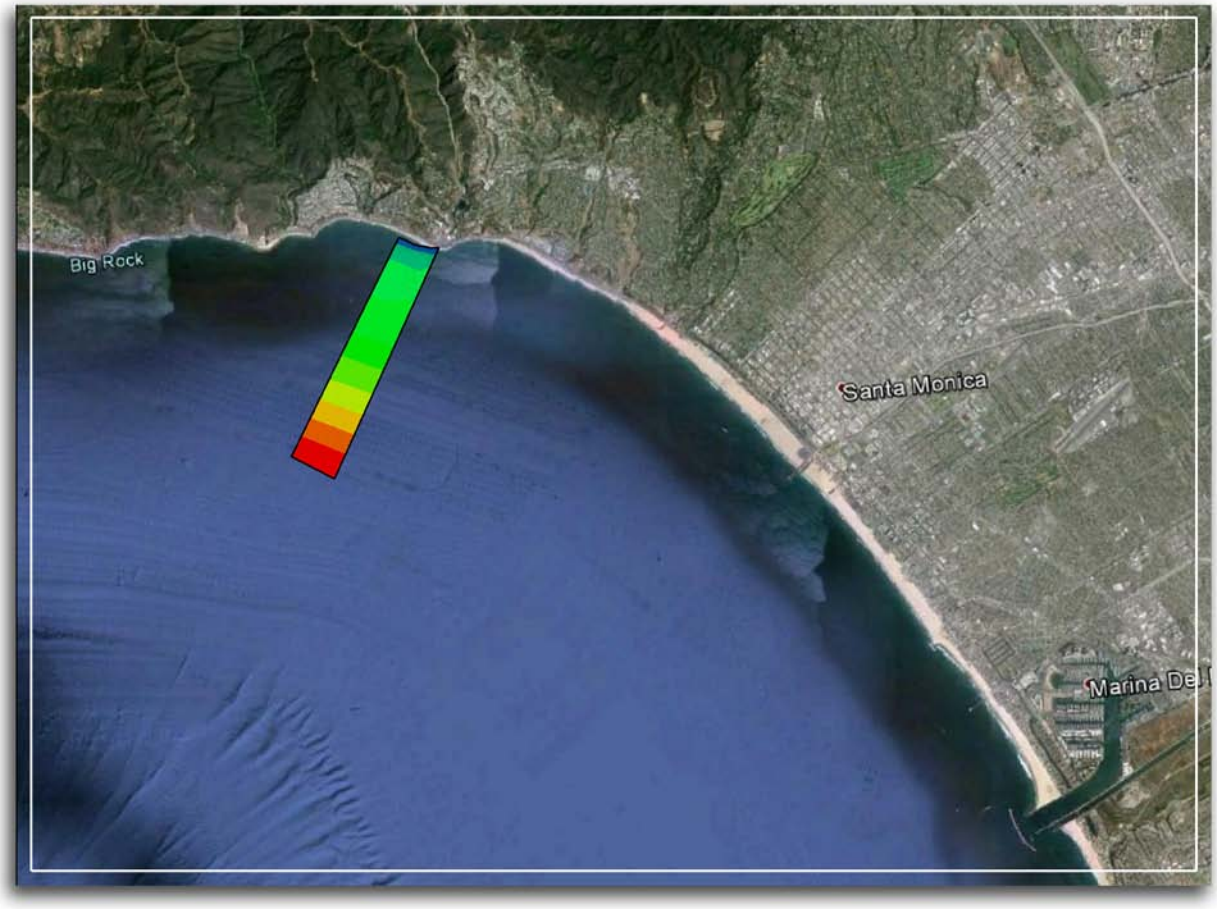
Sylmar Cable Route Survey

Gahagan & Bryant Associates, Inc.

Multi Beam / Side Scan / Sub Bottom Hydrographic Survey



November 2015

PREPARED FOR KINNETIC LABORATORIES INC.

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Executive Summary:

Multi Beam / Side Scan / Sub Bottom Survey of Sylmar Cable Route

Gahagan & Bryant Associates (GBA) performed a Multi beam / Side Scan / Sub bottom survey in the area offshore of Santa Monica, California. Figure 1 below displays the survey coverage area. This survey was conducted on November 18 & 19, 2015. The survey area was started at a safe distance nearshore to approximately 2 miles off shore with a width of 2000'. The purpose of this survey was to investigate the sea floor and sub sea floor conditions in an area for a proposed cable route.

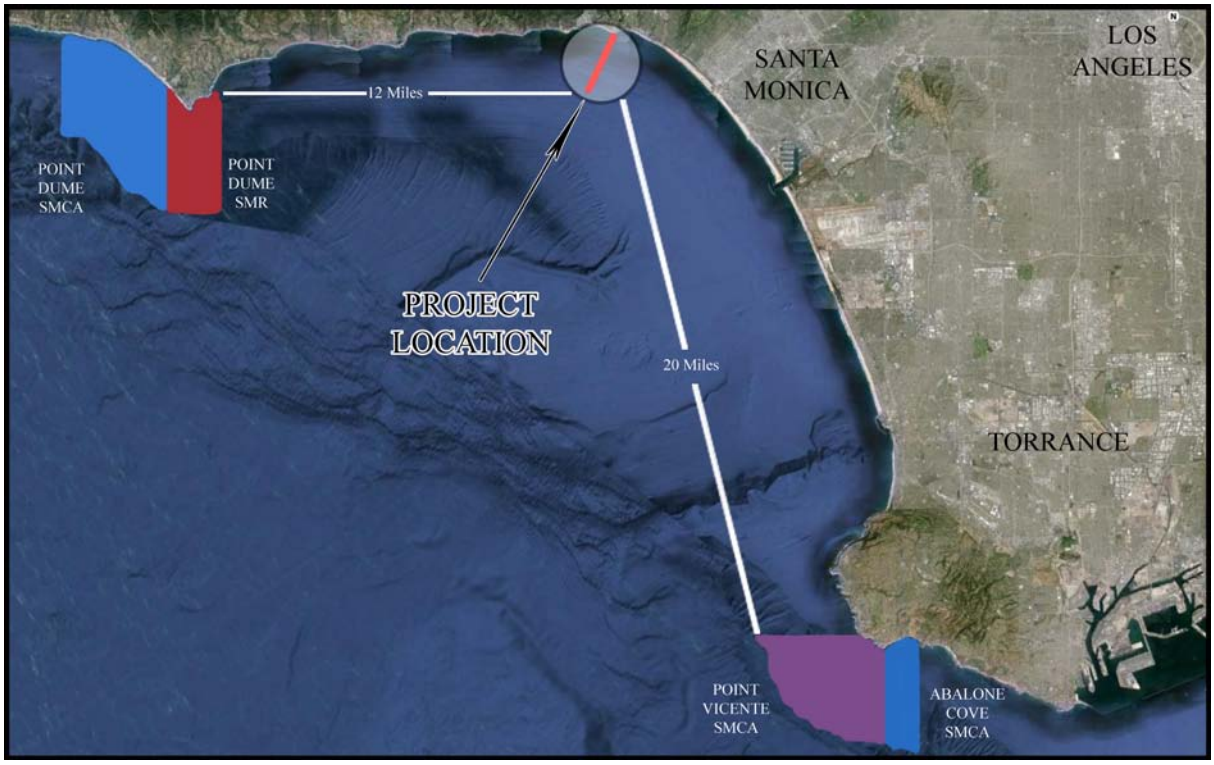


Figure 1: Survey Location: Santa Moncia Bay.

The multi beam sonar is capable of providing 100% bottom coverage of the survey area. The swath of acoustic returns collected provides highly accurate horizontal position and depth information. The multi beam data can also be used to locate large debris and obstructions on the bottom. Items like small boats and containers can be potentially identified with multi beam sonar. A model can be derived from the x, y, z information and the topography of the bottom can be mapped. The side scan sonar provides a dense display of the sonar return strength that amounts to something more akin to a photograph. This higher resolution display allows for smaller and more detailed shapes to seen and often results in more recognizable objects and improved target identification. The side scan sonar's optimal data collection method requires that the sonar "fish" be located approximately 20% of the total depth off the seafloor. This is accomplished by towing the fish behind the boat. Due to the variability in the distance off the bottom and the horizontal variability in towing the fish, the location of targets identified by the side scan can only be approximated. Combining the two methods, the side scan can be geo-

referenced and overlaid on the multi beam model to improve the x,y,z position accuracy of targets identified. Finally, the sub bottom data is collected via a low frequency acoustic pulse that penetrates multiple layers of subsurface strata. Using the multi beam data to determine the seafloor elevation, the sub bottom data can be used to determine the elevation of different material type interfaces.

EQUIPMENT:

Navigation

A Global Position System (GPS) with differential corrections broadcast by USCG Navigation Beacon provided vessel and towfish positioning. The accuracy of this system at the survey vessel is +/- 1 meters with a 95% confidence level. A dual Differential GPS (DGPS) receiver arrangement was utilized to provide position and heading information. DGPS location information was interfaced to Hypack navigation and data acquisition system to provide navigation information required for the operator to position the vessel along the pre-planned transects.

Multi beam

The R2 Sonic 2024 multi beam system was used to collect the bathymetric data and potentially provide an increased accuracy to targets identified with the side scan sonar. The multi beam was also used to provide the seafloor elevation which serves as the basis for analyzing sub bottom stratifications. The multi beam survey data was collected at an interval designed to ensure 100% bottom coverage of the survey area. The multi beam sounding information was the initial check to identify objects that may pose potential obstructions to the cable route. The multi beam data was collected using the dedicated survey vessel “Tati B”. Additional information on the R2 Sonic 2024 system can be found in Appendix A.

Side Scan Sonar

The Side Scan Sonar system used for this project was the Edgetech 4200 dual frequency, digital Side Scan with Oceanic Imaging Consultants (OIC) “Geodas” data collection and processing software.

The 4200 is one of the latest generation of digital, fully instrumented, side scan systems able to operate simultaneously at both 300 KHz and 600 KHz, providing very high resolution images. To provide the highest possible resolution and obtain 100% overlap across the entire survey area, the sonar was operated at a range of 75M per channel yielding a total swath of approximately 150M per line. With 50M line spacing, this range gave 150% overlap with 100% coverage throughout the survey area. Additional information on the Edgetech 4200 system can be found in Appendix A.

The side scan tow fish was deployed from a stern mounted "A" frame on the vessel "Theory" using a hydraulic winch, equipped with slip rings and cable payout metered sheave. The side scan sonar data is logged along with the vessels position and cable length deployed, using OIC's Geodas sonar collection software. Other than the actual sonar data, a number of other parameters are also available from the onboard sensors and are displayed in real time. These include, tow fish heading, towfish pitch and roll, towfish depth and towfish altitude.

Sonar layback was determined by combining the cable payout with the sonar recorded depth. OIC's Clean Sweep post processing software determines a sonar layback from the cable counter and recorded depth data, and combines it with navigation information to calculate a final fish position.

