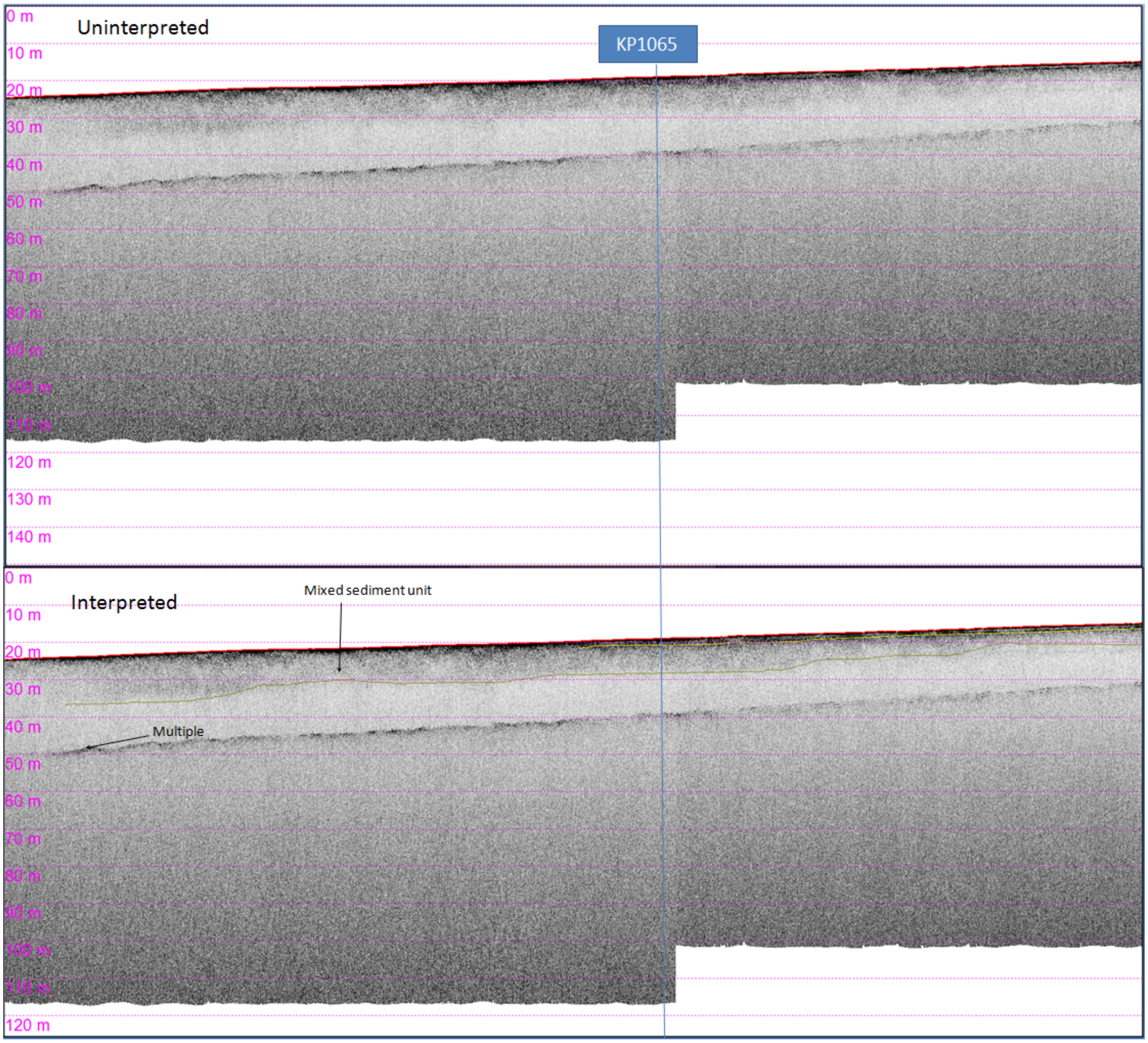


Figure 60: Example of Mixed Sediment Unit

A gas seep was identified in the sub-bottom, multibeam and sidescan data (KP 1061.30454, DCC 33.49). From the center of this seep below the surface is an apparent disturbance unit deemed to be associated with the seep feature. The subsurface feature is apparent up to 400m south of the detected seep location and up to 600m west. In all the sub-bottom profiles the water column has been blanked so as to focus on the subsurface environment. However, below in Figure 61 is a profile with water column data included to show the detection of the seep in the sub-bottom chirp data.

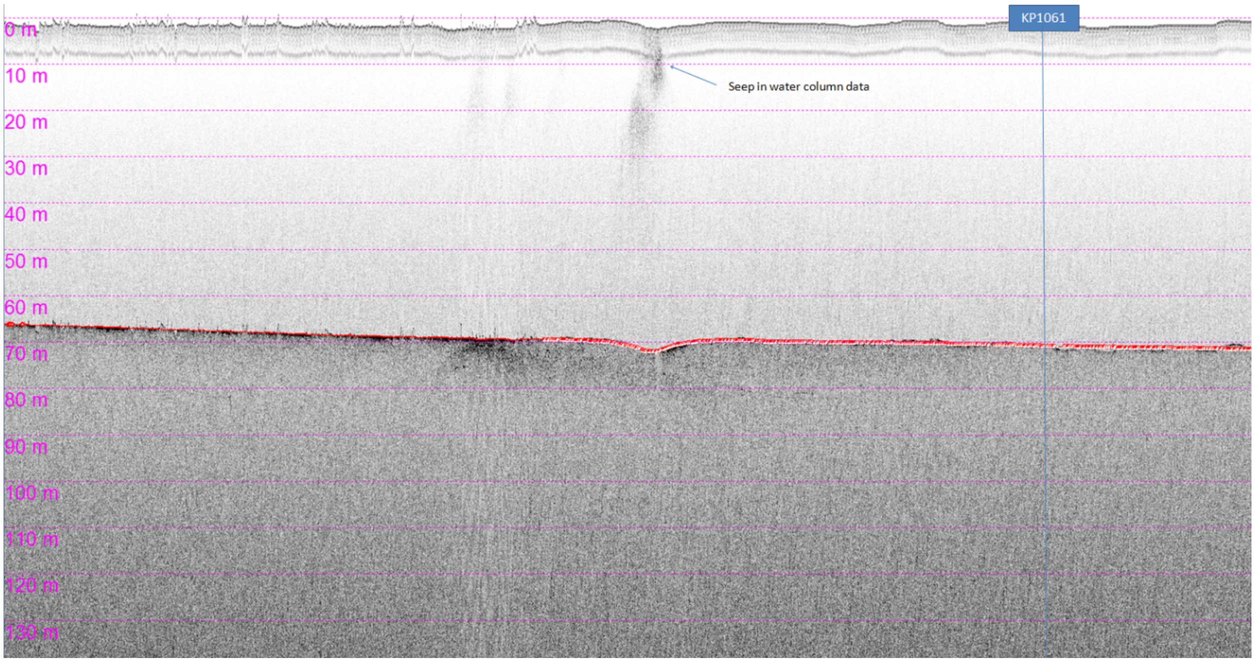


Figure 61 Sub-bottom Profile with water column data included showing the seep detected within the dataset

