UNDERWATER SONAR PROFILING SURVEY REPORT

BERTHS 1,2 AND 3 PORT OF PORT ALBERNI

BATHYMETRIC SURVEY

Port Alberni Port Authority

April 11-12, 2012

Information regarding survey techniques and processing contained within this report is proprietary information. Approval for disclosure of these practices to third parties must first be obtained in writing from AquaCoustic Remote Sensing Inc.

The following survey results represent the conditions on the date of the survey.

Prepared by
AquaCoustic Remote Technologies Inc
888 379 7601

May 4, 2012

Berth 1,2 and 3, Port Alberni Port Authority; Bathymetric Survey. Completed April 12, 2012

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Berth 1,2 and 3, Port Alberni Port Authority; Bathymetric Survey. Completed April 12, 2012

1.0 Introduction

At the request of Brad Madelung of Port Alberni Port Authority, AquaCoustic Remote Technologies Inc. has completed a "Rotating Head" Profiling Sonar survey of berths 1, 2 and 3. The authorization to proceed was confirmed by Brad Madelung in March 2012. The survey area was approximately 710 metres by 110 metres wide, including the area between berth 2 and 3. The purpose of the survey was to:

- Collect soundings in the survey area in front of berths 1, 2 and 3.
- Provide a bathymetric chart in AutoCAD summarizing the survey results.

AquaCoustic Remote Technologies was contacted because of their specialized equipment and experience in transitional sonar hydrography.

This report presents the results of the April 11-12, 2012 sonar survey and provides a description of the methodology and limitations.

2.0 Company Background

AquaCoustic is a company that specializes in the operation of remotely operated vehicles, the integration of specialized underwater sonar equipment, and the interpretation of the raw data. Utilizing a suite of software programs developed for this application, AquaCoustic can conduct surveys of underwater areas of concern, generate profiles, position underwater objects, and correlate this information to existing grids or coordinates.

The range of activities of this unique combination of equipment, technology, and personnel has included pipeline surveys, contour mapping, dredging profiles, positioning of underwater structures and volume measurements.

3.0 Scope of Work

The project required carrying out a sonar profiling survey of the below water area including under the pile dock. This entailed profiling an area of approximately 710 metres along the docks and 110 metres out from the dock face.

- Post process the sonar profiling data to include pitch, roll and heading data, along with RTK GPS positioning.
- Produce a draft report.
- Produce an AutoCAD drawing of the area with 1.0 metre contours.
- Provide a hard copy report with drawings.

4.0 Methodology

The sonar work was performed using a digital profiling sonar head attached to a sonar rod. The sonar head-to-rod connection consisted of a fabricated aluminum L-bracket so that the axis of the sonar head was perpendicular to the axis of the sonar survey rod. The RTK GPS receiver was fastened on the top of the rod, this gave centremetre accuracy for XY and Z positions. A solid state bearing and attitude sensor was also attached to the rod; this gave heading, pitch and roll information to 0.1 degree 25 times per second.
Appendix E contains project photographs showing the sonar head, rod and other details of the work. The survey equipment comprised the following:

- 12 foot Achilles inflatable boat.
- A "rotating head" digital profiling sonar head.
- Solid state bearing and inclinometer.
- Sonar processor and positioning software.
- Trimble RTK GPS. For details see 4.1.7 Positioning.
- 10ft of data cable.
- Proprietary software for post-processing of the sonar data.
- A base plate.
- Bubble type levelers.
- Aluminum survey rod and aluminum bracket for holding the sonar head and bearing and inclinometer.

The sonar survey was conducted from a 12 foot inflatable boat, the profiles were collected as the boat moved along track at approximately 2 knots, this produced across track data, each profile was collected at approximately 3 metre intervals. The data collecting aparatus consists of an aluminum rod with the sonar system attached to the bottom and the RTK GPS receiver on the top. A wooden fordeck was fastened athwart the bow section of the boat, with an aluminum swivel plate attached. The rod is passed through the swivel plate, this allows the rod to hang vertically from the boat. The sonar head was positioned approximately one half metre below the water surface.

The staging area for the survey was at the boat launch just north of the marina. The survey was commenced when the profiling sonar image was optimized for clarity and lateral distance accuracy. Also the pitch, roll and heading data was being saved to the sonar program with the positional data saved to the digital chart in the computer and also the hand held controller. The line to be surveyed was approximately 6 metres out from the dock face and ran from berth 1 in the south to berth 3 in the north. The sonar profiles extended up the bank under the pile dock and to the water level between berth 2 and 3.

The survey was carried out on April 11-12, 2012.

4.1 Calibration and Control

4.1.1 Speed of Sound

At the start of the survey, the velocity of sound in the local water was measured by performing a calibration check. The calibration check involved suspending a metal plate in the water at a known distance below the sonar head. The sonar software was used to measure the distance to the plate and the velocity of sound was adjusted so that the calculated depth shown on the sonar software and actual depth to the plate were equal. In general, the speed of sound of water was found to be about 1440 m/s. A number of chain soundings were also recorded at various position in the survey area as a check.

4.1.2 Survey Tie-In

Positions were collected on each corner of berth 3 and the north corner of berth 2 and the south corner of berth 1. These were used to position the survey data.

4.1.3 Compass

The compass calibration was conducted by the following method. The sonar head and bearing and inclinometer system are fastened onto a one piece bracket. This bracket is fastened on to a 10 foot aluminum pole. A transit is set on the top of the pole, in line with the sonar head. The whole assembly is hung vertically from the holding plate with the sonar in the water and the transit at eye level. The pole assembly is turned until the transit lines up with one of the control points. At this time pitch roll and heading data is stored along with the position. A series of control points were captured in this way. In post processing the true bearing from the survey pole to control points were calculated and compared with the captured bearing in the bearing and inclinometer data. A simple table is then produced and the compass bearings can be corrected for the location.

4.1.4 Roll

The roll in the pitch roll and heading system is calibrated by finding a flat area and collecting a profile then turning the sonar 180 degrees and collecting a second profile. Any errors in the roll can then be calculated out.

4.1.5 Pitch

The pitch can be calibrated in the field by collecting a profile on a slope and then turning the sonar 180 degrees any errors show up as a depth differential.

4.1.6 Sonar Head (see Appendix C)

Profiling data was collected using a narrow-beam, 675-kHz sonar head sealed in a sonar enclosure. The sonar head, when positioned underwater, generates an acoustic pulse in a narrow cone. The sound footprint is approximately 3% of depth or 0.3 metres diameter in 10 metres of water. A profile of the ocean bottom is built as the sonar head mechanically steps about the longitudinal axis of the sonar enclosure. When the acoustic pulse hits a target, it bounces back and the echo appears as a data point recorded in terms of travel time. The depth is then calculated using the angle of the profile head relative to vertical, the speed of sound in water and the travel time. Depending on the angle of incidence of the acoustic pulse cone with the river bottom, several echo returns are recorded. The profile data comprises first, intermediate and last returns of the acoustic pulse. For the work presented in this report, centre return of the acoustic pulse was used for individual depth measurements. As such, the accuracy is best when the pulse strikes the sea bottom at right angles. Accuracy diminishes as the angle of incidence of the pulse to the bottom diverges from 90°. Depth measurements are considered approximate when the angle of incidence with the ground is 45° and less. When operating within ±45°, the overall accuracy is considered to be better than 0.5% of range. For this survey a range accuracy of 7 cm is calculated. Through the use of software programs this data is translated into XYZ positions and can be plotted in a variety of formats.