Most modern Side Scan Sonar systems consist of four main components:

1) Tow Fish (Torpedo shaped underwater tow vehicle)
2) Tow Cable (Kevlar reinforced tow cable)
3) Transceiver (Topside control unit)
4) Acquisition Software (Running on Windows PC)

Overview of operation - The tow fish consists of two transducers (port and starboard), transmitter electronics, receiver and digitizer electronics mounted in a torpedo shaped pressure housing. On each side of the tow fish transducer line arrays are set up to transmit and then receive the returns from each side of the survey vessel's track line. The line arrays are used to convert an electrical signal into an acoustic pulse (transmit) and also convert the acoustic echo back into an electrical signal. The transducers are designed such that they produce a vertical fan beam that is very narrow in the along-track direction, but very wide in the across-track direction. Both transducers are 'fired' simultaneously to ensonify a narrow swath of the seabed perpendicular to the direction of travel.

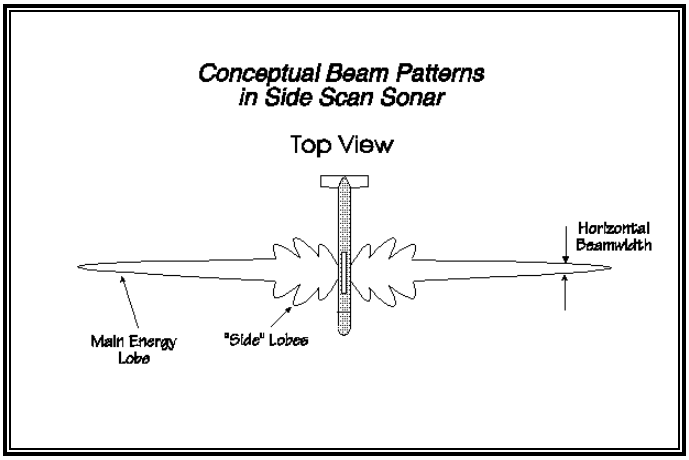


Figure 2: Top View of Side Scan Sonar Beam Pattern.

The transmit pulses are high power and very short in duration. A typical source level for modern digital side scan sonar is 220 dB +/- 3dB ref 1 µPa @ 1 meter. A series of echoes are then received, first from the sea bed directly under the tow fish and then from the sea bed perpendicular to the tow fish direction of travel. The echoes are used to build up an amplitude verses time plot (or trace) for each side of the vessel. These signals are amplified and digitized in the tow fish and then transmitted, via the tow cable, to the processing system. The processing system performs further signal processing before displaying the amplitude verses time plot on a waterfall display.

As the tow fish moves forward, a series of these amplitude verses time plots are laid side by side to produce a scrolling waterfall display.

Light areas on the display represent strong acoustic reflectors such as rocks, ledges, man-made debris and sand ripples. Dark areas of the display represent depressions, occluded regions and shadows. With the proper processing, the port and starboard halves of the image may be sutured to form a uniform swath. The swath may then be collaged with adjacent swaths to produce a seamless image of the sea floor.

The Side Scan Sonar produces an image of the seabed, similar to an image produced by an aerial photograph. Since the sonar fish is towed relatively close to the seabed and any targets are "illuminated" from the side rather than overhead, acoustic shadows can be used to calculate a target's height as well as its size. Additional information on the side scan sonar can be found in Appendix A.

The height of an object may be measured by comparing the similar triangles formed by

- The Fish height and slant range to target
- Acoustic Shadow length

This calculation is performed by the data collection software, either in real time during data collection or during post processing.

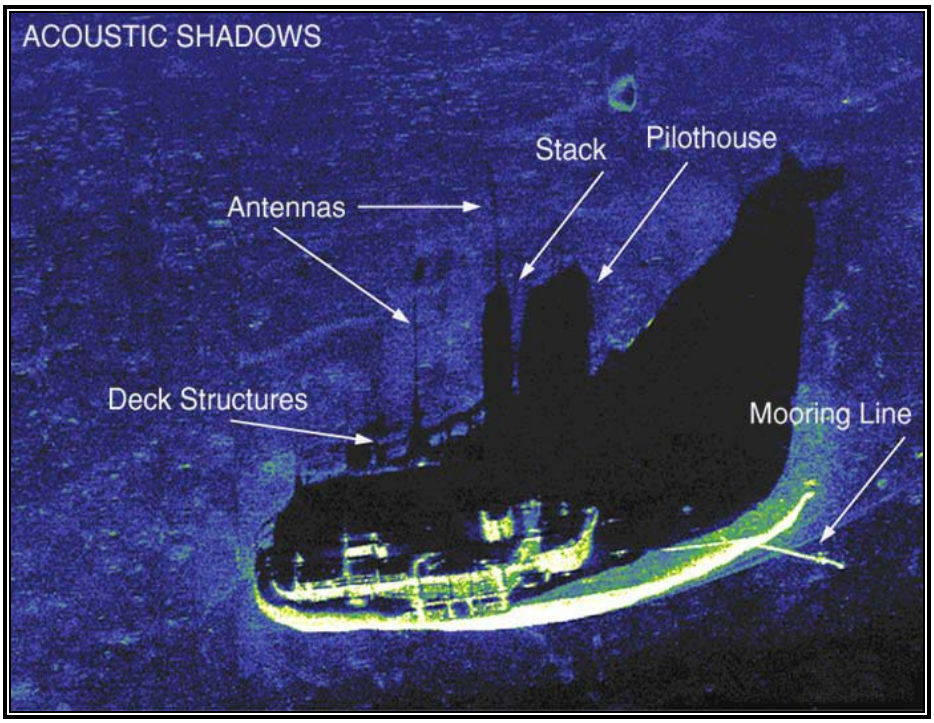


Figure 3: Example Data of Acoustic Shadows Generated By a Large Wreck.

Once all the data is collected a mosaic is generated based on tow fish position and heading. All the survey lines will then be combined into a single geo referenced image.

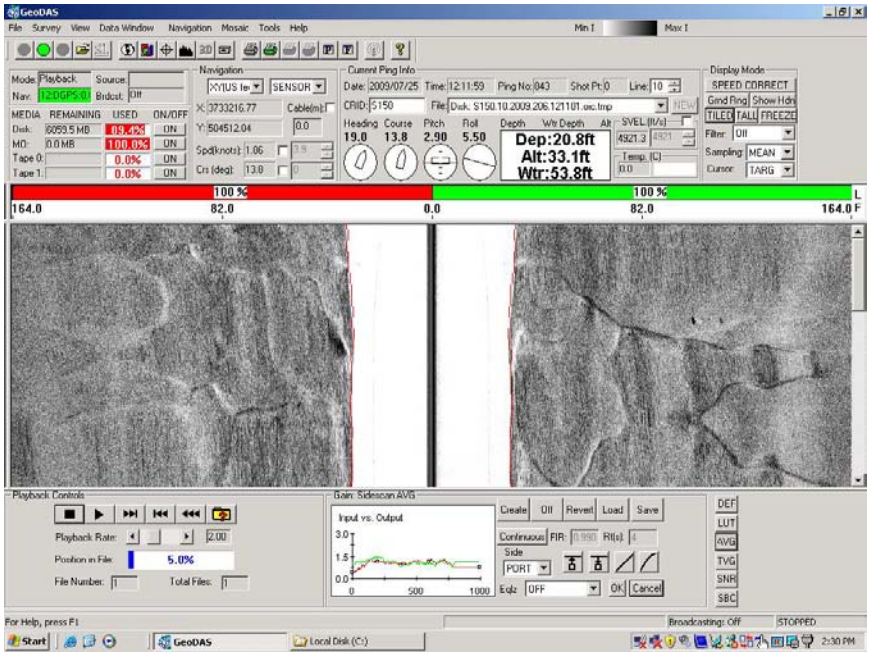


Figure 4: Example of OIC's "Geodas" Real Time Side Scan data collection display

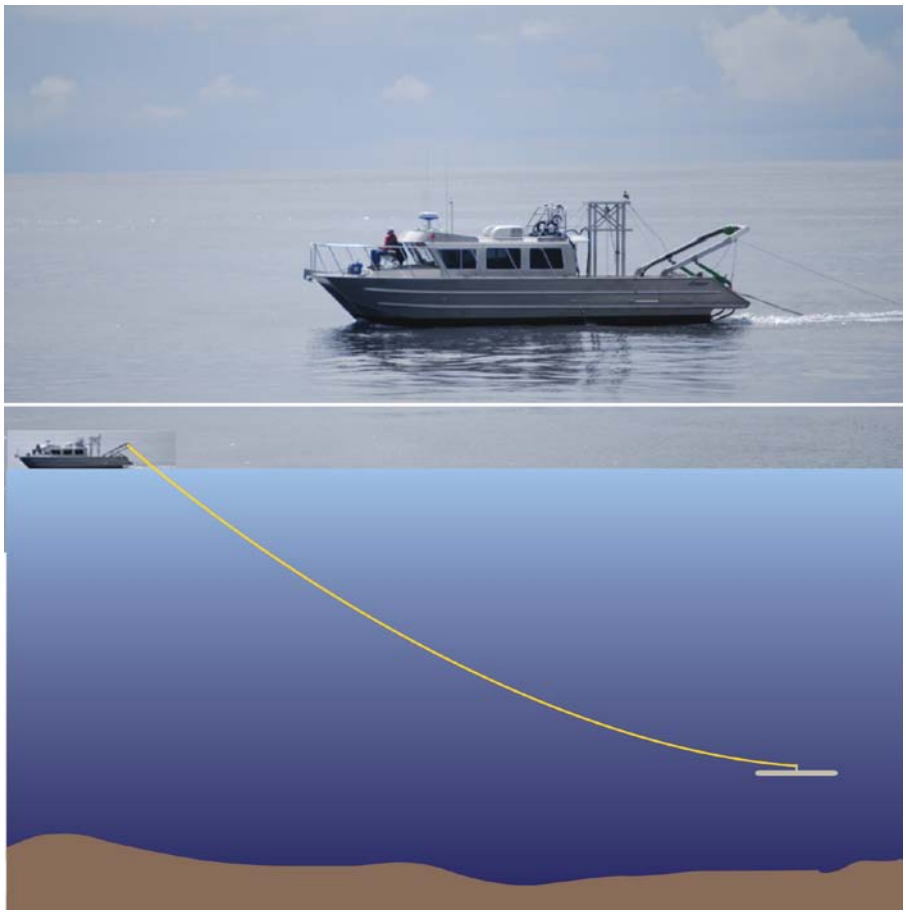


Figure 5: Schematic representation of sidescan sonar / sub bottom towing configuration .

Sub-Bottom Profiler

The Sub Bottom Profiler (SBP) is a tuned transducer system. Piezoelectric crystalline materials undergo deformation when subjected to an electrical signal. Conversely, if this same material is deformed, for example by an acoustic pressure wave, it will generate an electrical signal. A tuned transducer is constructed by forming these crystalline materials into various shapes and then placing them in a mechanically rugged housing. This device is capable of emitting and receiving acoustic signals at the frequency for which it was designed and constructed. Additional important characteristics that depend on the design are the conversion efficiency, the power handling capability, and the beam width of the transducers.