The disturbance unit is a mix of sediments causing a chaotic layering unit. The extents of the disturbance unit as detected in the sub-bottom profiles are shown below in Figure 62.

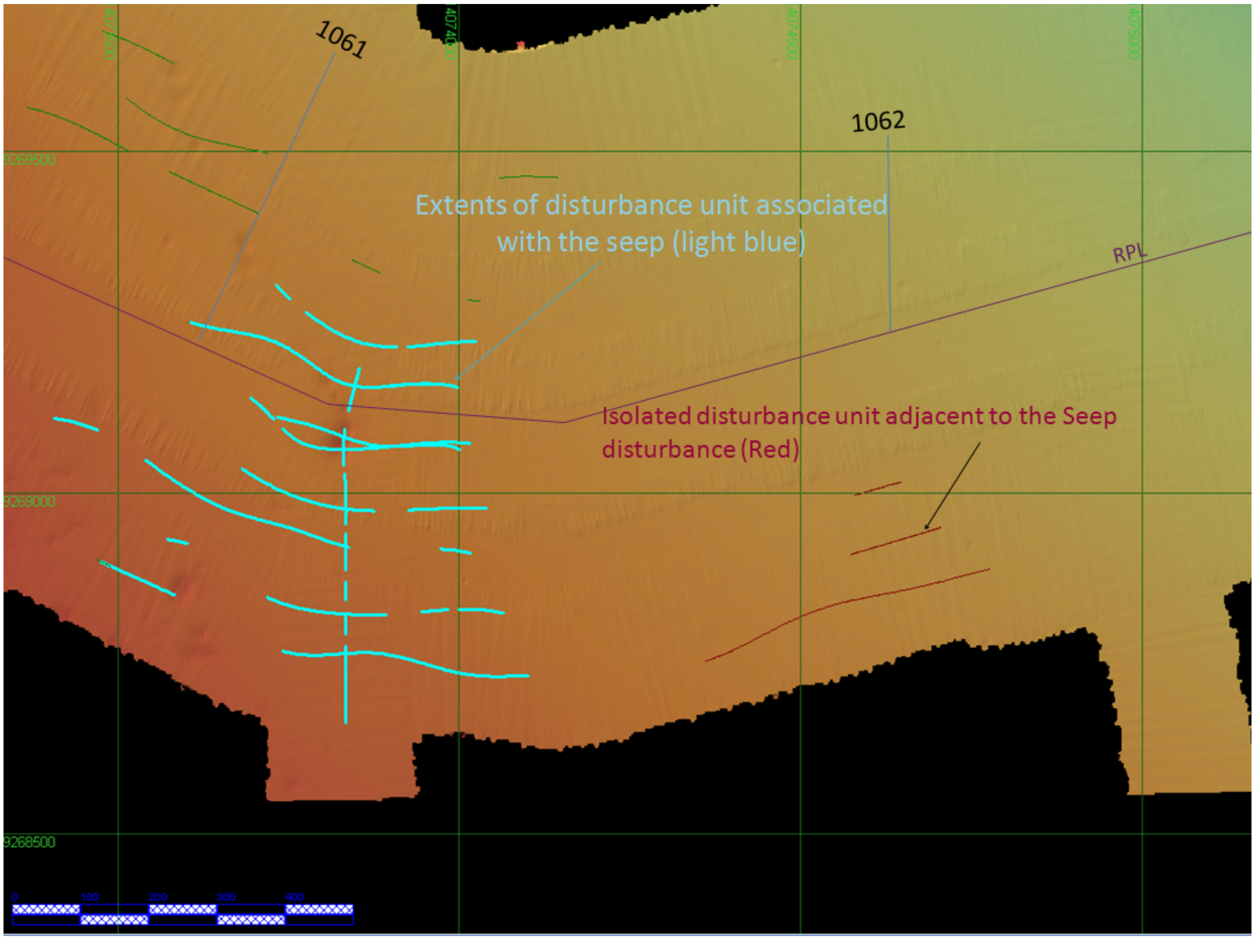


Figure 62: Disturbance Unit Associated with the Seep as Detected in the Sub-bottom Profiler

Below is an image from a profile directly over the seep location (Figure 63). This image shows the chaotic unit with amplitude changes detected at depths from 5 to 15m below the seabed.