4.1.7 Positioning

A Trimble R6 reciever and base station was used with satellite corrections. The XY and Z positional accuracy was approximately 2 to 3 cm.

5.0 Survey Results

The following survey results represent the conditions on the date of the survey.

The total number of sonar survey data points used is about 32,000.

The sonar settings were set to maximize the acoustic returns for the local conditions.

The survey was commenced at berth 1 and followed the face of the dock to berth 3 and included the area between berths 2 and 3. The anomaly on the north end of berth one may be a fishing net, the sonar data is not conclusive in this respect.

5.1 Survey Datum

Elevations are tied to local chart datum provided by Canadian Hydrographic Services. Horizontal positioning is in NAD83 zone 10N

Berth 3			Berth 1-2			Berth 1-2		
Metres	Depth (m)		Metres	Depth (m)		Metres	Depth (m)	
from N	2006	2012	from N	2006	2012	from N	2006	2012
0	11.506	11.6854	0	6.019	6.3075	190	8.9232	9.7318
10	11.8896	12.0067	10	5.8952	6.5139	200	9.5174	9.7645
20	11.795	12.0548	20	5.6555	6.5468	210	9.3997	9.9039
30	11.7976	12.0104	30	6.9476	6.4998	220	9.7545	9.8999
40	11.7363	11.9213	40	8.5532	8.2201	230	9.4135	10.3496
50	10.9529	11.7008	50	9.1968	9.5063	240	10.0751	10.6231
60	10.7667	11.3831	60	9.7352	10.2021	250	10.7473	10.9663
70	11.0108	11.0303	70	9.4604	10.2112	260	10.7482	11.6676
80	10.7707	11.0743	80	9.9375	10.2258	270	11.1708	12.1902
90	10.8149	11.0401	90	9.8086	10.3819	280	11.8299	12.616
100	10.465	10.8961	100	10.0109	10.1927	290	12.4853	12.999
110	10.8717	10.8481	110	9.7412	10.0605	300	12.7206	13.1894
120	10.7351	10.9507	120	9.9317	10.3893	310	12.4108	11.9106
130	10.5901	10.9633	130	10.1849	10.5192	320	11.3274	12.1338
140	10.8497	11.0667	140	10.2238	10.6018			
150	11.1967	11.2095	150	9.7687	10.4797			
160	11.0541	11.2447	160	10.2219	10.4816			
170	11.4267	11.3719	170	9.9579	10.5507			
180	11.7972	11.8007	180	10.9963	9.7579			

Depth at Face of Docks (2006 and 2012 Comparison)

5.2 Side-Scan Survey (see Appendix B)

The side scan image for berth 3 shows some possible log debris off shore of the berth. The debris field extends from about 15 metres from the toe of the berth, out to approximately 40 metres. The last 20 metres at the south end of the berth appears to be debris free. The bottom appears to be a sandy silt material from the sonar records.

The area between berths 2 and 3 has very little debris and shows a few logs sitting on a sandy silt bottom.

Berths 1 and 2 show very little log debris in the berth. The bottom appears to be a sandy silt with what appear to be scours running parallel to the dock face and about 30 metres out. These scour marks could possibly be anchor drag.

6.0 Summary of Results

The collected real time RTK GPS data was used and gave us good positions of between 2 and 3 centremetres.

The information gained gives an indication of the surficial features of the survey area. A careful study of the side-scan sonar data can reveal bottom information such as type and amount of debris, type and area of bottom sediment. Bottom trends are also revealed such as scouring or areas that may be of concern in the future such as depressions or buildup.

7.0 Difficulties and Discussion

No serious difficulties encountered.

The weather was calm with light winds.

8.0 Limitations

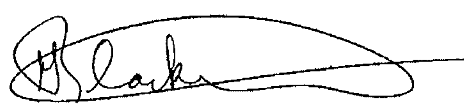
The distance to a given surface may be determined accurately based on the acoustic travel times; this is based on a sound velocity that is dependent on water temperature and salinity. An underestimate of the velocity function would produce distances that are too shallow, the reverse occurring with an overestimate of velocity. Some errors may also occur in gridding between interpreted data along discrete survey traverses. Several factors such as reflector strength, diffraction patterns, depth position, smoothness of reflectors and reflector relief may alter the expected sonar returns.

In addition, the nature and composition of bottom features identified in sonar surveys cannot be absolutely determined by inspection of the data.

The information in this report is based upon sonar measurements and field procedures, and our interpretation of the data. The information is based upon our estimate of conditions considering the geophysical and all other information available to us. The results are interpretive in nature and are considered to be a reasonably accurate presentation of conditions around the floating dock, within the limitations of the methodology employed.

A slight dishing effect of the data at the outer limits of the sonar profiles may occur. This is caused by the angle of incident of the acoustic signal. The effect is minimal and falls well within the accepted norms at the ranges used on this survey.

Respectfully submitted,



Michael Blackshaw
AquaCoustic Remote Technologies Inc.

Appendix A. QA/QC Program

AquaCoustic
REMOTE TECHNOLOGIES INC.

Quality Assurance and Quality Control Program

January 2005

AquaCoustic Remote Technologies Inc.
Quality Assurance and Quality Control Program

Background
The essential qualities for sonar bathymetry are accuracy, capability, and cost effectiveness. It is not hard to get answers from a system. It takes a great deal of understanding and effort, however, to obtain results that will meet international accuracy standards and the operational requirements of the typical client.

The primary considerations in the design, construction, and operation of a sonar system must be data quality and range measurement accuracy. Both the physical environment and system hardware components contribute error sources that must be overcome. This requires thoughtful hardware and software system design and construction, as well as the prediction, modeling, and application of appropriate correctors. Operational procedures for quality control, calibration, and maintenance must be established and followed.

Described below are the hardware design features, software algorithms, bias correctors, displays, and operational procedures that have been developed to provide the basis for a system which will meet required accuracy standards while maintaining efficiency and cost-effectiveness. The above features have all been incorporated to meet a wide range of survey requirements in categories such as charting, dredging, coastal engineering, resource management, modeling, and reconnaissance.

The post survey data processing software suite has provided high accuracy and been regularly upgraded to improve utility and efficiency. The overall system design has proven to be very flexible, and a number of new features and capabilities have been added in hardware and software in response to customer requirements.

Rationale
"Rotating Head" sonar is a technique for measuring the depths of relatively shallow, coastal waters from a small vessel or fixed structure. Typical applications include bathymetric surveys of reservoirs, dams, ports and shore protection projects such as jetties and breakwaters. The systems have also been used in trunk sewer lines to calculate buildup or damage in the pipes.

The primary reasons for pursuing this technology are that, for such areas, it provides:

A) The ability to perform surveys quickly, in a more cost-effective manner.
B) The capability to survey where it would be difficult, or dangerous, such as under overhangs or in sewer line.
C) The facility to survey the sea bottom and up to the shoreline.
D) The mobility to perform rapid assessments of seasonal changes or damage due to environmental conditions.

"Rotating Head" sonar bathymetry is an operational technique which we have proven to be an accurate, efficient, cost-effective, safe, and flexible method of mapping near-shore waters, adjacent vertical walls, and engineering structures. On the other hand, profiling sonar remains a state-of-the-art technique that requires knowledgeable implementation. New capabilities continue to be attained, and new products are produced.