The complete system consists of separate transmit and receive transducers housed in a hydrodynamic tow fish, transceiver and a recording system. The transceiver contains a transmitter that controls the pulse length and provides the electrical power at the proper frequency for driving the transducer. The receiver section of the transceiver amplifies the electrical signals coming from the transducer for display and storage on the recording system.

All continuous sub bottom profiling systems are dependent upon generation of relatively low-frequency, regularly pulsed acoustic energy (sound) and the detection and recording of that part of the sound output that is reflected back from boundaries between sub bottom materials of different acoustic impedance. The acoustic energy is introduced directly into the water beneath or behind a moving boat. Reflections resulting from each separate sound pulse are detected and are automatically correlated and successively displayed on a waterfall type computer display - hence, a cross section with constant scales is produced. The pulse rate of the energy source will determine the maximum range of the profile obtained, although fast pulse rates may be limited by the capacity of the sound source.

The horizontal scale is determined by the speed of the vessel, converted to distance and the vertical scale is controlled by the travel time of the sound waves in the water and sediment or rock below the seabed.
In general terms, the lower the frequency of the sound source the lower the resolution of the acquired data obtained. Because of this inherent inverse relationship between degree of resolution and penetration it is impossible to obtain both high resolution and deep penetration as with any acoustic system, a compromise is always necessary.

Recent developments in SBP systems have resulted in the "Chirp" (or spread spectrum) technology which improves on the original design by using a sweep (or Chirp) of frequencies instead of a single frequency. Most Chirp systems operate in the 2 KHz to 20 KHz band. The use of Chirp technology also allow for the use of matched filters in the receiver which can significantly improve the signal to noise ratio (SNR). The chirp transmit pulse is significantly longer than a single frequency system which allows the peek power to be reduced.
In very simple terms the SBP can be considered a single beam echo sounder that is able to not only receive a reflection from the sea bed but to penetrate the sedimentary layers of the sea bed. The amount of sub surface penetration will depend on many factors such as the sea bed material, organic growth, and vessel or background noise.

The Sub-Bottom profiler is able to detect sub seabed strata, buried pipelines and other covered debris as well as shallow gas and other potential hazards. There are many variations of the sub-bottom profiler and the term covers a wide range of devices. The main difference between types of SBP is the power level and frequency of the sound source. In general the lower the frequency and higher power will result in greater penetration of the seabed at the expense of lower resolution. The systems resolution is a parameter that defines the smallest vertical distance that can be defined. A typical resolution of a chirp type SBP is 1 to 2 feet but this is very dependant on a number of external factors.

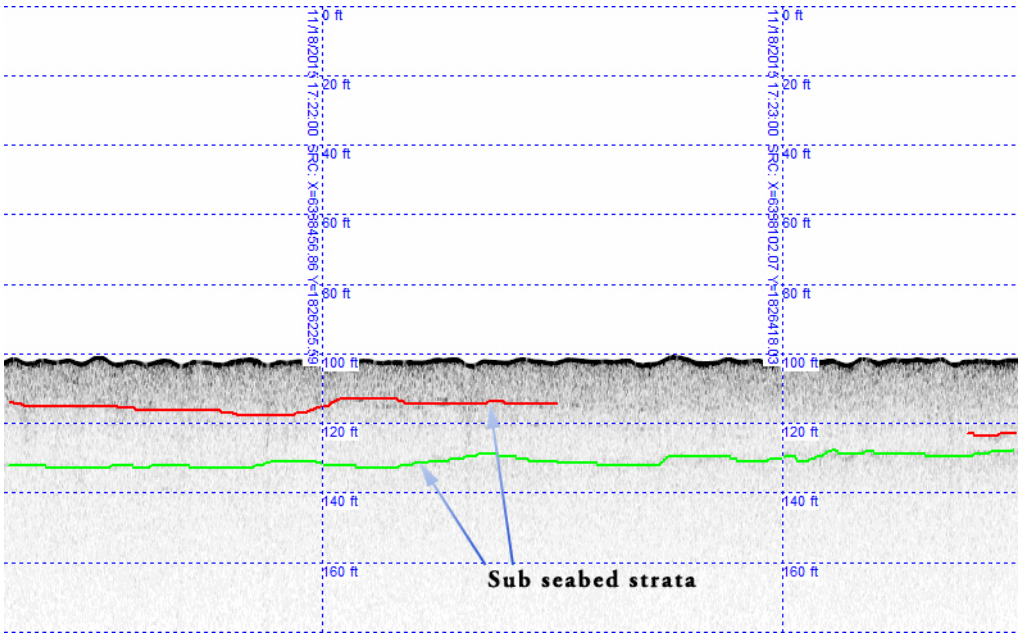


Figure 6: Sub bottom data display

RESULTS:

Multi Beam

The multi beam data was processed using Hypack and a standard 3'x3' average cell center bin was exported. GBA included bathymetry and contours (5' interval) of the multi beam survey in the plan view CAD drawing as well as an xyz ascii file.

Side Scan Sonar

All Meta data was cleaned and smoothed using OIC's "**N**avigation **A**nd **P**rocessing" (NAP) utility. OIC's Cleansweep III was then utilized to adjust bottom tracking and gain adjustment to obtain optimum image quality across the entire 75M.
Even though Geodas has a very reliable and robust bottom tracking algorithm, mid water features (such as fish, sea noise and vessel noise) can cause the bottom tracker to momentary "lose" the seabed. The loss of bottom tracking results in changes in the Time and Angle varying gains (TVG) (AVG), resulting in less than optimal image quality during data collection. These problems are easily corrected in processing as the data recorded is raw – ie no video gains have been applied. Cleansweep III allows the operator to use the original (from real time) bottom tracking or allows the operator to manually correct any bottom tracking problems.
After bottom tracking has been optimized, TVG and AVG adjustment are reapplied to compensate for signal attenuation and transducer lobe variations.

Offsets from the primary DGPS antenna to the side scan tow fish were calculated based on offset from DGPS antenna to tow point, cable out and tow fish depth. After gains and bottom tracking had been optimized a mosaic of the entire project was generated. The resulting mosaic generated is at a resolution of 2 pixels per meter.

The mosaic was rectified into a geotiff image and overlaid in CAD on to publicly available geo-referenced satellite imagery. The mosaic was reviewed to identify targets that may represent obstructions or objects of interest within the survey area.

Side scan sonar data was acquired over the project area on 50m line spacing with 75 meter range. Data was acquired as close to shore as feasible with the full coverage shown below.

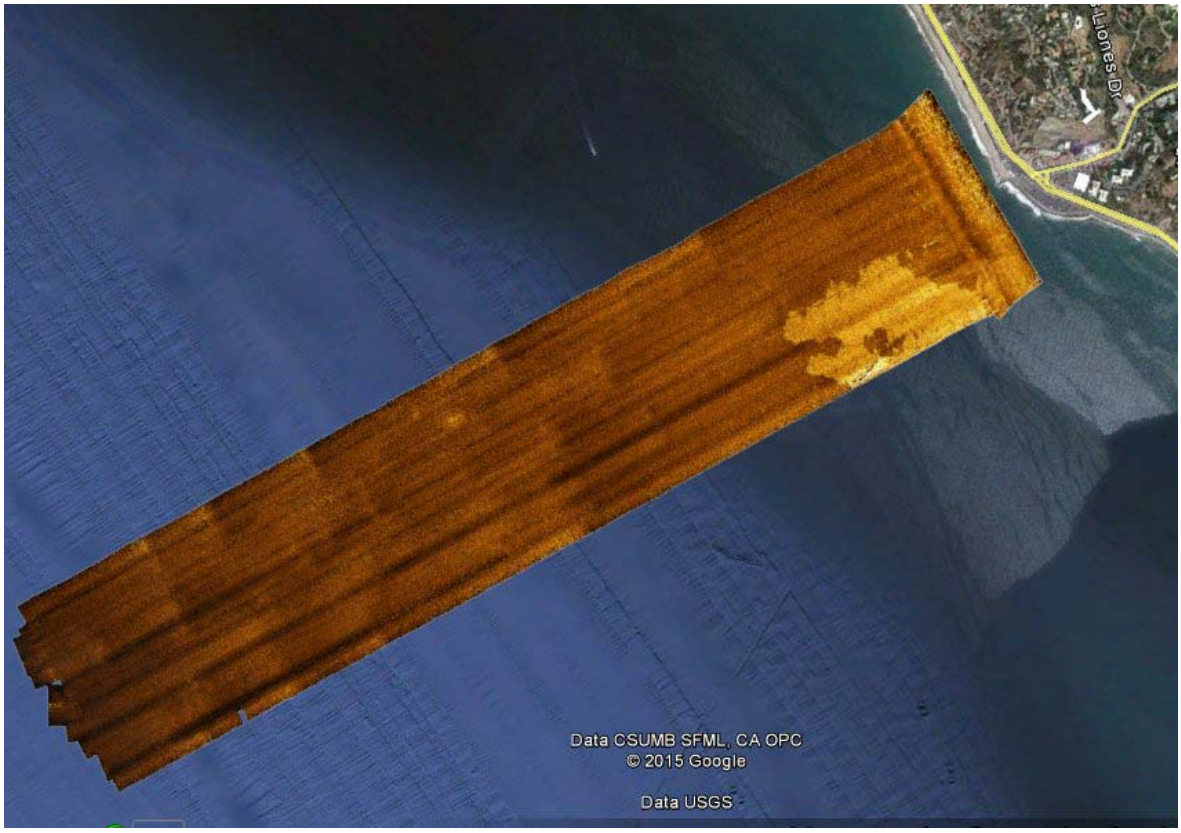


Figure 7: Side Scan Sonar Data

Of the data acquired the majority was a soft bottom with no features (darker brown color) The other surfaces were the hard surface and nearer to shore scattered rocks as shown below.