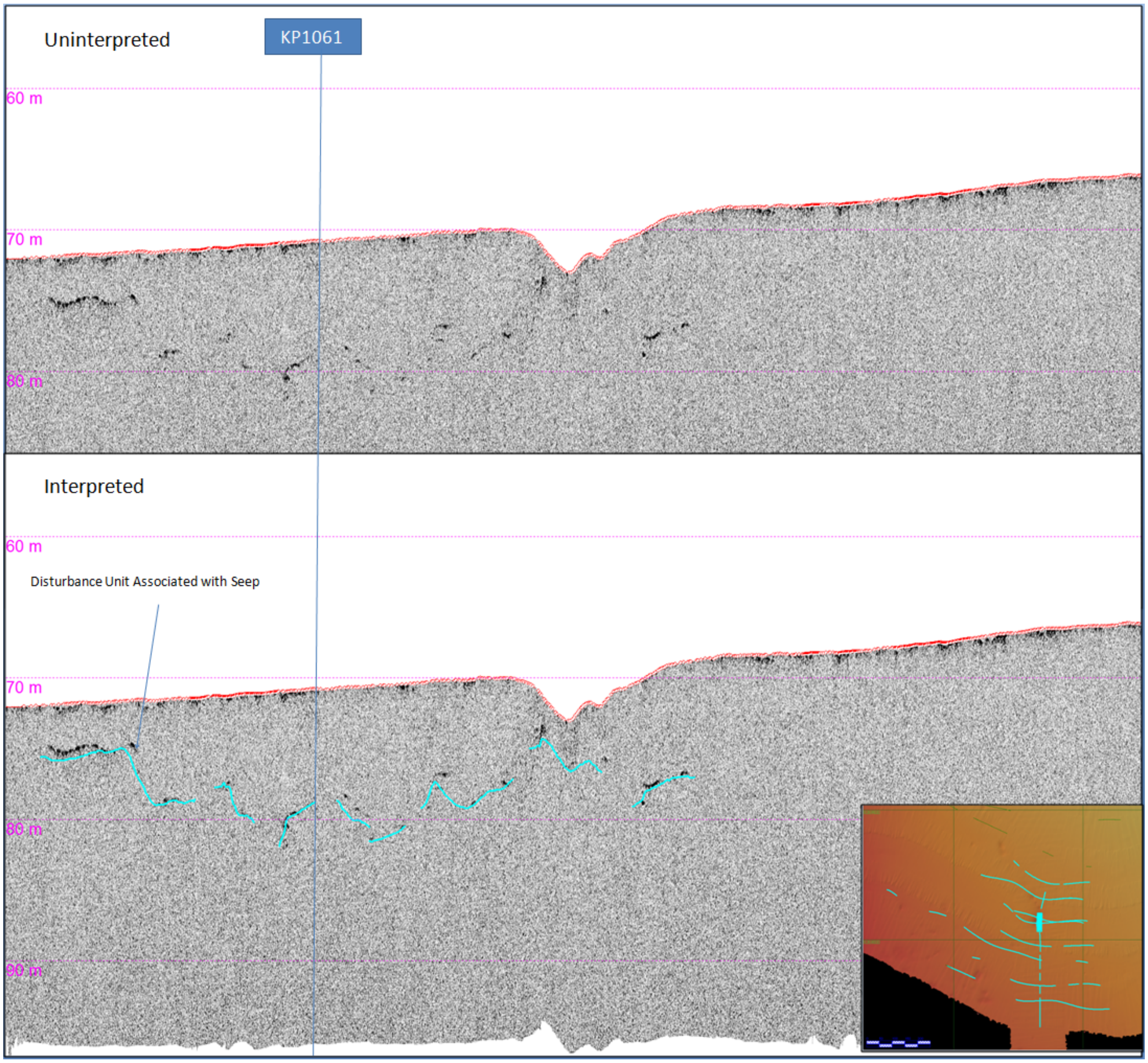


Figure 63: Profile from the CHIRP Sub-bottom Profiler Over the Seep

The same chaotic layer is located out from the seep allowing the determination that this is one consistent facies associated with the seep. It is assumed these subsurface chaotic units are related to the seep. The amplitude change and uneven refraction at the bottom of the unit in the sub-bottom data could suggest the presence of gas. This could be gas accumulation across the subsurface area where there is the chaotic unit, or the transit of gas through layers has created mixing and uneven sediment with pockets of gas. There is no penetration below this unit where it exists. This could be due to the presence of gas or a hard surface that could not be penetrated. Below (Figure 64) is a profile 150m south of the seep location showing a similar subsurface formation.