Limitations

- An underestimate of the sound velocity would produce distances that are too shallow; the reverse occurs with an overestimate of sound velocity.
- Environmental conditions such as wave action or wind that would cause excessive movement of the sonar head will degrade the accuracy of the sonar data.
- Bottom reflectivity such as reflector strength, diffraction patterns, smoothness of reflectors and reflector relief may alter the expected return signal.
- Holes smaller than the sound footprint may not be seen, protruding areas may show as the same diameter as the sound footprint.
- Depth measurements are considered inexact when the angle of incidence with the ground is 45° and less.
- A slight dishing effect of the data at the outer limits of the sonar profiles may occur. This is caused by the angle of incident of the acoustic signal. This effect can be mitigated by our software.
- Target resolution is affected by range (greater ranges result in less detail.)
- Aeration or biota in water effects data quality. This requires that the bottom-return signals be reasonably strong and free from excessive noise.
- There are approximations inherent in fitting a theoretical model to real world data.

The Challenge
Each of these factors contributes important error sources that must be ameliorated. The development of a system must begin with proper hardware and software design in which all major error sources are recognized and minimized so that the data has desirable characteristics and all necessary system outputs are available and unambiguous. One of the biggest problems that must be solved in the design of bathymetric sonar involves the accurate and reliable determination of the location, bearing and attitude of the sonar head.

Hardware Considerations
The goals are to meet accuracy standards, to minimize sensitivity to unavoidable environmental effects, and to produce a compact and cost-effective system with a flexible operational envelope.

Sonar
Relatively narrow pulse widths and pulse lengths are needed to provide accuracy and resolution of bottom features; a pulse width of less than 1.7° is desirable. Such a pulse, with a typical length of 10 micro seconds, can provide centimeter measurement precision.

Measurements
A great deal of attention, during both design and operation, must be paid to the precise and accurate measurement of offsets and angles in the set up.

Electronic time delays through the system, both fixed and variable, must be carefully determined, and errors must be either eliminated or calibrated and corrected in software. All inputs related to attitude and location must be corrected and appropriately interpolated. Computer latencies must be well understood and carefully handled. It is important to design the system such that any correctors are small so that errors in the correctors do not have a substantial impact on overall system performance. Timing calibration must be measured and corrected to millisecond accuracy. System installation angles, orientation angles, and the resulting beam nadir angle must be known to high accuracy for every pulse because their effect is magnified by the sonar range.

It is desirable to limit system error components and thus system angle errors to about 0.01 degrees.

Finally, precision, repeatability, and absolute accuracy of time and angle measurements must be checked on a regular basis through monitoring overlap areas between swaths, cross lines, and by performing occasional intercomparisons against independent standards such as direct measurement.

Gain
Only a portion of the transmitted energy is reflected from the bottom and returned to the receiver. If the dynamic range capability of the receiver is a limiting design factor, then either weak signal performance will be compromised or saturated echo returns may result. The return signal is displayed on the computer screen and settings such as gain can be controlled to produce the best results.

Frequency and Pulse Length
Frequency and pulse length can be controlled via the computer program. The onscreen display is an accurate reflection of the collected data and is monitored at all time.

Beam angle
The range accuracy is best when the sonar beam strikes the bottom at right angles, when the beam angle becomes more acute the sound footprint elongates. The beam spreading affects the arrival time of the bottom return to the receiver and effectively shortens the range. Another issue is due to the fact that a significant amount of energy is scattered and does not return to the sonar transducer.

Vertical reference
The traditional approach is to perform bathymetry with respect to the extant mean water level.

With the application of absolute water levels measured concurrently at nearby water level (tide) gages, depths measured with respect to the mean water level are reduced to appropriate project tidal data for charting and mapping.

Kinematic GPS (KGPS), using carrier phase techniques, can be used to provide highly precise horizontal and vertical positions with respect to the WGS-84 ellipsoid.

Local reference using survey monuments with a Total Station.

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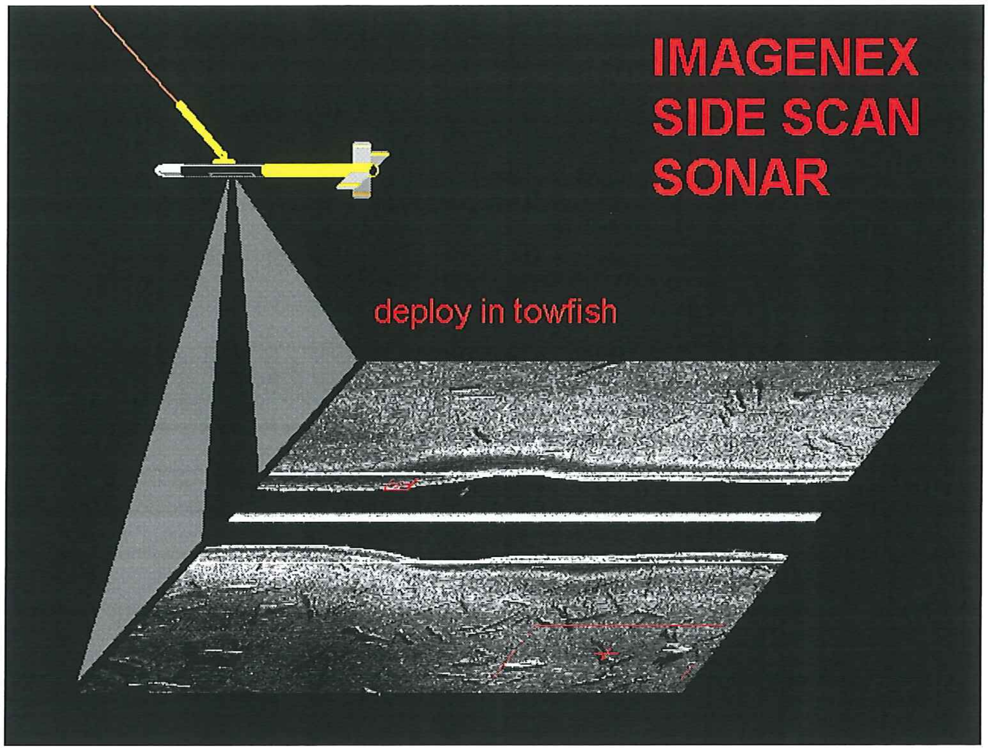
Operator interface
For efficient data collection, the operator is presented with access to the following displays: digital survey area boundaries, track lines, all available parameter values, error messages and warnings, and visual cues of the received data. For ease of use, all receiver options are computer controlled through a graphical user interface.

Procedures
1) Periodic angle calibrations of the sonar head are carried out in our test tank.
2) The sonar and bearing and attitude sensor are fastened to a carefully machined bracket that keeps the instruments parallel with each other and square to the holding rod.
3) The positioning instrument is attached on top of the holding rod, offset calculations are minimal.
4) Speed of sound calculations in the local waters are made before each survey.
5) Latency calibrations are made for positioning and pitch, roll and heading.
6) Heading calibrations are made using a transit and known monuments.
7) All survey lines are run to overlap adjacent lines. Repeatability of results throughout every survey area is constantly reviewed by operators for quality control.
8) Difficult or questionable data segments can be reprocessed. False data due to environmental effects can be selected by the operator and replaced with the underlying true bottom depths.
9) All raw data are permanently recorded and saved.

Post Processing
1) Timing latencies in sonar data, position and attitude are calibrated in situ.
2) Each profile is manually examined for noise, system artifacts, and some false targets in the environment and wild points are rejected in order to protect the integrity of the data set.
3) Timing correctors are utilized for hardware and environmental time delays.
4) The mean water level is calculated.
5) For bottom returns, strongest-pulse, first-pulse and center-pulse modes of depth calculation are available.
6) Processing is conducted in a flexible framework that provides interactive data displays and adaptability through efficient operator involvement.
7) Calculated depths for multiple profiles are color-coded in a geographical display. The user may view selected regions in a magnified "zoom window".
8) Quality control is augmented by redundancy in a number of areas such as overlapping depth ranges and overlapping scan edges between swaths. A spatial data editing and three dimensional visualization program is used as a final check for wild depths in geographic context.