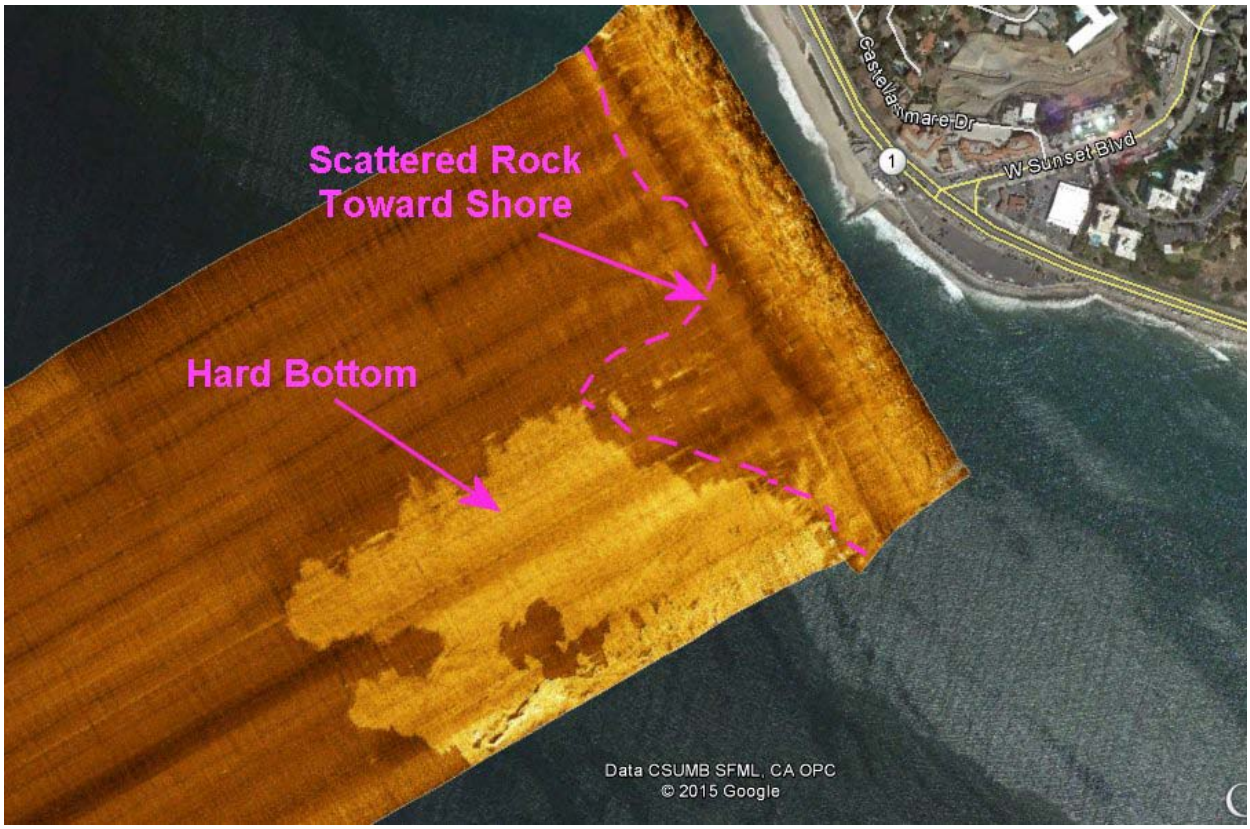


Figure 8: Side Scan Sonar Data Detail

In terms of targets, a trench was visible crossing the area as well as a cable or wire laying across the hard bottom.

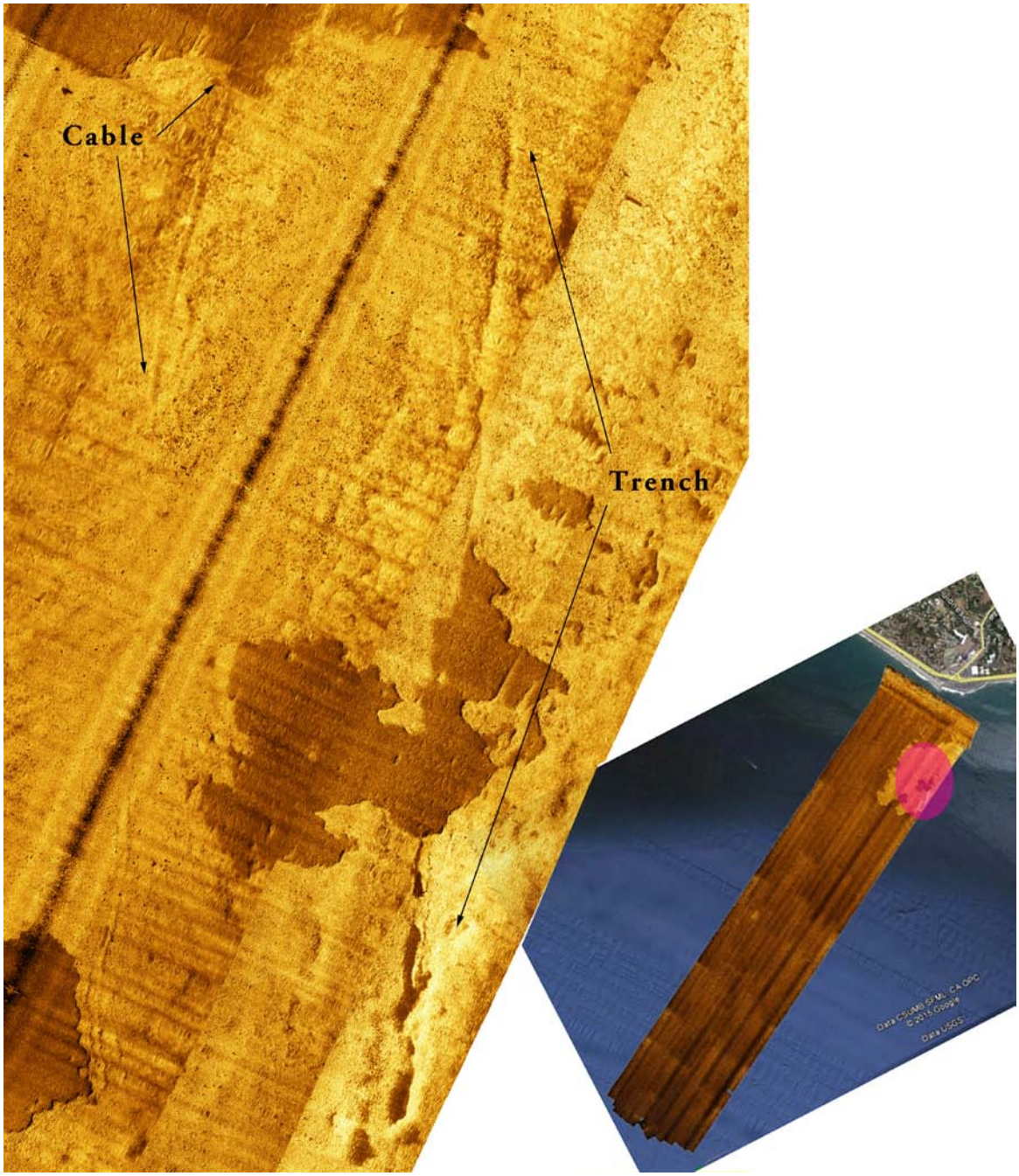


Figure 9: Side Scan Sonar Targets

Numerous scattered rocks exist within the survey area and were not identified individually. In addition, there are in many places in the side scan data and side scan mosaic that have anomalies that would appear to be possible targets. However after review of adjacent transects, in which those anomalies are not present, it was determined that they are probably fish. Image below is an example of those anomalies in the side scan data that are part of the mosaic and are fish. Note – for the most part these schools of fish are located on the outer 1/2 of the project area.

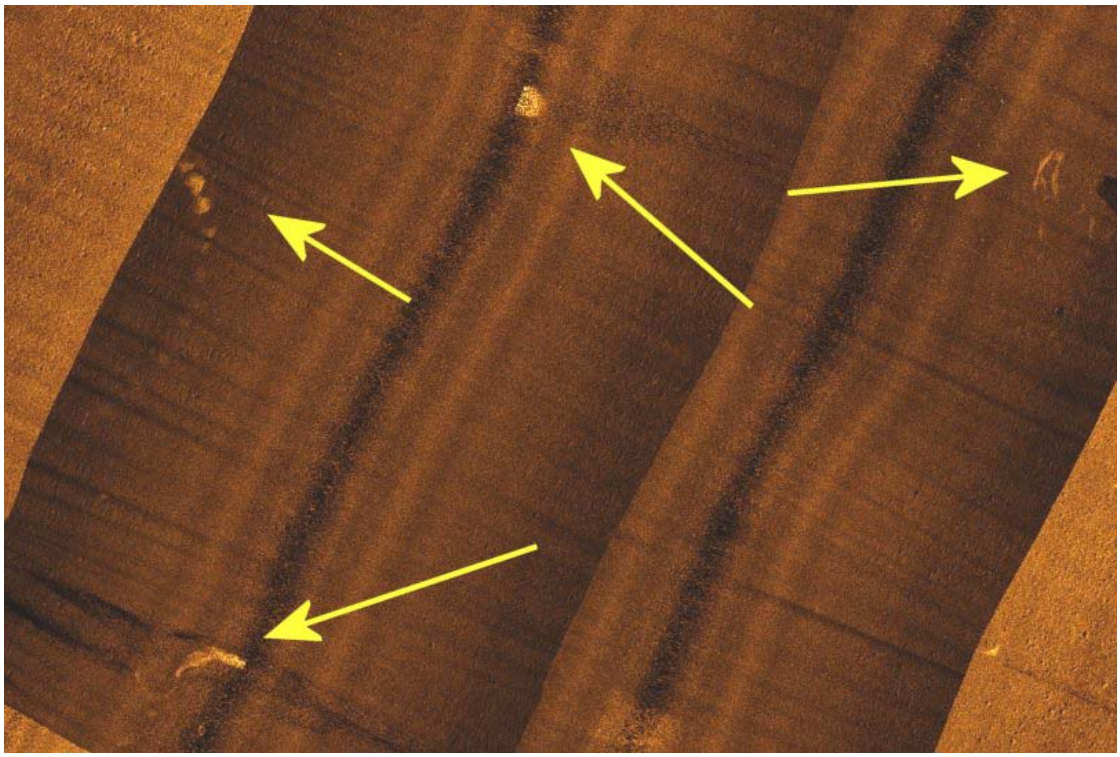


Figure 10: Side Scan Sonar Anomolies

Sub Bottom Profiler

Chesapeake Technologies "SonarWiz 5" software package was used to process and inspect the sub-bottom profiler data. SonarWiz 5 first converts the Discover *.jsg format into **C**ompressed **S**onar **F**ormat (CSF) during data import. Gains and bottom tracking were adjusted to obtain a solid first return from the seabed. This first return was then converted to a reflector to be used as a reference depth. Other layers, when visible, were also digitized and exported in the same manner, no conclusions were made as to the geology. The exported sub bottom images were imported into CAD and referenced to the vessel trackline to provide approximate position of sub bottom survey findings within the survey area.

The sub bottom data showed a typical pattern

1) hard bottom near the shore
2) 2nd layer developing past the hard bottom noted on the side scan.
3) 2nd layer was periodically obscured by a harder layer. Some of those areas of a shallower hard layer may be gas pockets.