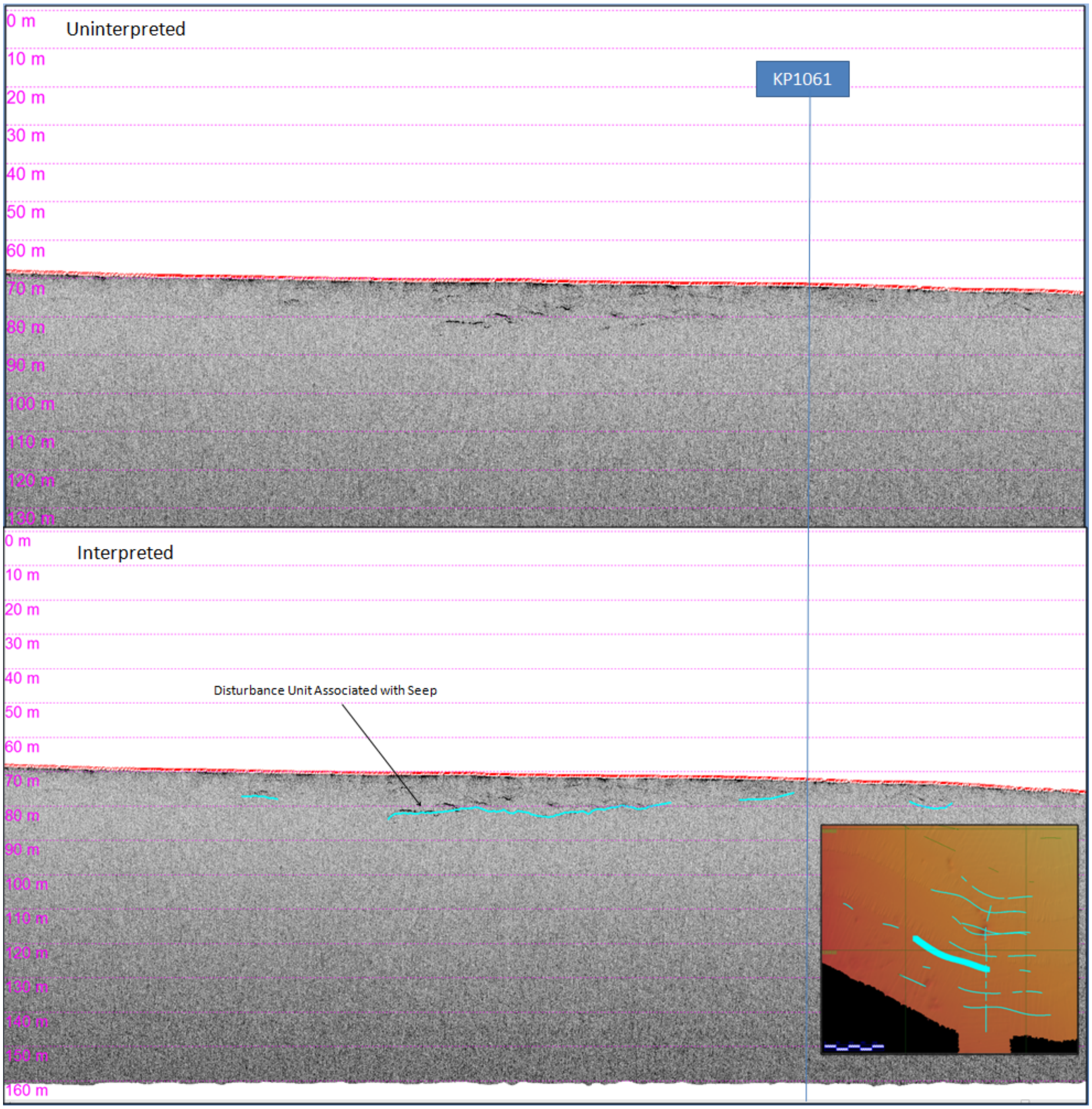


Figure 64: Profile for the CHIRP Sub-bottom Profiler 150m South of the Seep

An uneven horizon adjacent to the disturbance unit associated with the seep is located 300m east of the seep and shown below in Figure 65.

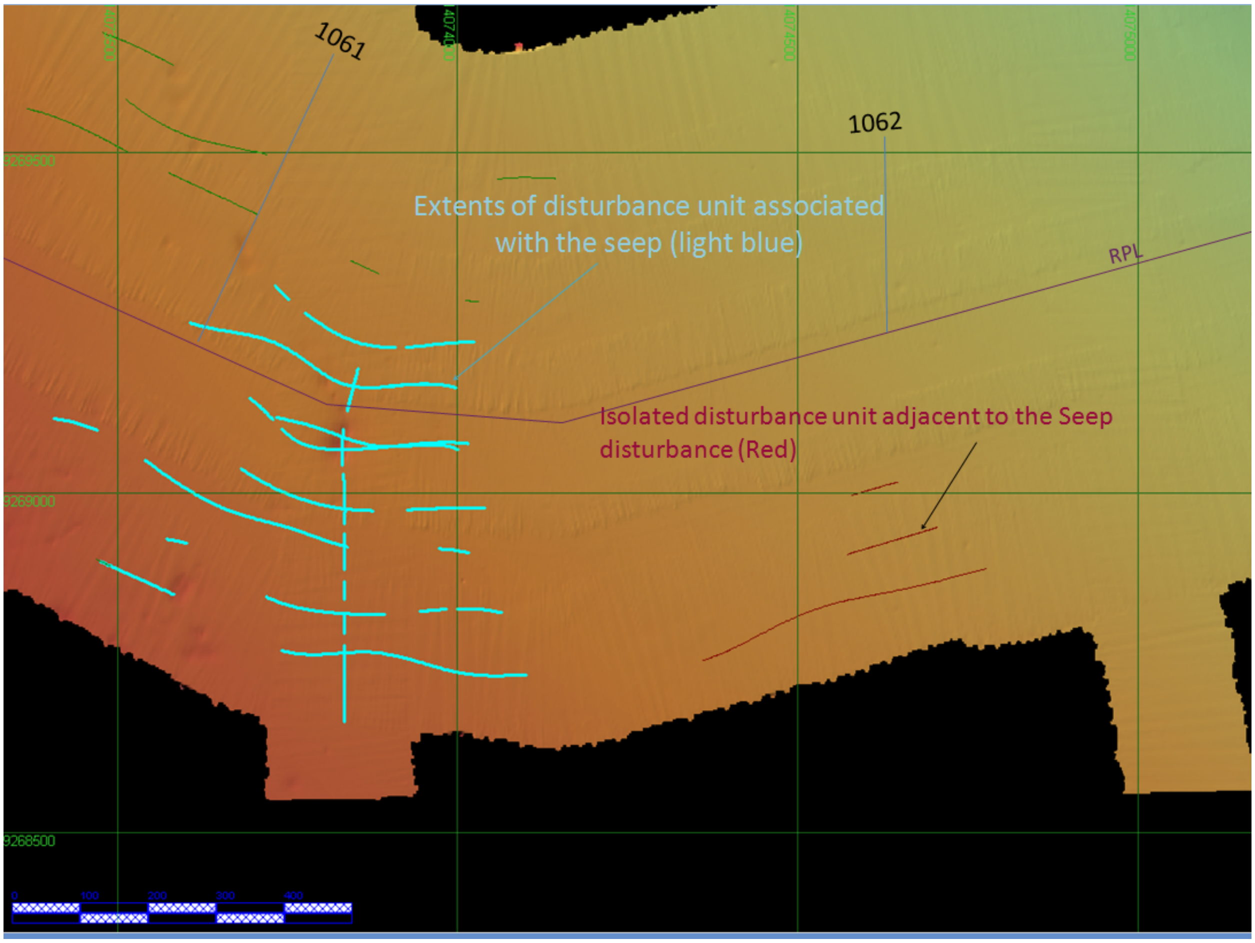


Figure 65: Location of the Isolated Uneven Disturbance Unit Adjacent to the Disturbance Unit Associated with the Seep

A profile below in Figure 66 shows the uneven layering across the area. This could be associated with another seep or the same seep identified, however, due to the lack of contiguity it is deemed separate from the other facies identified.