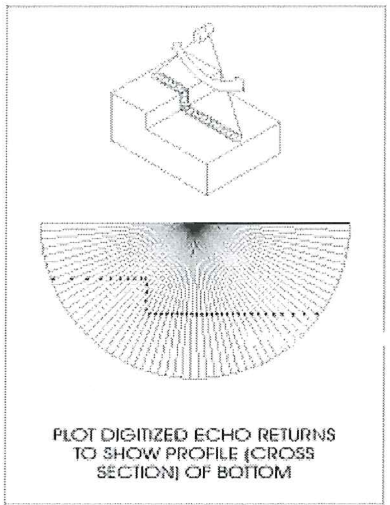
Appendix B. Side-Scan Sonar Images



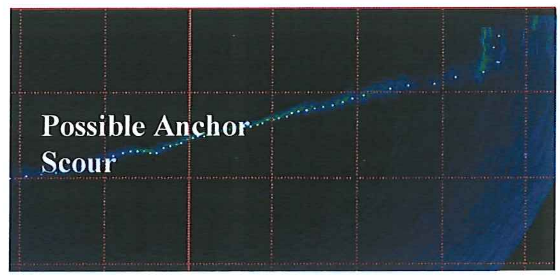
A side scan sonar emits sound pulses down toward the seafloor across a wide angle.The pulses are emited perpendicular to the track of the sensor, which may be towed from a surface vessel or mounted on a small boat.

The intensity and time of flight of each acoustic reflections is recorded in a series of cross-track slices, which when stitched together along the direction of motion, become an image of the sea bottom. The time of flight indicates the distance from the sonar head of a target The strength of the sonar return determines the texture of the seafloor. For example, most of a sound pulse impinging on a mud bottom will be absorbed with only a small percentage returning to the receiver. But a rock bottom will absorb very little sound and return a higher percentage.

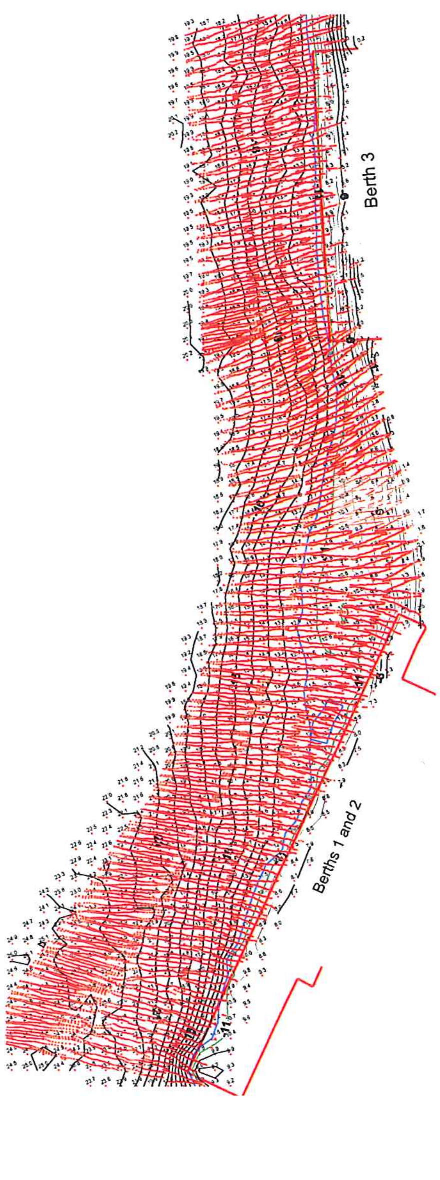
Appendix C. "Rotating Head" Sonar



The image to the left shows how the rotating head sonar collects sonar data from under obstructions.



The screen capture above is taken from the sonar program and shows a vertical pile and the ships berth as a cross-section. The data is viewed in real time and adjustments can be made in the software to maximize the quality of the return. We can also adjust the survey plan to take advantage of anomalies that may be seen in the sonar returns.



The image to the left shows the density of data gathered. Each red dot is an actual X,Y and Z data point. The sonar is fastened to a small boat and survey tracks are run guided by an on screen chart. The sonar collects data across track in a zig-zag fashion.

Appendix D. Photographs

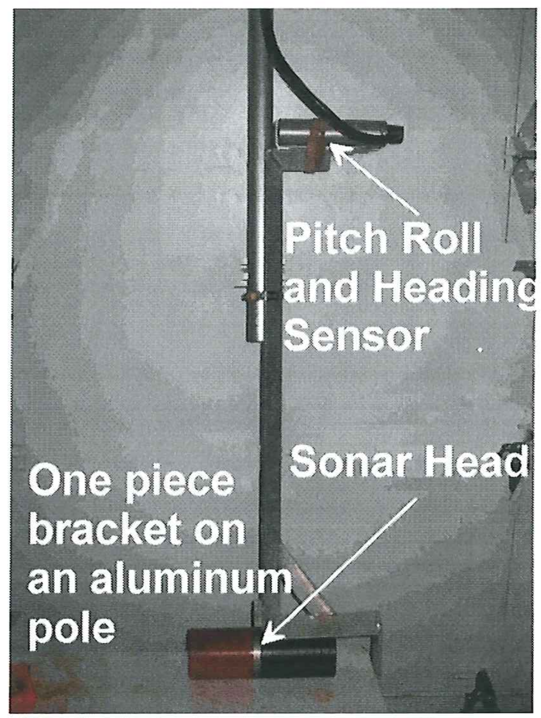
The photograph to the left shows the inflatable used to gather sonar data. The computers are in the housing on the bow, the sonar is attached to the aluminum holder with the RTK GPS receiver fastened to the top of the survey rod. An inflatable boat is a remarkably stable work platform and is very useful in getting close to the shoreline.