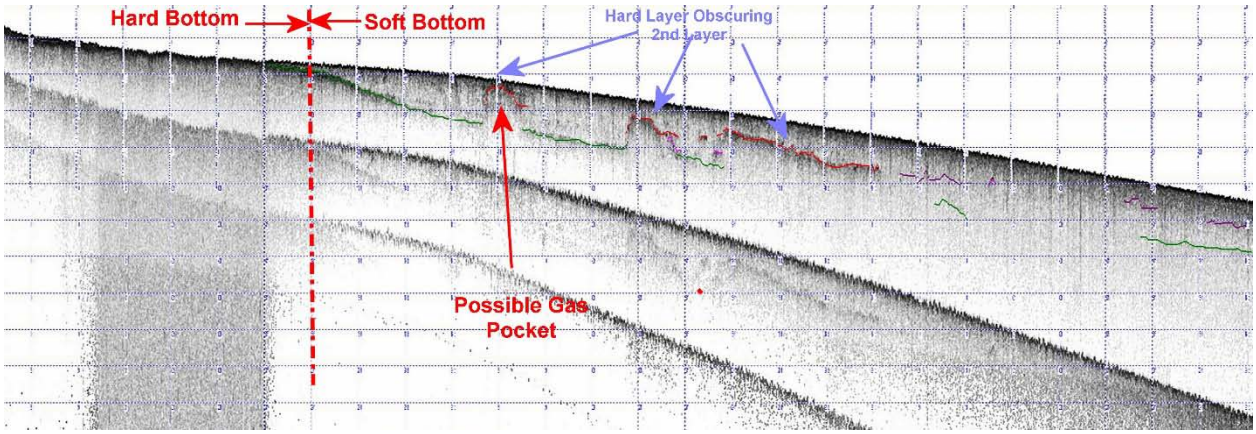


Figure 11: Sub Bottom Typical Result

The side scan penetration layer overlayed on the side scan is shown below. The colored steaks across the side scan mosaic are the locations where sub bottom data exhibited a 2nd layer below the immediate surface that could be digitized. It is easily visible that in the area of hard bottom no penetration in sub bottom is visible.

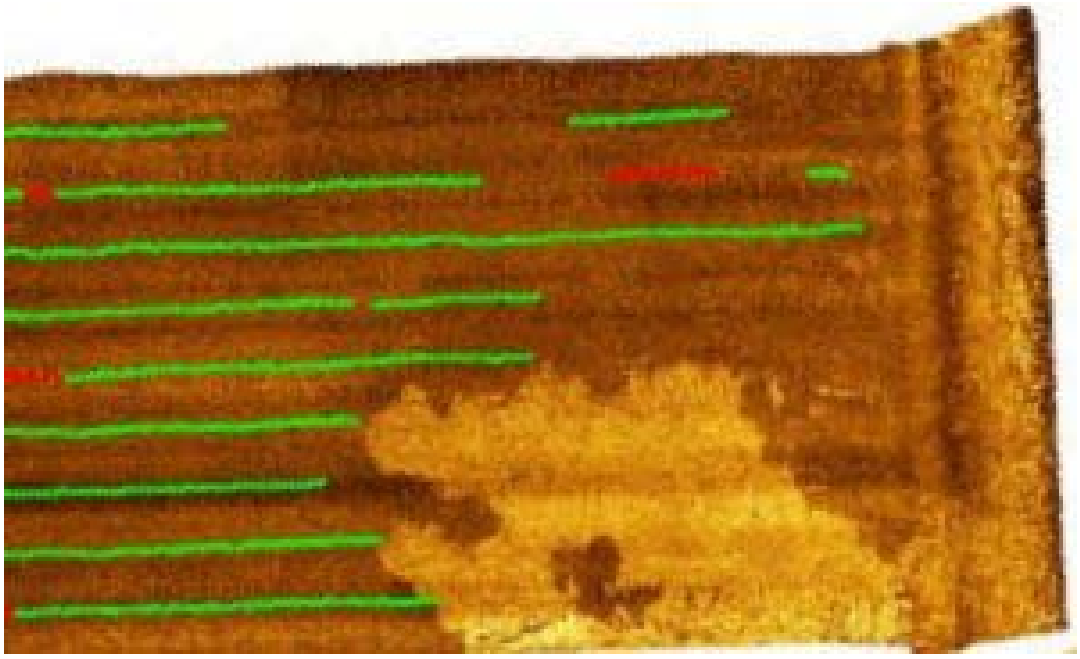


Figure 11: Sub Bottom Penetration on Side Scan Return

Processing Considerations

A problem common to all, single channel, continuous recording profiling systems is recognition of multiples. Multiples can occur when sound energy reflects from the water bottom, travels back to the air-water interface, and is reflected downward a second time. When sufficient energy is involved and sediment conditions are conducive, as many as four or five or even more round trips are observed. In deeper water the multiples will be offset from the area of interest and are not a major problem, but as the water depth is reduced the multiples may obscure the real area of interest. A more problematic situation can occur when multiples are mistaken for real primary data. Other than experienced human interpretation, there is no automatic method that multiples can be removed from a single channel data set. However, multiples can be detected visually, as the second multiple will have exactly twice the depth and twice the slope (twice the vertical distance with the same horizontal distance) as the original return. Each succeeding multiple will be displaced further downward by a distance equal to the water depth. Due to the effect of Time Varying Gain (TVG) applied to the raw data, multiples can appear stronger than the original reflections.

A second common problem is transducer reverberation. This occurs more often in single frequency pulse systems where the transducer will continue to "ring" after the end of the transmit pulse. The result is a widening of the transmit pulse and less well defined returns from the seabed strata. The effect is less evident in chirp systems as the total energy is spread over a wider pulse length.

Shallow gas and / or organic material will rapidly attenuate acoustic pulses in this frequency band. Most of the acoustic energy is absorbed by the gas or organic material and very little energy passes thru to be reflected by lower changes in the seabed. This can also occur when the organic material is in the water column and appears as "gaps" in the sub-seabed strata. With high frequency sub-bottom systems it is usually possible to differentiate areas of soft clays and silts from areas of dense sands at the immediate water bottom. The latter materials allow much less penetration and usually result in a series of strong multiples. However these are not absolute criteria because the presence of air and gas bubbles (as discussed above) can have essentially the same effect.

Sensor Offsets

Offsets between the DGPS antenna, the Side-Scan Sonar tow point and the Sub-Bottom tow fish were measured and applied to calculate the sensor positions.

DGPS primary antenna to Side Scan Tow Point

Side Scan Tow Point is 13.6 ft Aft of the DGPS antenna
Side Scan Tow Point is 4.2 ft Starboard of the DGPS antenna

DGPS primary antenna to Sub Bottom Fish

Sub-Bottom Profiler is 13.6 ft Aft of the DGPS antenna
Sub-Bottom Profiler is 4.2 ft Starboard of the DGPS antenna

APPENDIX A

2 SONIC SPECIFICATIONS

2.1 Sonic 2024 System Specification

System Feature	Specification
Frequency	400kHz / 200kHz
Beamwidth – Across Track (at nadir)	0.5°@ 400kHz / 1.0° @ 200kHz
Beamwidth – Along Track (at nadir)	1.0° @ 400kHz / 2.0° @ 200kHz
UHR Beamwidth (at nadir)	**0.3° Across Track x 0.6° Along Track**
Number of Beams	256
Swath Sector	10° to 160° (user selectable)
UHR Swath Sector	**10° to 60°** (user selectable)
Maximum Slant Range	1200 metres
Pulse Length	15µSec – 1000µSec
Pulse Type	Shaped Continuous Wave (CW)
Depth Rating	100 metres (3000 metres optional)
Operating Temperature	-10° C to 40° C
Storage Temperature	-30° C to 55° C

Table 2: System Specification

2.2 Sonic 2022 System Specification

System Feature	Specification
Frequency	400kHz / 200kHz
Beamwidth – Across Track (at nadir)	1.0°@ 400kHz / 2.0° @ 200kHz
Beamwidth – Along Track (at nadir)	1.0° @ 400kHz / 2.0° @ 200kHz
UHR Beamwidth (at nadir)	**0.6° Across Track x 0.6° Along Track**
Number of Beams	256
Swath Sector	10° to 160° (user selectable)
UHR Swath Sector	**10° to 60°** (user selectable)
Maximum Slant Range	1200 metres
Pulse Length	15µSec – 1000µSec
Pulse Type	Shaped Continuous Wave (CW)
Depth Rating	100 metres (3000 metres optional)
Operating Temperature	-10° C to 40° C
Storage Temperature	-30° C to 55° C

2.3 Sonic 2024 Dimensions and Weights

Component	Dimensions (L x W x D) / Dry Weight
Receiver Module	480mm x 109mm x 190mm / 12.9kg
Projector	273mm x 108mm x 86mm / 3.3kg
Sonar Interface Module (SIM)	280mm x 170mm x 60mm / 2.4kg
I2NS Sonar Interface Module (SIM)	280mm x 170mm x 126.4mm / 4.2kg
Receive module and Projector mass in water	**5.9kg (Fresh)**

Table 3: Component Dimensions and Mass

2.4 Sonic 2022 Dimensions and Weights

Component	Dimensions (L x W x D) / Dry Weight
Receiver Module	276mm x 109mm x 190mm / 7.7kg
Projector	273mm x 108mm x 86mm / 3.3kg
Sonar Interface Module (SIM)	280mm x 170mm x 60mm / 2.4kg
I2NS Sonar Interface Module (SIM)	280mm x 170mm x 126.4mm / 4.2kg
Receive module and Projector mass in water	**4.0kg (Fresh)**

2.5 Sonic 2024/Sonic 2022 Electrical Interface

Item	Specification
Mains Power	90 – 260 VAC; 45 – 65 Hz
Power Consumption (SIM and Sonar Head)	75 Watt (Sonic 2022: 54 Watt)
Power Consumption (Sonar Head Only)	50W avg.; 90W Peak (Sonic 2022: 35W avg.; 70W Peak)
Integrated Inertial Navigation System (I2NS)	38.4W (SIM and IMU with Antennas)
Uplink/Downlink	10/100/1000Base-T Ethernet
Data Interface	10/100/1000Base-T Ethernet
Sync IN/OUT	TTL
GPS Timing	1PPS; RS232 NMEA
Auxiliary Sensors	RS232 / Ethernet
Deck Cable Length	15 metre (optional to 50 metres)

Table 4: Electrical Interface

2.6 Sonic 2024/2022 Ping Rates (SV = 1500.00m/sec)

RANGE	PING RATE
2 - 7	60.0
10	55.4
15	39.4
20	30.6
25	25.0
30	21.1
35	18.3
40	16.1
50	13.0
70	9.4
100	6.7
150	4.5
200	3.4
250	2.7
300	2.3
400	1.7
450	1.5
500	1.4
700	1.0
1000	0.7
1200	0.6

Table 5: Ping Rate table

WARNING

THE RECEIVE MODULE IS FILLED WITH OIL THAT WILL FREEZE TO A SOLID AT -10°C. STORAGE BELOW THIS TEMPERATURE (TO -30°C) IS POSSIBLE IF THE HEAD IS SLOWLY THAWED OUT PRIOR TO OPERATION.

4200 SERIES

SIDE SCAN SONAR SYSTEM

FEATURES

- Optional Multi-Pulse (MP) technology for high speed surveys
- Crisp, high resolution CHIRP images
- Multiple dual simultaneous frequency sets to choose from
- Stainless steel towfish
- Easily integrates to other 3rd party sensors
- Meets IHO & NOAA Survey Specifications

APPLICATIONS

- Cable & Pipeline Surveys
- Geological/Geophysical Surveys
- Mine Countermeasures (MCM)
- Geohazard Surveys
- Channel Clearance
- Search and Recovery
- Archeological Surveys

The 4200 Series is a versatile side scan sonar system that can be configured for almost any survey application from shallow to deep water operations. The 4200 utilizes EdgeTech's Full Spectrum® CHIRP technology to provide crisp, high resolution imagery at ranges up to 50% greater than non-CHIRP systems; thus allowing customers to cover larger areas and save money spent on costly surveys.