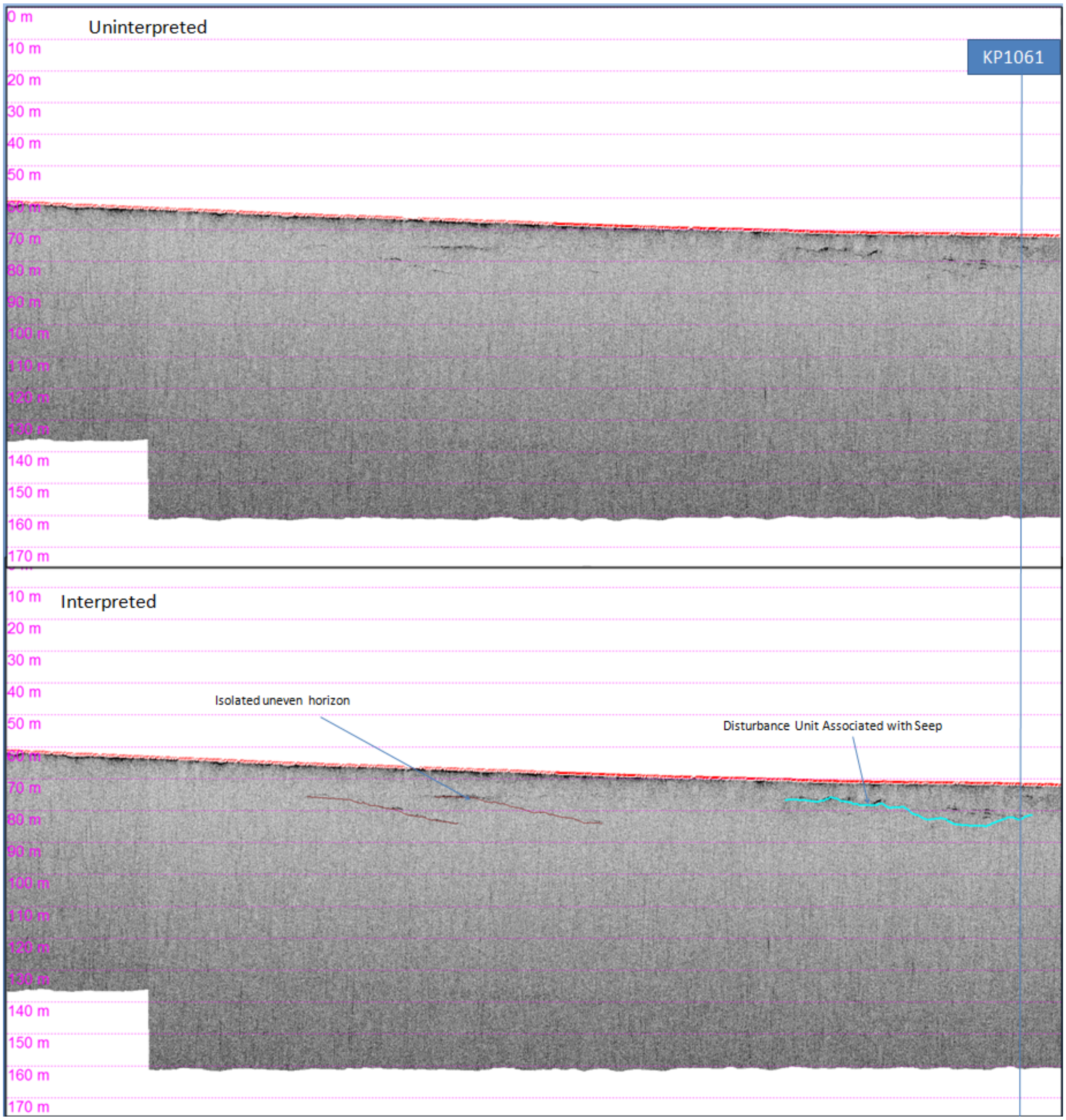


Figure 66: Profile from the CHIRP Sub-bottom Profiler Showing the Isolated Uneven Unit Adjacent to the Disturbance Unit Associated with the Seep

In the deepest section of the survey area at the foot of the offshore slope the subsurface suggests a mixture of depositional sediments creating a chaotic unit. The thickness of this unit is on average 5m, with the seabed surface being the top vertical bounding horizon. This is shown below in Figure 67. This slope was also identified in the multibeam data.

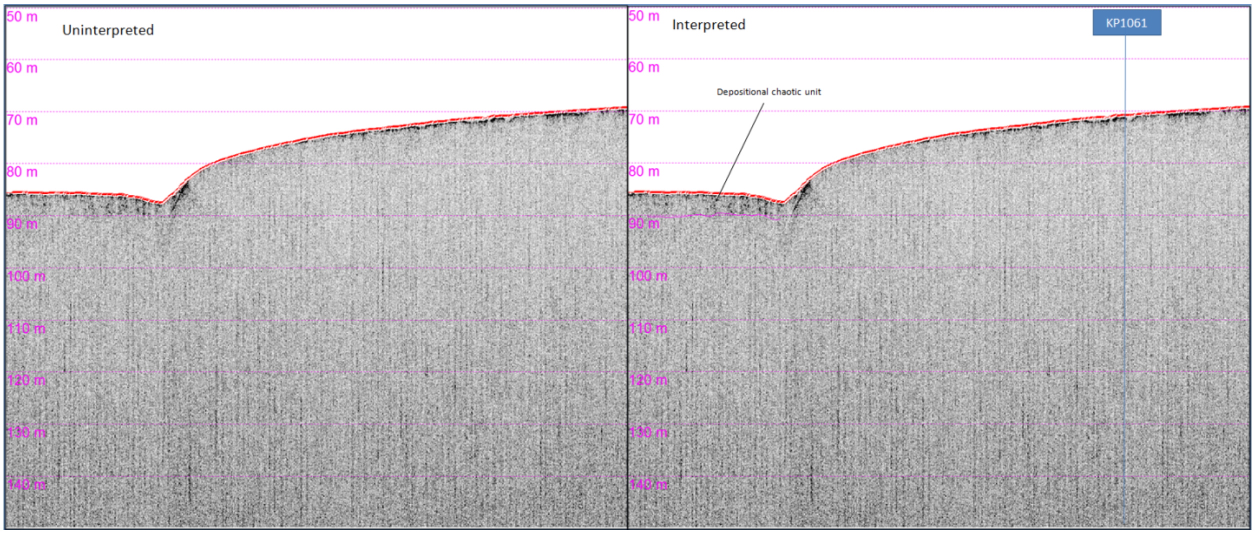


Figure 67: Profile from the CHIRP Sub-bottom Profiler Showing the Chaotic Unit at the Foot of the Slope Offshore in the Survey Area

5.5 Isolated Subsurface Features

Twelve (12) isolated subsurface features were identified across the survey area. The locations of these features are shown below in Figure 68.