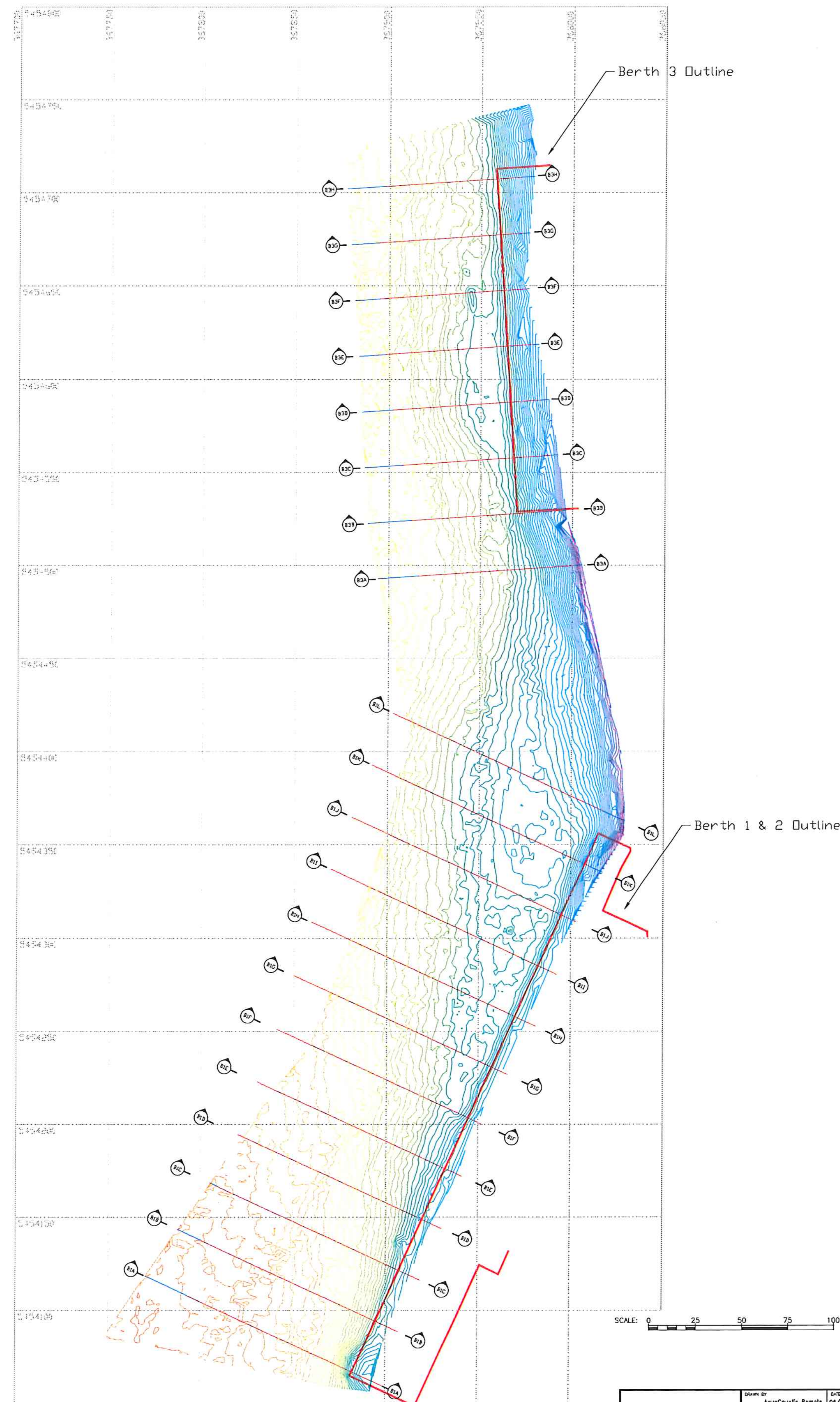
The photograph to the right shows part of berth 1 and 2.

The photograph to the left shows our electric outboard motor used to eliminate emissions while surveying.

The photograph to the right shows the northern edge of berth 1 and 2.

The photograph to the right shows how the machined, one piece bracket holds the sonar and solid state bearing and inclinometer in the same orientation





SCALE: 0 25 50 75 100 METRES

1) LOCAL CHART DATUM ELEVATIONS BASED ON TIDE ELEVATIONS NAD83, ZONE 10N

2) BASED ON DATA COLLECTED ON MAY 2006 & APRIL 2012

3) ALL MEASUREMENTS IN METRES

DRAWN BY AquaCoustic Remote	DATE 06/12/12
CHECKED	
ENGINEERING	
QUALITY CONTROL	
PRODUCTION	
PROJECT SUPERVISOR	
APPROVED	

Prepared for
Port Alberni Port Authority
by
AquaCoustic Remote Technologies Inc

TITLE
Port Alberni Port Berths 1, 2, 3
Bathymetry Re-Survey
2006 Contour Map

SIZE A1	DWG.NO. AQC-56001-1
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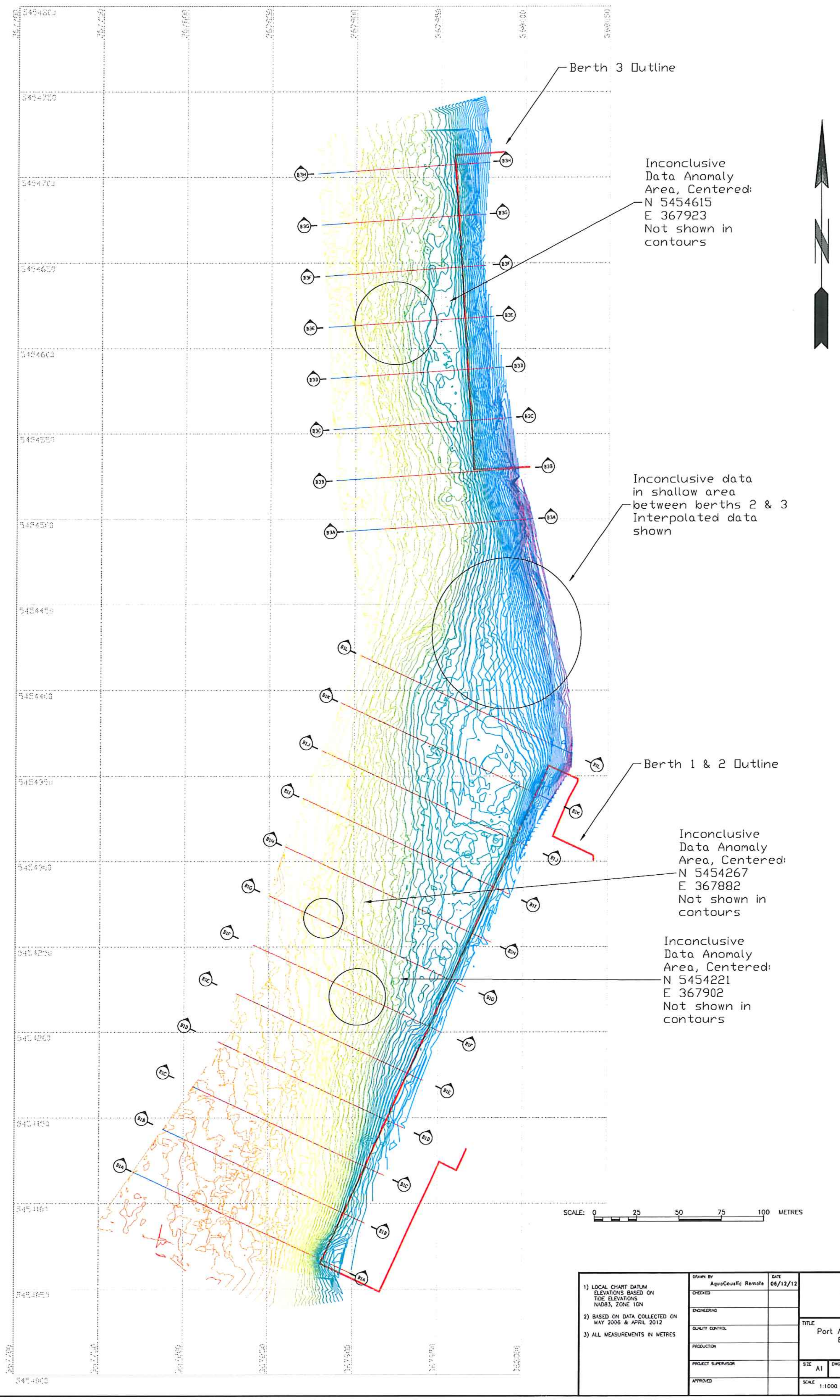

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3) ALL MEASUREMENTS IN METRES