One of the unique features of the 4200 is the optional Multi-Pulse (MP) technology, which places two sound pulses in the water rather than one pulse like conventional side scan sonar systems. This allows the 4200 to be towed at speeds of up to 10 knots while still maintaining 100% bottom coverage. In addition, the MP technology will provide twice the resolution when operating at normal tow speeds, thus allowing for better target detection and classification ability. The addition of the optional MP technology provides the operator with two modes of operation; either High Definition Mode (HDM) or High Speed Mode (HSM). This software-selectable mode of operation provides the operator the ability to select the best configuration for the specific job type.

All EdgeTech 4200 systems are comprised of a topside system and a reliable stainless steel towfish. A choice of dual simultaneous frequency sets are available to the user and topside processors come in a choice of configurations from portable to rack mounted units. In addition, an easy-to-use GUI software is supplied with every unit.

EdgeTech

4200 SERIES

SIDE SCAN SONAR SYSTEM

KEY SPECIFICATIONS

SONAR SPECIFICATIONS	STANDARD	WITH OPTIONAL MP TECHNOLOGY	
Frequency	Choice of either 100/400, 300/600 or 300/900 kHz dual simultaneous		
Operating Range (meters/side)	100 kHz: 500m, 300 kHz: 230m, 400 kHz: 150m, 600 kHz: 120m, 900 kHz: 75m		
Horizontal Beam Width:	100 kHz: 1.5°, 300 kHz: 0.5°, 400 kHz: 0.4°, 600 kHz: 0.26°, 900 kHz: 0.2°	In High Speed Mode: 100 kHz: 1.26°, 300 kHz: 0.54°, 400 kHz: 0.4°, 600 kHz: 0.34°, 900 kHz: 0.3° In High Definition Mode: 100 kHz: 0.64°, 300 kHz: 0.28°, 400 kHz: 0.3°, 600 kHz: 0.26°, 900 kHz: 0.2°	
Resolution Along Track	100 kHz: 5 m @ 200 m 300 kHz: 1.3 m @ 150 m 400 kHz: 0.6 m @ 100 m 600 kHz: 0.45 m @ 100 m 900 kHz: 18 cm @ 50 m	High Definition Mode: 100 kHz: 2.5m @ 200m 300 kHz: 1.0m @ 200m 400 kHz: 0.5m @ 100m 600 kHz: 0.45m @ 100m 900 kHz: 18 cm @ 50m	HIgh Speed Mode: 100 kHz: 4.4m @ 200m 300 kHz: 1.9m @ 200m 400 kHz: 0.7m @ 100m 600 kHz: 0.6m @ 100m 900 kHz: 26 cm @ 50m
Resolution Across Track	100 kHz: 8 cm, 300 kHz: 3 cm, 400 kHz: 2 cm, 600 kHz: 1.5 cm, 900 kHz: 1 cm		
Vertical Beam Width	50°		
Depression Angle	Tilted down 20°		
TOWFISH	**STAINLESS STEEL**		
Diameter	11.4 cm (4.5 inches)		
Length	125.6 cm (49.5 inches)		
Weight in Air/Saltwater	48 / 36 kg (105 / 80 pounds)		
Depth Rating (Max)	2,000m		
Standard Sensors	Heading, pitch & roll		
Optional Sensor Port	(1) Serial – RS 232C, 9600 Baud, Bi-directional & 27 VDC		
Options	Pressure Sensor, Magnetometer, Integrated USBL Acoustic Tracking System, Built-in Responder Nose, Depressor, Power Loss Pinger and Custom Sensors		
TOPSIDE PROCESSOR	**4200-P**	**4200**	**701-DL INTERFACE**
Hardware	Portable splash-proof case	19" rack mount computer	19" rack mount interface
Display & Interface	Splash-proof laptop	21" flat panel monitor, keyboard & trackball	Customer-supplied
Power Input	20-36 VDC or 115/230 VAC	115/230 VAC	115/230 VAC
Operating System	Windows© XP Pro		
File Format	Native JSF or XTF		
Output	Ethernet		
TOW CABLE			
	Coaxial Kevlar or double-armored up to 6,000m, winches available		

info@EdgeTech.com | USA 1.508.291.0057

EdgeTech
An Affiliate of ORE Offshore

3200
SUB-BOTTOM PROFILING SYSTEM

FEATURES

- Choice of 3 towfish depending on the application
- Low frequency for greater penetration
- Pole mount option for shallow water surveys

APPLICATIONS

- Geological Surveys
- Geohazard Surveys
- Sediment Classification
- EEZ Resource Development
- Buried Object Location
- Bridge/Shoreline Scour Surveys
- Mining/Dredging Surveys

The EdgeTech 3200 Sub-bottom Profiling System is a wideband Frequency Modulated (FM) sub-bottom profiler utilizing EdgeTech's proprietary Full Spectrum CHIRP technology. The 3200 generates high resolution images of the sub-bottom stratigraphy in oceans, lakes, and rivers and provides penetration of up to 200m.

The 3200 comes available with a choice of three stable, low drag towfish that operate at different frequencies and can be used at depths of up to 300m. The selection of towfish depends on the sub-bottom characteristics as well as the resolution and penetration requirements.

Along with a towfish, a standard 3200 system comes with a topside processor running EdgeTech's DISCOVER sub-bottom acquisition & processing software as well as a customer-specified length of tow cable. Additional optional sensors are also available.

EdgeTech
An Affiliate of ORE Offshore

3200
SUB-BOTTOM PROFILING SYSTEM

KEY SPECIFICATIONS

TOWFISH	SB-0512i	SB-216S	SB-424
Frequency Range	500 Hz–12 kHz	2-16 kHz	4-24 kHz
Vertical Resolution (depends on pulse selected)	8–20 cm	6-10 cm	4-8 cm
Penetration (typical)			
In coarse calcareous sand	20 meters	6 meters	2 meters
In clay	200 meters	80 meters	40 meters
Length	160 cm	105 cm	77 cm
Width	124 cm	67 cm	50 cm
Height	47 cm	40 cm	34 cm
Weight in Air	204 kg	76 kg	45 kg
Weight in Water	68 kg	32 kg	18 kg
Depth Rating	300 meters		
TOPSIDE PROCESSOR			
Hardware	Standard 19 inch rack mount with portable aluminum enclosure for transport		
Operating System	Windows XP		
Display	High resolution 21 inch flat panel display		
Archive	Hard drive and/or DVD-R/W		
File Format	Native JSF or SEG-Y		
Output	Ethernet		
Power Input	120/220 VAC		
SYSTEM OPTIONS			
	Integrated depth sensor, USBL acoustic tracking system		

SB-0512i

SB-216S

SB-424

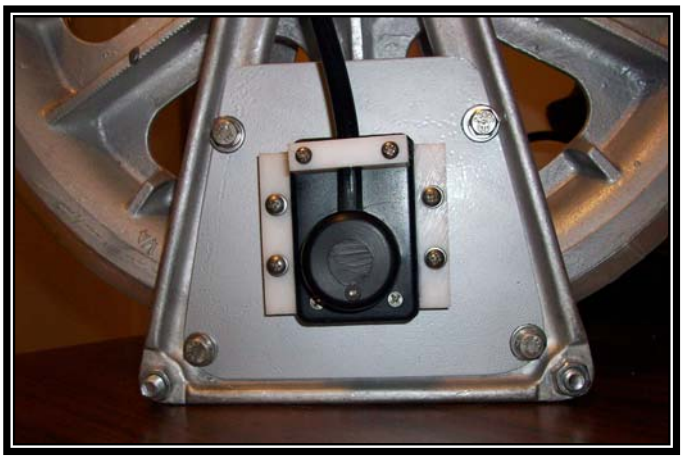
Hydrographic Survey Products, Inc.

6523 Homestead Road
Houston, Texas 77028
Tel. 713 302 3710
Fax. 713 432 9909
tseward@hydro-ltd.com

SCC Smart Sensor Cable Payout Measurement System

The *Hydrographic Survey Products* SCC is an automated, cable payout indicator system, specifically designed for the offshore survey and Oceanographic industries. It is ideally suited to measure the cable layback of Side Scan Sonar, Magnetometer, and Sub-Bottom Profiler tow fish as well as a wide range of Oceanographic sensors and corer systems. All counting and processor functions are integrated into the sensor itself, so costs have been reduced, whilst retaining all the required capability of higher priced systems. By offering the sensor alone, a very cost effective upgrade path is available for users with existing, non-instrumented sheave wheels. The sensor may be fitted to almost any sheave wheel or supplied fitted to a wheel of the customer's specifications. A number of magnets, attached to the wheel, are used to measure movement and direction of the wheel and hence movement of the cable as it is deployed or retrieved. The sensor is environmentally sealed with waterproof connections, making it ideal for harsh oceanographic environments. The Display / Interface Unit option provides a very simple to operate display of the cable deployed, cable line speed and an RS232 output as well as providing power to the sensor.

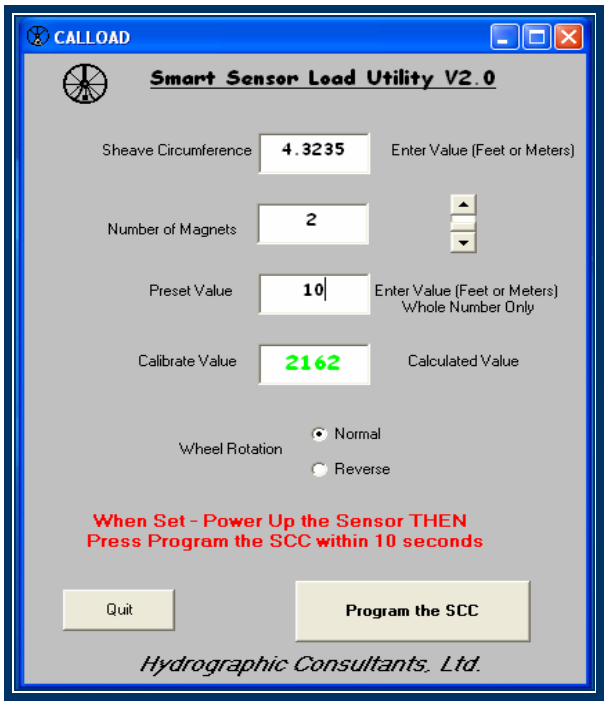
Display and Interface Unit



Sensor Installation

FEATURES:

- Monitors length of cable continuously during deployment and recovery.
- Continuously displays cable line speed in units selected.
- Feet or Meters operations.
- Can be used with almost any size sheave wheel and any number of magnets.
- Outputs the deployed cable length in meters or feet via RS232 9600 8N1 at 2 Hz.
- Ability to set a Preset value for simple cable length checking and resetting.
- Calibration and Preset values stored in internal “Flash” memory.
- The sensor can be easily re-calibrated in the field with a simple PC communications program (supplied with the sensor).
- Electronic Serial Number hard coded into each sensor.
- Allows the operator to reverse the rotational sense without the need to move the sheave block.
- Selectable Sensor ID in serial header for multiply sensor installations.
- Compatible with HCL Display/Interface unit and Dual Channel Video Overlay Interface.
- Direct interface to Chesapeake Technologies “SonarWiz” and Triton “Isis” and “Hypack” survey packages.
- Terminated deck cables available to any length.
- Aluminum Sheave Blocks available from 10” to 32” Diameter. Other sizes can be specially ordered. Options for filled and machined grooves available.
- The sensor may be ordered alone or as part of the complete system.