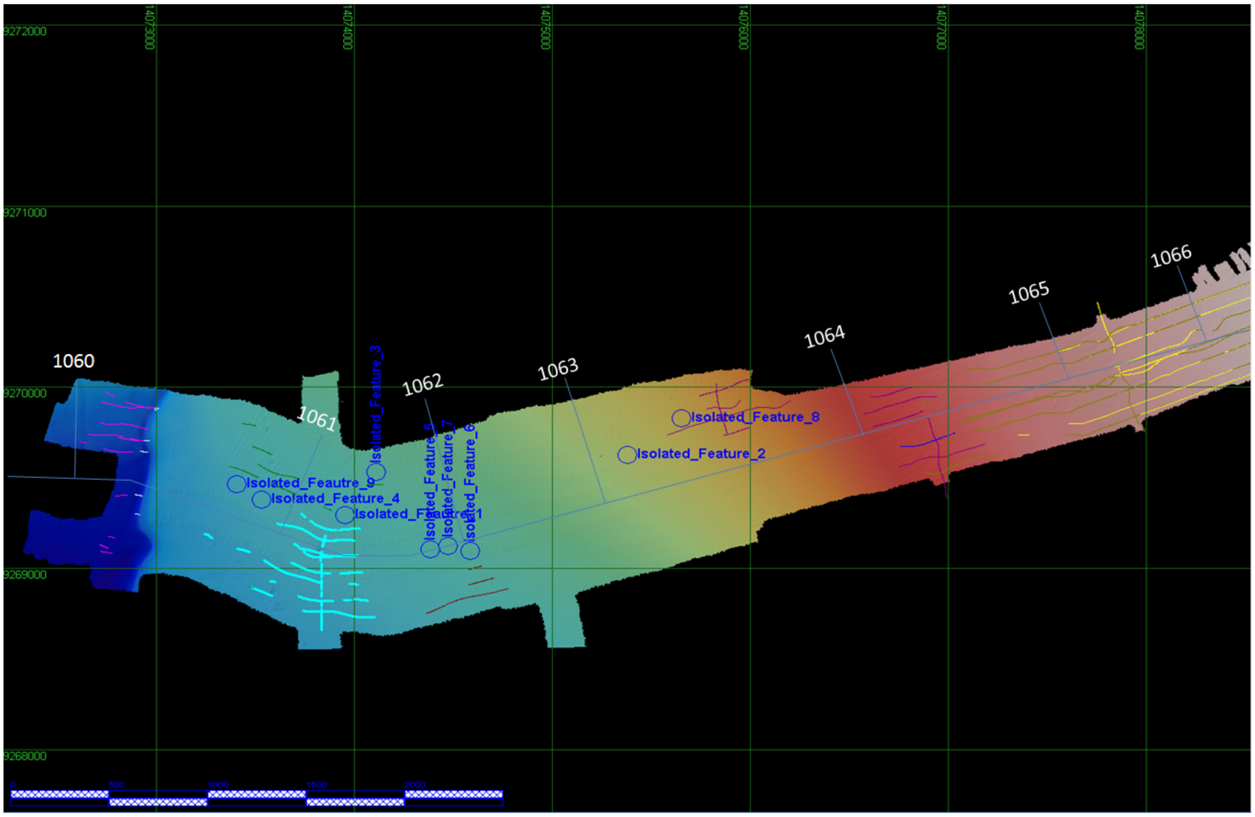


Figure 68: Distribution of Isolated Features within the Survey Area

The features vary in depths below the seabed from 2 to 15m. The features did not create clear parabola with which to be able to define these as buried objects, but they are noted as features as they are a clear amplitude anomaly within the profiles.

Table 4 lists the isolated features with depths below the seabed and examples of the features are shown below in Figure 69, Figure 70, and Figure 71.

Table 4: Subsurface Isolated Features

Object ID	Coordinates (WGS84)		Coordinates (Easting, Northing)		KP	DCC	Depth Below Seabed (meters)
Isolated Feature 1 (SBP_1)	33;51.8078536 N	118;27.8356855 W	14073956.22	9269295.073	1061.4128	-203.10	11.15
Isolated Feature 2(SBP_2)	33;51.9879773 N	118;26.8990975 W	14075381.21	9269623.590	1062.9558	-213.27	7.77
Isolated Feature 3 (SBP_3)	33;51.9383843 N	118;27.7342704 W	14074110.52	9269533.139	1061.7019	-446.90	2.93
Isolated Feature 4 (SBP_4)	33;51.8547459 N	118;28.1144291 W	14073532.12	9269380.596	1060.9128	-138.04	4.1
Isolated Feature 5 (SBP_5)	33;51.7030801 N	118;27.5547991 W	14074383.58	9269103.988	1061.8579	37.33	5.8
Isolated Feature 6 (SBP_6)	33;51.6982834 N	118;27.4216121 W	14074586.22	9269095.240	1062.052	97.01	16.32
Isolated Feature 7 (SBP_7)	33;51.7136707 N	118;27.4939566 W	14074476.15	9269123.303	1061.9524	42.04	9.77
Isolated Feature 8 (SBP_8)	33;52.0995606 N	118;26.7179634 W	14075656.80	9269827.106	1063.2743	-340.53	6.58
Isolated Feature 9 (SBP_9)	33;51.8994167 N	118;28.1963500 W	14073407.48	9269462.068	1060.7652	-158.70	9.82