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ENGINEERING		
QUALITY CONTROL		
PRODUCTION		
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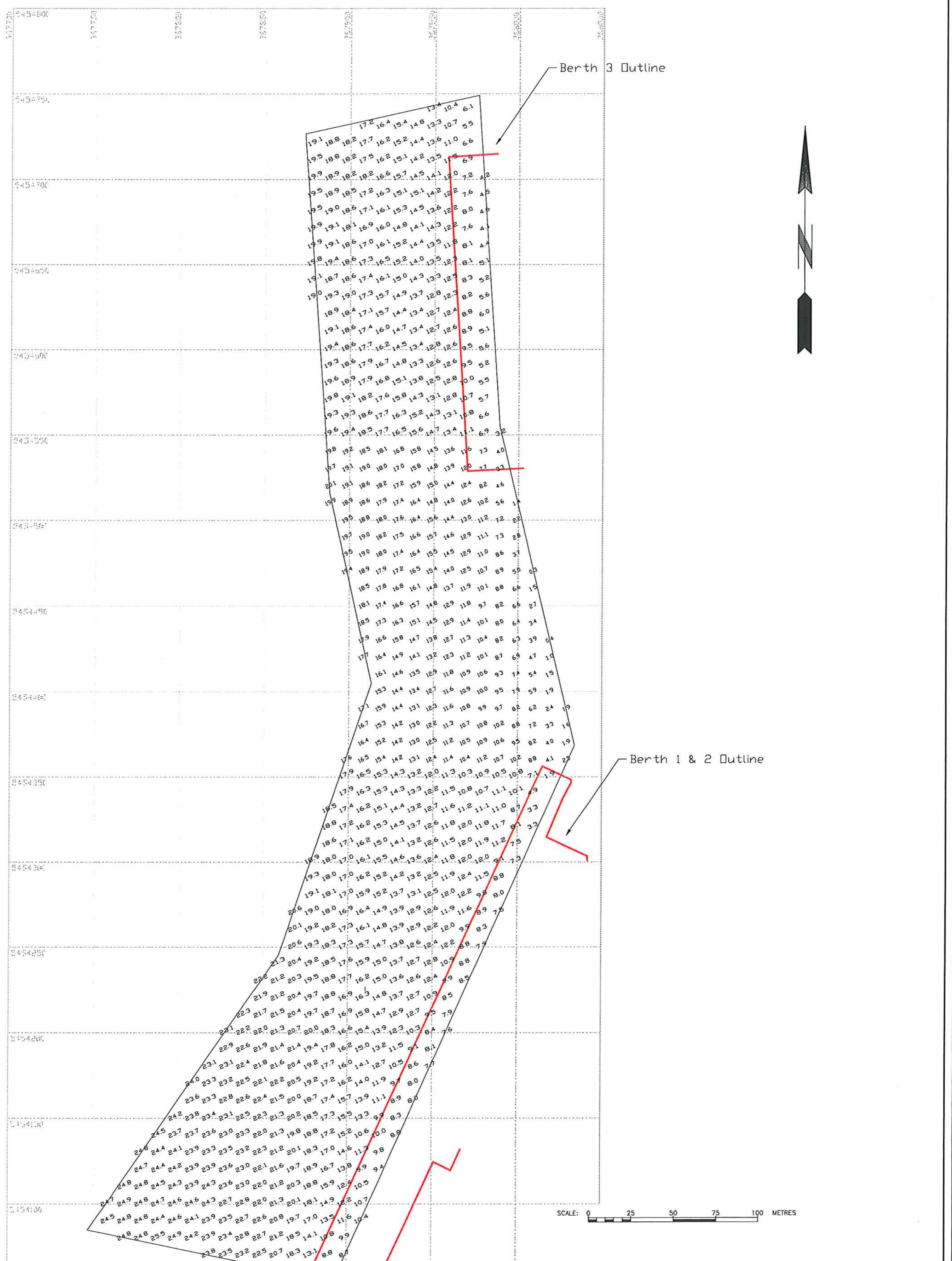

1) LOCAL CHART DATUM ELEVATIONS BASED ON TIDE ELEVATIONS NAD83, ZONE 10N

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3) ALL MEASUREMENTS IN METRES

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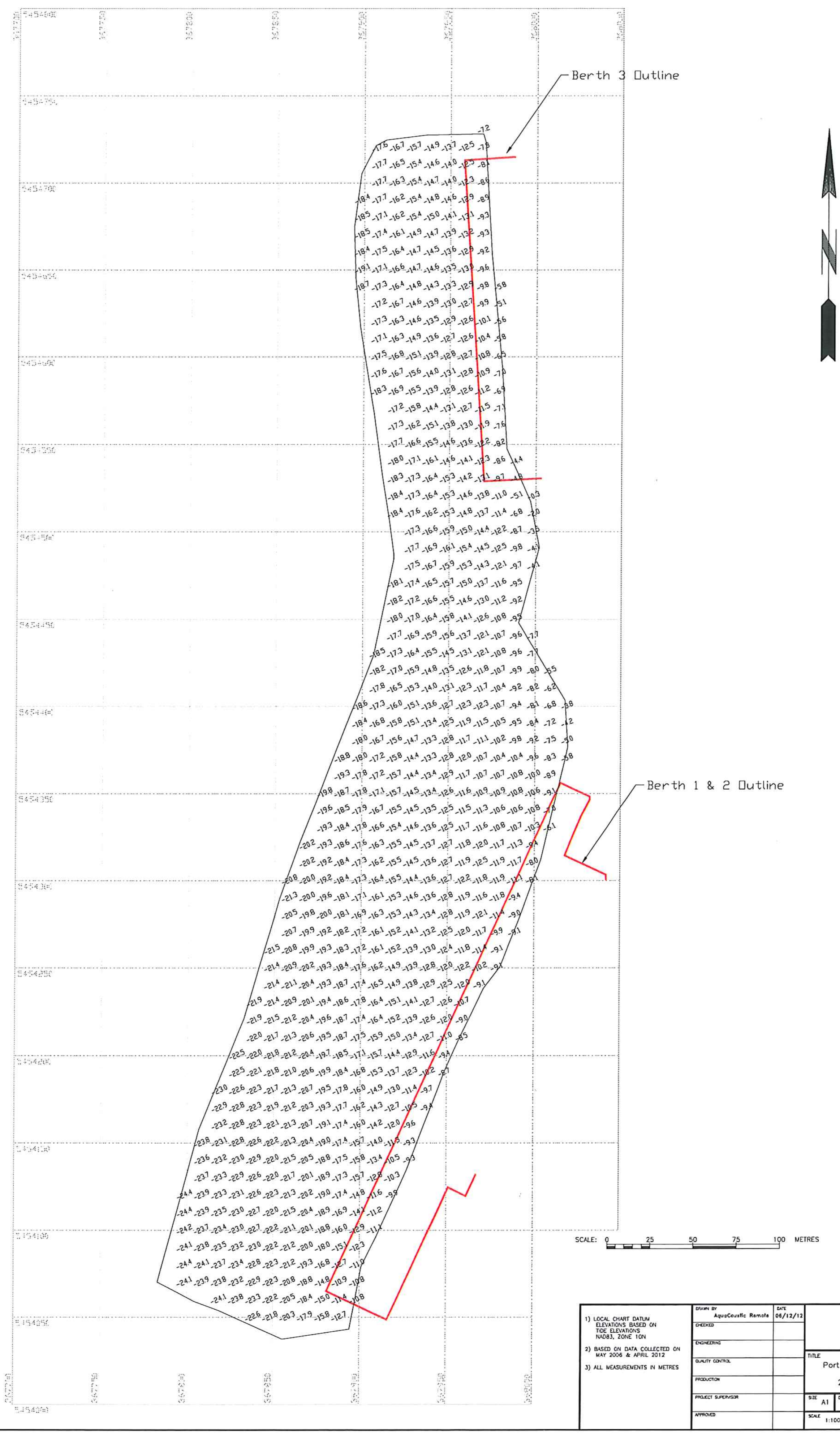