Calibration Software Window
Calibration value is calculated and downloaded into Sensor's flash memory.

SCC Smart Sensor shown with mounting blocks and cable clamp

APPENDIX B

760.438.8968 office *5225 Avenida Encinas,Suite H, Carlsbad, CA 92008* *www.KinneticLabs.com*

Sylmar Survey Marine Mammal Monitoring

On November 18th, multi beam survey was conducted from the Research Vessel (RV) 'Tati B' and sub bottom survey was conducted from "RV Theory". Conditions were favorable all day for both sampling and mammal observations. There was a west north west swell 1-3 feet with light west winds 0 – 8 knots.

Common dolphins (*Delphinius delphis*) came within 300 feet of the instrument and interrupted sampling 2 times on RV 'Theory and 3 times on RV 'Tati B'. Sea Lions (*Zalophus californianus*) came within 150 feet and interrupted sampling 3 times on the RV 'Theory' and didn't affect sampling on RV 'Tati B'. There were no harbor seals (*Phoca vitulina*) or whales (Mysticeti) spotted from either vessel. Other than apparent curiosity the animals appeared to be unaffected by our operations. Feeding behaviors continued uninterrupted while instruments were operating within the set distances and they continued feeding while the vessel was within 100' feet. The outer 1500 feet of the transect area was most affected by mammal activity. Mammal observations and results are recorded in the below two tables.

Sub-bottom acoustic sampling on RV 'Theory'; November 18th, 2015

Time	Mammal Observed	Result
08:42	3 common dolphin, 2 Sea Lion	In transit. Not sampling
09:16 – 09:18	Sea lion	Shut down
09:20	Dolphin	Safe distance, no stop
10:14	Dolphin Pod	Not sampling at time
10:19 – 10:23	Dolphin	Shut down
10:29 – 10:31	Dolphin	Shut down
10:53	Sea lion	Safe distance, no stop
12:30 – 12:32	Sea Lion	Shut down
13:27 – 13:29	Sea Lion	Shut down

Multi Beam sampling operations on RV 'Tati B'; November 18th, 2015

Time	Mammal Observed	Result
08:30	Dolphins	Shut down
08:41	Dolphins	Shut down
15:38	Dolphins	Shut down

On November 19th, side scan sonar survey was conducted from the RV 'Theory'. Conditions were favorable all day for both sampling and mammal observations. Morning conditions were west north west swell 2-3 feet with west winds 0 – 5 knots and variable afternoon

conditions with seas 2-4 feet and winds 5-14 knots. Except for about an hour of slight wind chop, seas were extremely favorable for spotting marine mammals in the area.

Common dolphins came within 300 feet of the instrument and interrupted sampling 3 times on RV 'Theory'. Sea Lions and harbor seals both remained outside safety parameters. There were no whales (Mysticeti) spotted. Other than apparent curiosity, the animals appeared to be unaffected by our operations. Again, the outer 1500 feet of the transect area was most affected by mammal activity. Mammal observations and results are recorded in the below table.

Side Scan Sonar operations on RV 'Theory'; November 19th, 2015

Time	Mammal Observed	Result
08:35	Dolphin and sea lion	In transit. Not sampling
09:05	Harbor Seal	Safe distance, no stop
09:17	Harbor Seal	Safe distance, no stop
09:26	Sea Lion	Safe distance, no stop
09:51 – 09:57	Dolphin	Shut down
10:46	Dolphin	Safe distance, no stop
10:58	Dolphin	Safe distance, no stop
12:41 – 12:44	Dolphin (2)	Shut down
15:10 – 15:15	Dolphin (6)	Shut down

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials
Air Quality and Greenhouse Gas (GHG) Emissions (MND Section 3.3.3)						
MM AIR-1: Engine Tuning, Engine Certification, and Fuels. The following measures will be required to be implemented by all Permittees under the Offshore Geophysical Permit Program (OGPP), as applicable depending on the county offshore which a survey is being conducted. Pursuant to section 93118.5 of CARB's Airborne Toxic Control Measures, the Tier 2 engine requirement applies only to diesel-fueled vessels.	All Counties: Maintain all construction equipment in proper tune according to manufacturers' specifications; fuel all off-road and portable diesel-powered equipment with California Air Resources Board (CARB)-certified motor vehicle diesel fuel limiting sulfur content to 15 parts per million or less (CARB Diesel).	Daily emissions of criteria pollutants during survey activities are minimized.	Determine engine certification of vessel engines. Review engine emissions data to assess compliance, determine if changes in tuning or fuel are required.	OGPP permit holder and contract vessel operator; California State Lands Commission (CSLC) review of Final Monitoring Report.	Prior to, during, and after survey activities. Submit Final Monitoring Report after completion of survey activities.	11/17-20/2015
	Los Angeles and Orange Counties: Use vessel engines meeting CARB's Tier 2-certified engines or cleaner; the survey shall be operated such that daily NO_x emissions do not exceed 100 pounds based on engine certification emission factors. This can be accomplished with Tier 2 engines if daily fuel use is 585 gallons or less, and with Tier 3 engines if daily fuel use is 935 gallons or less.		Verify that Tier 2 or cleaner engines are being used. Calculate daily NO_x emissions to verify compliance with limitations.			11/17-20/2015
	San Luis Obispo County: Use vessel engines meeting CARB's Tier 2-certified engines or cleaner, accomplished with Tier 2 engines if daily fuel use is 585 gallons or less; all diesel equipment shall not idle for more than 5 minutes; engine use needed to maintain position in the water is not considered idling; diesel idling within 300 meters (1,000 feet) of sensitive receptors is not permitted; use alternatively fueled construction equipment on site where feasible, such as compressed natural gas, liquefied natural gas, propane or biodiesel.		Verify that Tier 2 or cleaner engines are being used. Inform vessel operator(s) of idling limitation. Investigate availability of alternative fuels.			N/A
	Santa Barbara County: Use vessel engines meeting CARB's Tier 2-certified engines or cleaner, accomplished with Tier 2 engines if daily fuel use is 790 gallons or less.		Verify that Tier 2 or cleaner engines are being used. Investigate availability of alternative fuels.			N/A
	Ventura County: Use alternatively fueled construction equipment on site where feasible, such as compressed natural gas, liquefied natural gas, propane or biodiesel.		Investigate availability of alternative fuels.			N/A

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials
MM BIO-1: Marine Mammal and Sea Turtle Presence – Current Information.	All State waters; prior to commencement of survey operations, the geophysical operator shall: (1) contact the National Oceanic and Atmospheric Administration Long Beach office staff and local whale-watching operations and shall acquire information on the current composition and relative abundance of marine wildlife offshore, and (2) convey sightings data to the vessel operator and crew, survey party chief, and onboard Marine Wildlife Monitors (MWMs) prior to departure. This information will aid the MWMs by providing data on the approximate number and types of organisms that may be in the area.	No adverse effects to marine mammals or sea turtles due to survey activities are observed.	Document contact with appropriate sources. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder; Inquiry to NOAA and local whale watching operators.	Prior to survey.	11/18-20/2015
MM BIO-2: Marine Wildlife Monitors (MWMs).	Except as provided in section 7(h) of the General Permit, a minimum of two (2) qualified MWMs who are experienced in marine wildlife observations shall be onboard the survey vessel throughout both transit and data collection activities. The specific monitoring, observation, and data collection responsibilities shall be identified in the Marine Wildlife Contingency Plan required as part of all Offshore Geophysical Permit Program permits. Qualifications of proposed MWMs shall be submitted to the National Oceanic and Atmospheric Administration (NOAA) and CSLC at least twenty-one (21) days in advance of the survey for their approval by the agencies. Survey operations shall not commence until the CSLC approves the MWMs.	Competent and professional monitoring or marine mammals and sea turtles; compliance with established monitoring policies.	Document contact with and approval by appropriate agencies. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Prior to survey.	11/18-20/2015
MM BIO-3: Safety Zone Monitoring.	Onboard Marine Wildlife Monitors (MWMs) responsible for observations during vessel transit shall be responsible for monitoring during the survey equipment operations. All visual monitoring shall occur from the highest practical vantage point aboard the survey vessel; binoculars shall be used to observe the surrounding area, as appropriate. The MWMs will survey an area (i.e., safety or exclusion zone) based on the equipment used, centered on the sound source (i.e., vessel, towfish), throughout time that the survey equipment is operating. Safety zone radial distances, by equipment type, include:	No adverse effects to marine mammals or sea turtles due to survey activities are observed; compliance with established safety zones.	Compliance with permit requirements (observers); compliance with established safety zones. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Prior to survey.	11/18-20/2015

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials
	factors the CSLC will consider will include the timing, type, and location of the survey, the size of the vessel, and the availability of alternate vessels for conducting the proposed survey. CSLC authorizations under this subsection will be limited to individual surveys and under any such authorization; the Permittee shall update the MWCP to reflect how survey operations will occur under the authorization.					
MM BIO-4: Limits on Nighttime OGPP Surveys.	All State waters; nighttime survey operations are prohibited under the OGPP, except as provided below. The CSLC will consider the use of single beam echosounders and passive equipment types at night on a case-by-case basis, taking into consideration the equipment specifications, location, timing, and duration of survey activity.	No adverse effects to marine mammals or sea turtles due to survey activities are observed.	Presurvey request for nighttime operations, including equipment specifications and proposed use schedule. Document equipment use. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Approval required before survey is initiated. Monitoring Report following comple-tion of survey.	N/A
MM BIO-5: Soft Start.	All State waters; the survey operator shall use a "soft start" technique at the beginning of survey activities each day (or following a shut down) to allow any marine mammal that may be in the immediate area to leave before the sound sources reach full energy. Surveys shall not commence at nighttime or when the safety zone cannot be effectively monitored. Operators shall initiate each piece of equipment at the lowest practical sound level, increasing output in such a manner as to increase in steps not exceeding approximately 6 decibels (dB) per 5-minute period. During ramp-up, the Marine Wildlife Monitors (MWMs) shall monitor the safety zone. If marine mammals are sighted within or about to enter the safety zone, a power-down or shut down shall be implemented as though the equipment was operating at full power. Initiation of ramp-up procedures from shut down requires that the MWMs be able to visually observe the full safety zone.	No adverse effects to marine mammals or sea turtles due to survey activities are observed.	Compliance with permit requirements (observers); compliance with safe start procedures. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Imme-diately prior to survey.	11/18-20/205

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials

Equipment Type	Safety Zone (radius, m)
Single Beam Echosounder	50
Multibeam Echosounder	500
Side-Scan Sonar	600
Subbottom Profiler	100
Boomer System	100

If the geophysical survey equipment is operated at or above a frequency of 200 kilohertz (kHz), safety zone monitoring and enforcement is not required; however, if geophysical survey equipment operated at a frequency at or above 200 kHz is used simultaneously with geophysical survey equipment less than 200 kHz, then the safety zone for the equipment less than 200 kHz must be monitored. The onboard MWMs shall have authority to stop operations if a mammal or turtle is observed within the specified safety zone and may be negatively affected by survey activities. The MWMs shall also have authority to recommend continuation (or cessation) of operations during periods of limited visibility (i.e., fog, rain) based on the observed abundance of marine wildlife. Periodic reevaluation of weather conditions and reassessment of the continuation/cessation recommendation shall be completed by the onboard MWMs. During operations, if an animal's actions are observed to be irregular, the monitor shall have authority to recommend that equipment be shut down until the animal moves further away from the sound source. If irregular behavior is observed, the equipment shall be shut-off and will be restarted and ramped-up to full power, as applicable, or will not be started until the animal(s) is/are outside of the safety zone or have not been observed for 15 minutes.