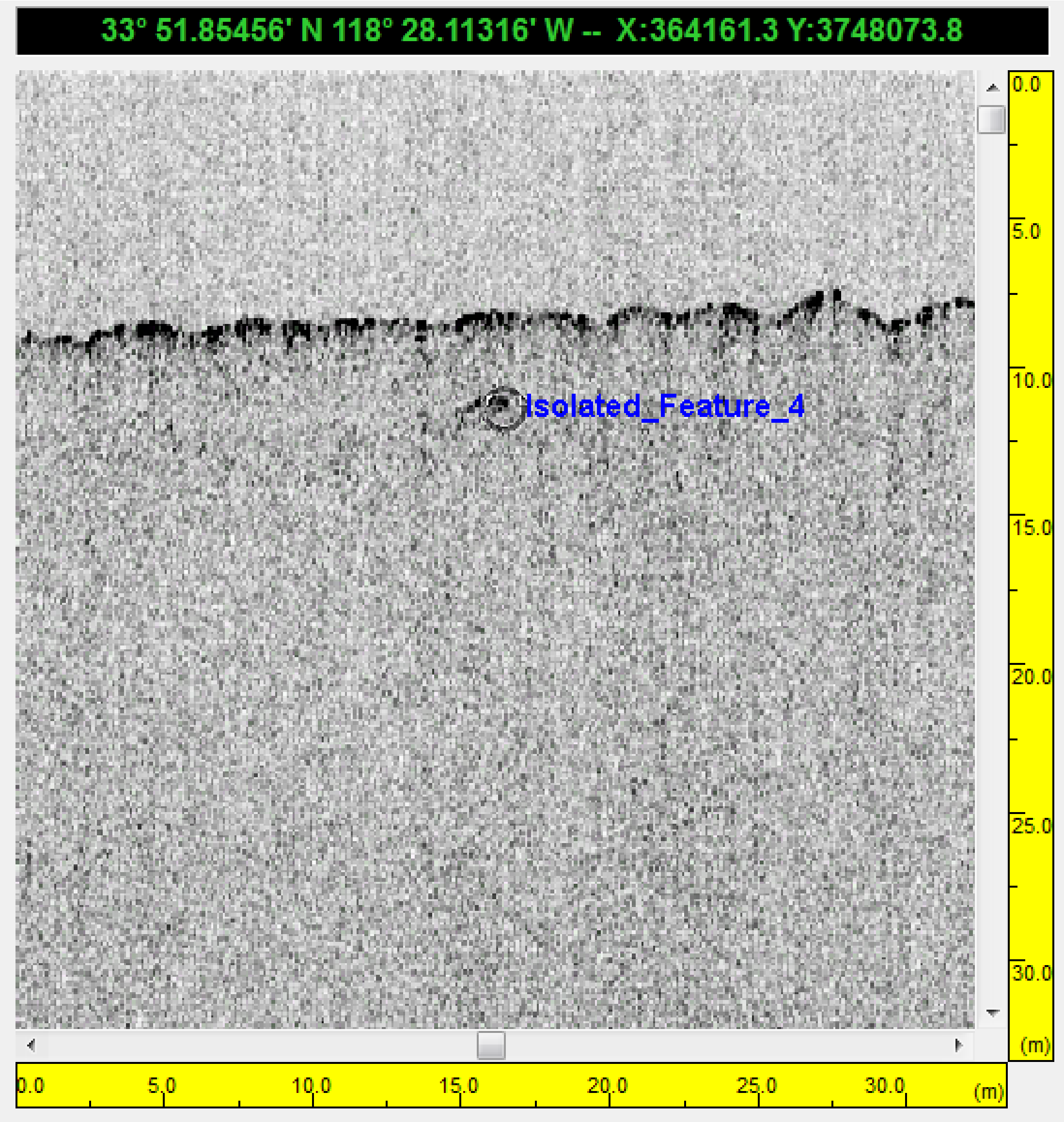


Figure 69: Isolated Feature 4 (SBP_4) - An Unknown Subsurface Anomaly 3m below the Seabed

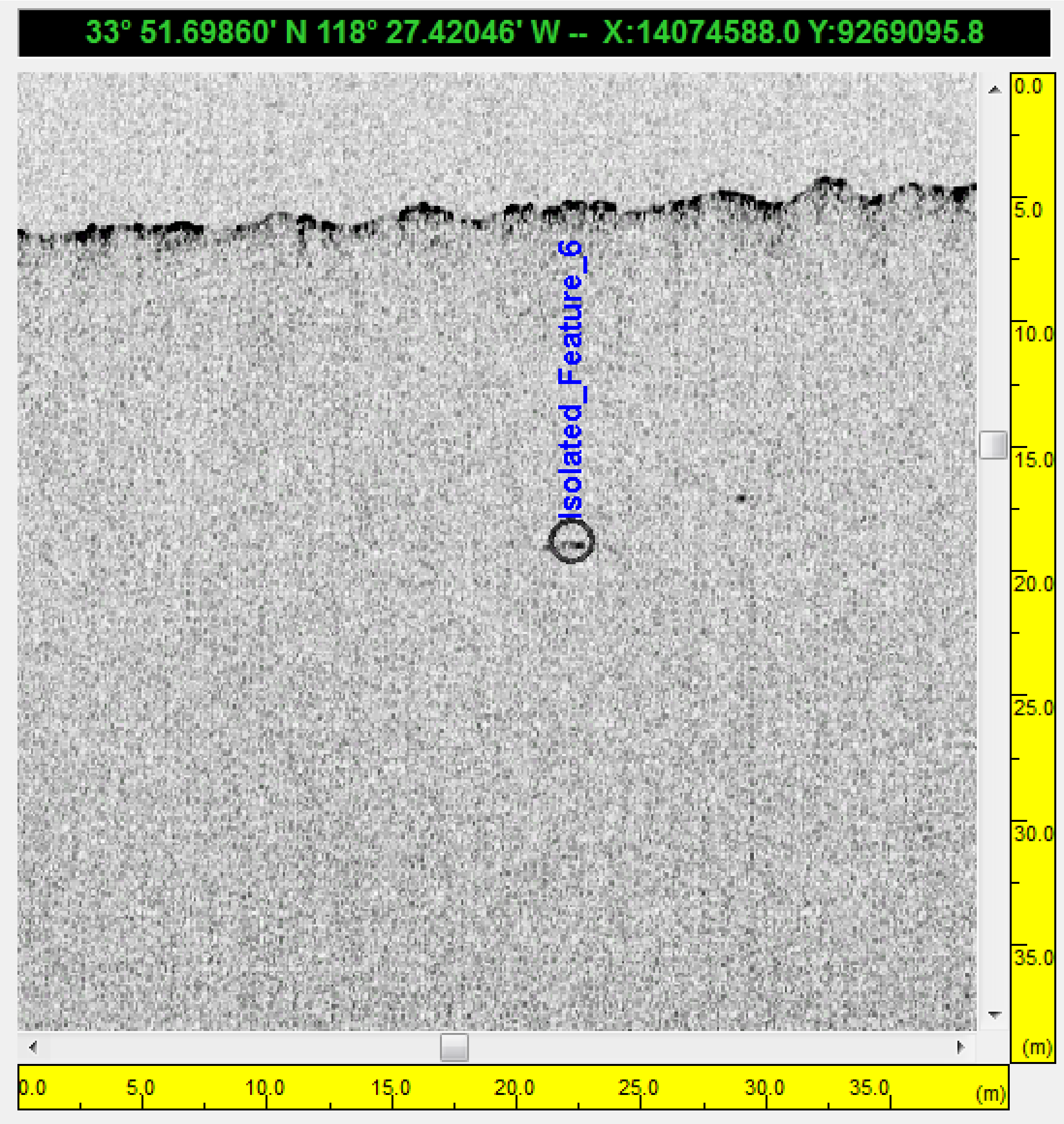


Figure 70: Isolated Feature 6 (SBP_6) - An Unknown Subsurface Anomaly 12m below the Seabed