1) LOCAL CHART DATUM ELEVATIONS BASED ON TIDE ELEVATIONS NAD83, ZONE 10N

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DRAWN BY AquaCoustic Remote	DATE 06/12/12	Prepared for: Port Alberni Port Authority by AquaCoustic Remote Technologies Inc	
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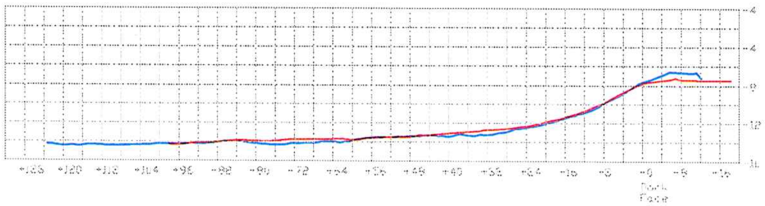
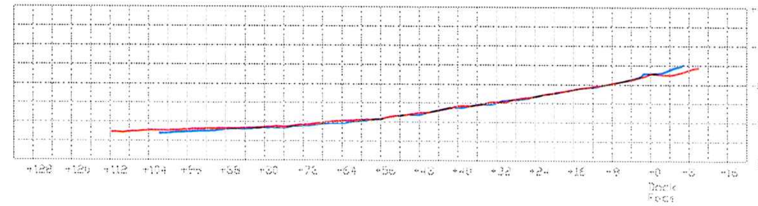
APPROVED		SCALE 1:1000 (1 cm = 10 m)	SHEET 4 of 8

2006 SURVEY
2012 SURVEY



SECTION "B1A"



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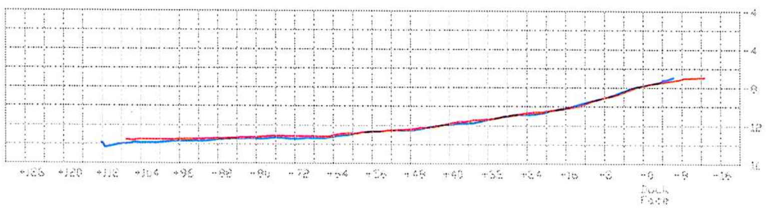
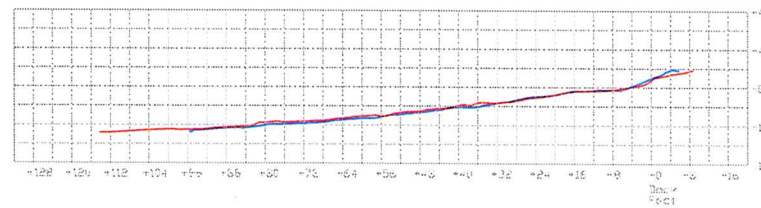


SECTION "B1B



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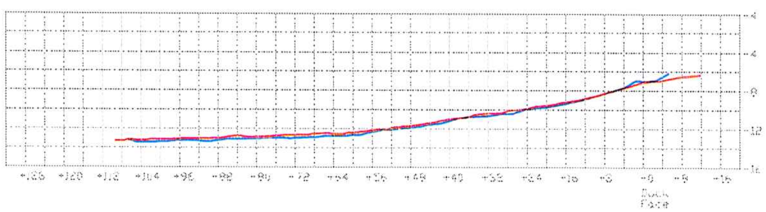
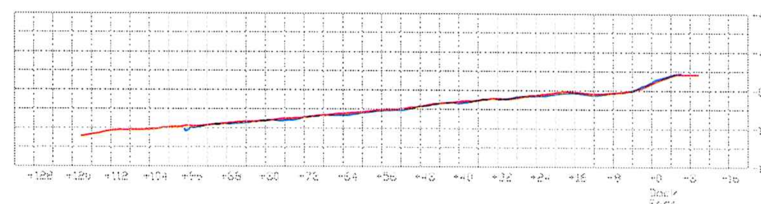


SECTION "B1C"



SECTION "B1F"

1) LOCAL CHART DATUM ELEVATIONS BASED ON TIDE ELEVATIONS NAD83, ZONE 10N
2) BASED ON DATA COLLECTED ON MAY 2006 & APRIL 2012
3) ALL MEASUREMENTS IN METRES

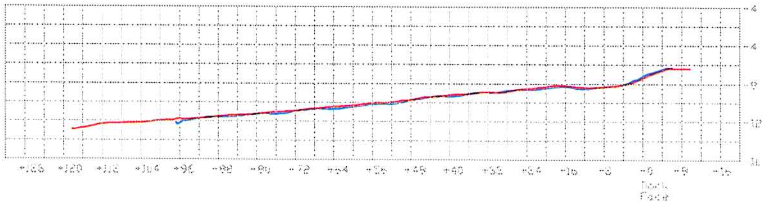
DRAWN BY	AquaCoustic	DATE 06/12/12
CHECKED		
ENGINEERING		
QUALITY CONTROL		
PRODUCTION		
PROJECT SUPERVISOR		
APPROVED		

Prepared for
Port Alberni Port Authority
by
AquaCoustic Remote Technologies Inc

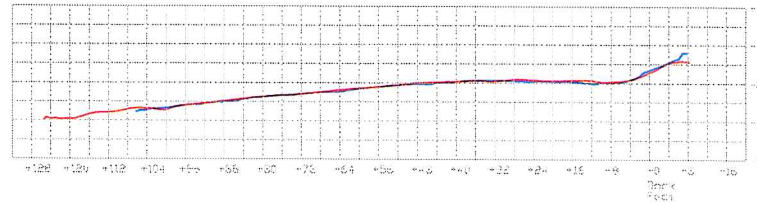
TITLE
Port Alberni Port Berths 1, 2, 3
Bathymetry Re-Survey
Cross-Sections

SIZE A1 | DWG.NO. AQC-56001-5
SCALE 1:500 (1cm = 5m) | DRF | SHEET 5 of 8

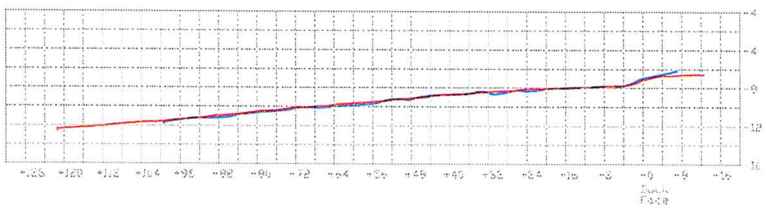
2006 SURVEY
2012 SURVEY



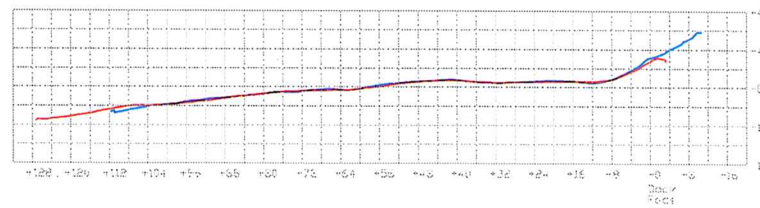
SECTION "B1G"



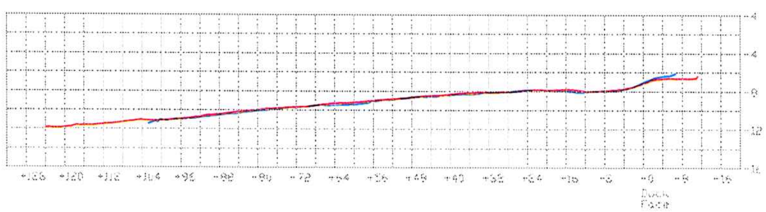
SECTION "B1J"