For nearshore survey operations utilizing vessels that lack the personnel capacity to hold two (2) MWMs aboard during survey operations, at least twenty-one (21) days prior to the commencement of survey activities, the Permittee may petition the CSLC to conduct survey operations with one (1) MWM aboard. The CSLC will consider such authorization on a case-by-case basis and

see MARINE MAMMAL REPORT

11/18-20/201

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials
MM BIO-6: Practical Limitations on Equipment Use and Adherence to Equipment Manufacturer's Routine Maintenance Schedule.	All State waters; geophysical operators shall follow, to the maximum extent possible, the guidelines of Zykov (2013) as they pertain to the use of subbottom profilers and side-scan sonar, including: • Using the highest frequency band possible for the subbottom profiler; • Using the shortest possible pulse length; and • Lowering the pulse rate (pings per second) as much as feasible. Geophysical operators shall consider the potential applicability of these measures to other equipment types (e.g., boomer). Permit holders will conduct routine inspection and maintenance of acoustic-generating equipment to ensure that low energy geophysical equipment used during permitted survey activities remains in proper working order and within manufacturer's equipment specifications. Verification of the date and occurrence of such equipment inspection and maintenance shall be provided in the required presurvey notification to CSLC.	No adverse effects to marine mammals or sea turtles due to survey activities are observed.	Document initial and during survey equipment settings. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Imme-diately prior to and during survey.	11/18-24/20
MM BIO-7: Avoidance of Pinniped Haul-Out Sites.	The Marine Wildlife Contingency Plan (MWCP) developed and implemented for each survey shall include identification of haul-out sites within or immediately adjacent to the proposed survey area. For surveys within 300 meters (m) of a haul-out site, the MWCP shall further require that: • The survey vessel shall not approach within 91 m of a haul-out site, consistent with National Marine Fisheries Service (NMFS) guidelines; • Survey activity close to haul-out sites shall be conducted in an expedited manner to minimize the potential for disturbance of pinnipeds on land; and • Marine Wildlife Monitors shall monitor pinniped activity onshore as the vessel approaches, observing and reporting on the number of pinnipeds potentially disturbed (e.g., via head lifting, flushing into the water). The purpose of such reporting is to provide CSLC and California Department of Fish and Wildlife (CDFW) with information regarding potential disturbance associated with OGPP surveys.	No adverse effects to pinnipeds at haul outs are observed.	Document pinniped reactions to vessel presence and equipment use. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Monitoring Report following comple-tion of survey.	N/A

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials
MM BIO-8: Reporting Requirements – Collision.	All State waters; if a collision with marine mammal or reptile occurs, the vessel operator shall document the conditions under which the accident occurred, including the following: • Vessel location (latitude, longitude) when the collision occurred; • Date and time of collision; • Speed and heading of the vessel at the time of collision; • Observation conditions (e.g., wind speed and direction, swell height, visibility in miles or kilometers, and presence of rain or fog) at the time of collision; • Species of marine wildlife contacted (if known); • Whether an observer was monitoring marine wildlife at the time of collision; and, • Name of vessel, vessel owner/operator, and captain officer in charge of the vessel at time of collision. After a collision, the vessel shall stop, if safe to do so; however, the vessel is not obligated to stand by and may proceed after confirming that it will not further damage the animal by doing so. The vessel will then immediately communicate by radio or telephone all details to the vessel's base of operations, and shall immediately report the incident. Consistent with Marine Mammal Protection Act requirements, the vessel's base of operations or, if an onboard telephone is available, the vessel captain him/herself, will then immediately call the National Oceanic and Atmospheric Administration (NOAA) Stranding Coordinator to report the collision and follow any subsequent instructions. From the report, the Stranding Coordinator will coordinate subsequent action, including enlisting the aid of marine mammal rescue organizations, if appropriate. From the vessel's base of operations, a telephone call will be placed to the Stranding Coordinator, NOAA National Marine Fisheries Service (NMFS), Southwest Region, Long Beach, to obtain instructions. Although NOAA has primary responsibility for marine mammals in both State and Federal waters, the California Department of Fish and Wildlife (CDFW) will also be advised that an incident has occurred in State waters affecting a protected species.	No adverse effects to marine mammals or sea turtles due to survey activities are observed.	Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Monitoring Report following comple-tion of survey.	

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials
MM BIO-9: Limitations on Survey Operations in Select Marine Protected Areas (MPAs).	All MPAs; prior to commencing survey activities, geophysical operators shall coordinate with the CLSC, California Department of Fish and Wildlife (CDFW), and any other appropriate permitting agency regarding proposed operations within MPAs. The scope and purpose of each survey proposed within a MPA shall be defined by the permit holder, and the applicability of the survey to the allowable MPA activities shall be delineated by the permit holder. If deemed necessary by CDFW, geophysical operators will pursue a scientific collecting permit, or other appropriate authorization, to secure approval to work within a MPA, and shall provide a copy of such authorization to the CSLC as part of the required presurvey notification to CSLC. CSLC, CDFW, and/or other permitting agencies may impose further restrictions on survey activities as conditions of approval.	No adverse effects to MPA resources due to survey activities are observed.	Monitor reactions of wildlife to survey operations; report on shutdown conditions and survey restart. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder; survey permitted by CDFW.	Prior to survey.	N/A
MM HAZ-1: Oil Spill Contingency Plan (OSCP) Required Information.	Permittees shall develop and submit to CSLC staff for review and approval an OSCP that addresses accidental releases of petroleum and/or non-petroleum products during survey operations. Permittees' OSCPs shall include the following information for each vessel to be involved with the survey: • Specific steps to be taken in the event of a spill, including notification names, phone numbers, and locations of: (1) nearby emergency medical facilities, and (2) wildlife rescue/response organizations (e.g., Oiled Wildlife Care Network); • Description of crew training and equipment testing procedures; and • Description, quantities, and location of spill response equipment onboard the vessel.	Reduction in the potential for an accidental spill. Proper and timely response and notification of responsible parties in the event of a spill.	Documentation of proper spill training. Notification of responsible parties in the event of a spill.	OGPP permit holder and contract vessel operator.	Prior to survey.	11/17-24/2015
MM HAZ-2: Vessel fueling restrictions.	Vessel fueling shall only occur at an approved docking facility. No cross vessel fueling shall be allowed.	Reduction in the potential for an accidental spill.	Documentation of fueling activities.	Contract vessel operator.	Following survey.	
MM HAZ-3: OSCP equipment and supplies.	Onboard spill response equipment and supplies shall be sufficient to contain and recover the worst-case scenario spill of petroleum products as outlined in the OSCP.	Proper and timely response in the event of a spill.	Notification to CSLC of onboard spill response equipment/supplies inventory, verify	Contract vessel operator.	Prior to survey.	

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials
			ability to respond to worst-case spill.			
MM HAZ-1: Oil Spill Contingency Plan (OSCP) Required Information.	Outlined under **Hazards and Hazardous Materials** (above)					
MM HAZ-2: Vessel fueling restrictions.	Outlined under **Hazards and Hazardous Materials** (above)					
MM HAZ-3: OSCP equipment and supplies.	Outlined under **Hazards and Hazardous Materials** (above)					
MM BIO-9: Limitations on Survey Operations in Select MPAs.	Outlined under **Biological Resources** (above)					
MM REC-1: U.S. Coast Guard (USCG), Harbormaster, and Dive Shop Operator Notification.	All California waters where recreational diving may occur; as a survey permit condition, the CSLC shall require Permittees to provide the USCG with survey details, including information on vessel types, survey locations, times, contact information, and other details of activities that may pose a hazard to divers so that USCG can include the information in the Local Notice to Mariners, advising vessels to avoid potential hazards near survey areas. Furthermore, at least twenty-one (21) days in advance of in-water activities, Permittees shall: (1) post such notices in the harbormasters' offices of regional harbors; and (2) notify operators of dive shops in coastal locations adjacent to the proposed offshore survey operations.	No adverse effects to recreational divers from survey operations.	Notify the USCG, local harbormasters, and local dive shops of planned survey activity. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Prior to survey.	11/17-20/2015

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials
MM FISH-1: U.S. Coast Guard (USCG) and Harbormaster Notification.	All California waters; as a survey permit condition, the CSLC shall require Permittees to provide the USCG with survey details, including information on vessel types, survey locations, times, contact information, and other details of activities that may pose a hazard to mariners and fishers so that USCG can include the information in the Local Notice to Mariners, advising vessels to avoid potential hazards near survey areas. Furthermore, at least twenty-one (21) days in advance of in-water activities, Permittees shall post such notices in the harbormasters' offices of regional harbors.	No adverse effects to commercial fishing gear in place.	Notify the USCG and local harbormasters of planned survey activity. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Prior to survey.	
MM FISH-2: Minimize Interaction with Fishing Gear.	To minimize interaction with fishing gear that may be present within a survey area: (1) the geophysical vessel (or designated vessel) shall traverse the proposed survey corridor prior to commencing survey operations to note and record the presence, type, and location of deployed fishing gear (i.e., buoys); (2) no survey lines within 30 m (100 feet) of observed fishing gear shall be conducted. The survey crew shall not remove or relocate any fishing gear; removal or relocation shall only be accomplished by the owner of the gear upon notification by the survey operator of the potential conflict.	No adverse effects to commercial fishing gear in place.	Visually observe the survey area for commercial fishing gear. Notify the gear owner and request relocation of gear outside survey area. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Imme-diately prior to survey (prior to each survey day).	N/A
MM FISH-1: USCG and Harbormaster Notification.	Outlined under **Commercial and Recreational Fisheries** (above)					11/17/20/2015

Acronyms/Abbreviations: CARB = California Air Resources Board; CDFW = California Department of Fish and Wildlife; CSLC = California State Lands Commission; dB = decibels; kHz = kilohertz; MPA = Marine Protected Area; MWCP = Marine Wildlife Contingency Plan; MWM = Marine Wildlife Monitor; m= meter(s); NOAA = National Oceanic and Atmospheric Administration; NO_x = Nitrogen Oxide; OGPP = Offshore Geophysical Permit Program; OSCP = Oil Spill Contingency Plan; USCG = U.S. Coast Guard

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