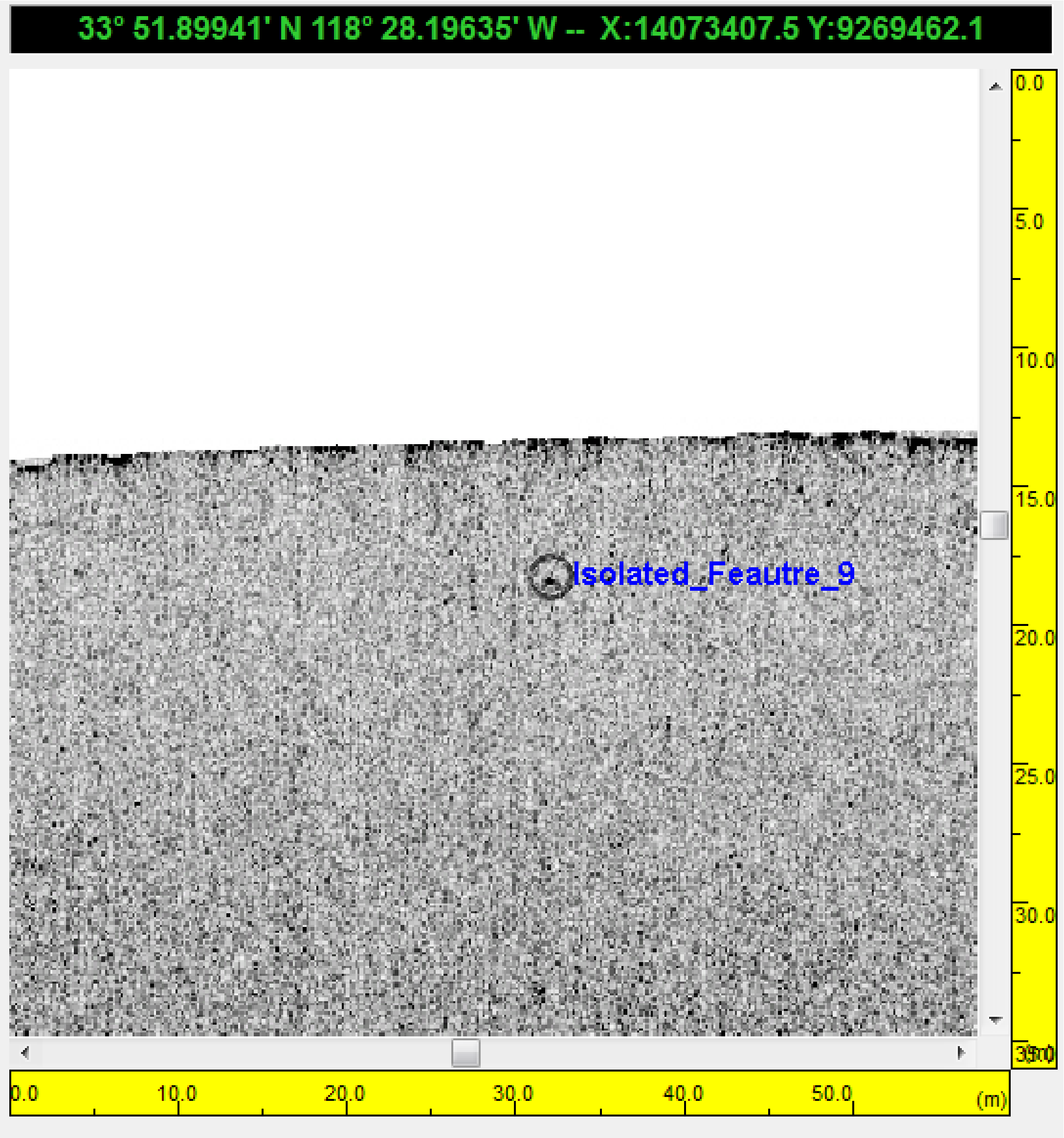


Figure 71: Isolated Feature 9 (SBP_9) - An Unknown Subsurface Anomaly 5.5m below the Seabed

7 CONCLUSIONS

The Hermosa survey comprised of multibeam, singlebeam, sidescan sonar, and sub-bottom profiler along the proposed cable route. Sediment samples were also conducted along the cable route to establish sediment types for correlation with the bathymetric and geophysical data. Topographic data was also collected on the beach in the proposed corridor and BMH.

Generally, the seabed gradient in the survey area is shallow, with the exception of a shelf that was observed at the western end of the survey area with an approximately 14% grade slope. Depths in the survey area range from approximately 1m LAT to 99m LAT.

The majority of seabed sediments along the proposed route were found to be composed of soft sandy/silt and clay. As you approach the shoreline of Hermosa Beach to the Hermosa BMH along the alignment the seabed sediments change from the Soft Sandy Silt Clay of the Western offshore area and Central area to coarse sand with shell fragments, clayey sand with shell fragments, and loose sand with shell fragments.

The major seabed features observed along the corridor were a gas seep that was visible in MBES, SSS, and SBP data, and a slope visible in the MBES and SBP data and small debris features visible in the SSS data.

Thirteen (13) objects with a strong return were found in the survey area using sidescan sonar. All 13 objects were classified as debris with 1 of the objects being a cluster of identifiable 20"+ tires and another identified as possible exposed pipe.

Twelve (12) isolated subsurface features were identified across the survey area using CHIRP sub-bottom profiler.

Nine (9) subsurface sediment facies were identified in the CHIRP sub-bottom data.

Nine (9) categories of horizon or subsurface sediment unit were created; shallow water subsurface horizon (horizon found in the shallow water depths from 0-20m), two medium water depth horizons (located in water depths of 25-50m) were identified and divided as A and B. A final deep water depth horizon was identified (below depths of 65m). In addition, the bottom of the deposit layer horizon, a deep chaotic unit, a mixed deposit unit, isolated uneven horizon and subsurface disturbance unit were identified.