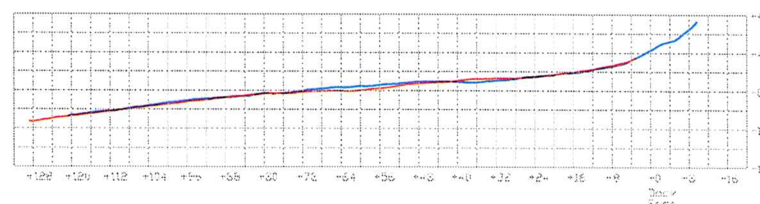
SECTION "B1H



SECTION "B1K"



SECTION "B1I"



SECTION "B1L"

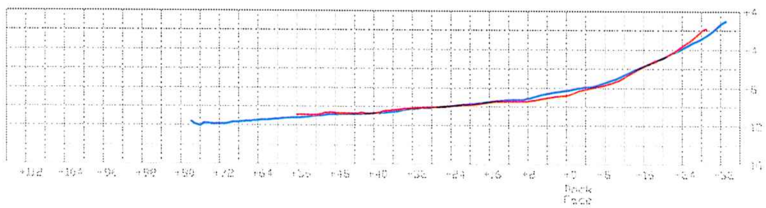
1) LOCAL CHART DATUM ELEVATIONS BASED ON TIDE ELEVATIONS NAD83, ZONE 10N

2) BASED ON DATA COLLECTED ON MAY 2006 & APRIL 2012

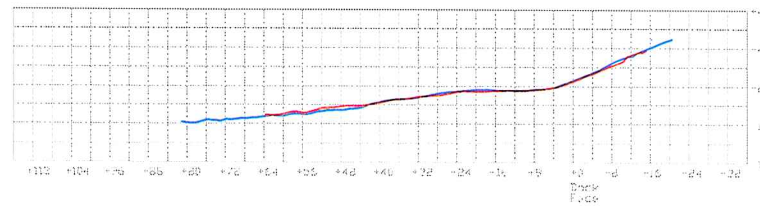
3) ALL MEASUREMENTS IN METRES

DRAWN BY AquaCoustic	DATE 06/12/12	Prepared for: Port Alberni Port Authority by AquaCoustic Remote Technologies Inc
CHECKED		
ENGINEERING		TITLE Port Alberni Port Berths 1, 2, 3 Bathymetry Re-Survey Cross-Sections
QUALITY CONTROL		
PRODUCTION		
PROJECT SUPERVISOR		SIZE A1 · DWG.NO. AQC-56001-6
APPROVED		SCALE 1:250 (1cm = 2.5m) · DRF · SHEET 6 of 8

2006 SURVEY
2012 SURVEY



SECTION "B3A"



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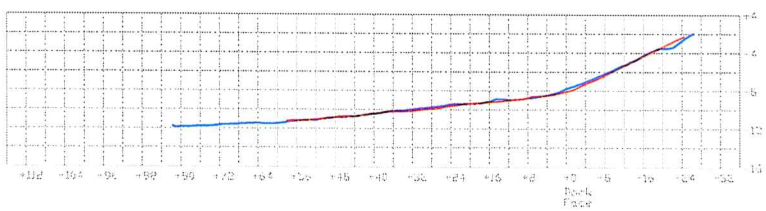
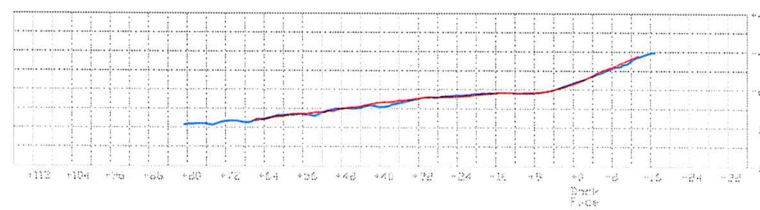
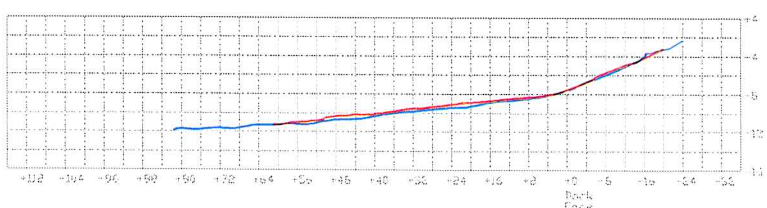


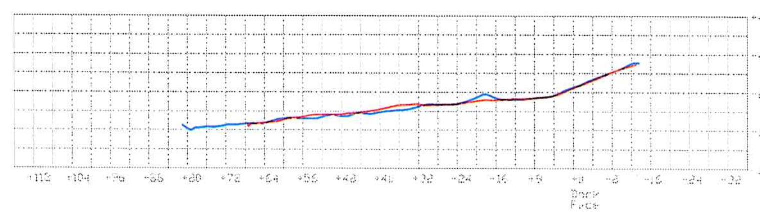
SECTION "B3B



SECTION "B3E"



SECTION "B3C"



SECTION "B3F"

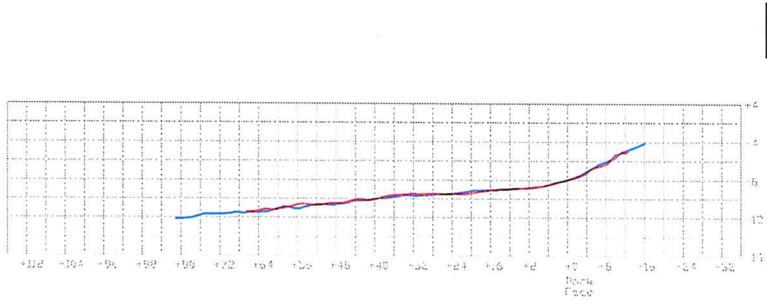
1) LOCAL CHART DATUM ELEVATIONS BASED ON TIDE ELEVATIONS NAD83, ZONE 10N
2) BASED ON DATA COLLECTED ON MAY 2006 & APRIL 2012
3) ALL MEASUREMENTS IN METRES

DRAWN BY	AquaCoustic	DATE 06/12/12
CHECKED		
ENGINEERING		
QUALITY CONTROL		
PRODUCTION		
PROJECT SUPERVISOR		
APPROVED		

Prepared for: Port Alberni Port Authority
by AquaCoustic Remote Technologies Inc

TITLE
Port Alberni Port Berths 1, 2, 3
Bathymetry Re-Survey
Cross-Sections

SIZE	DWG.NO.	
A1	AQC-56001-7	
SCALE 1:500 (1cm = 5m)	DWF	SHEET 7 of 8



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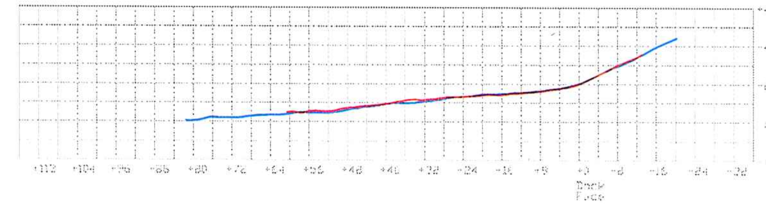


SECTION "B3H"

1) LOCAL CHART DATUM ELEVATIONS BASED ON TIDE ELEVATIONS NAD83, ZONE 10N

2) BASED ON DATA COLLECTED ON MAY 2006 & APRIL 2012

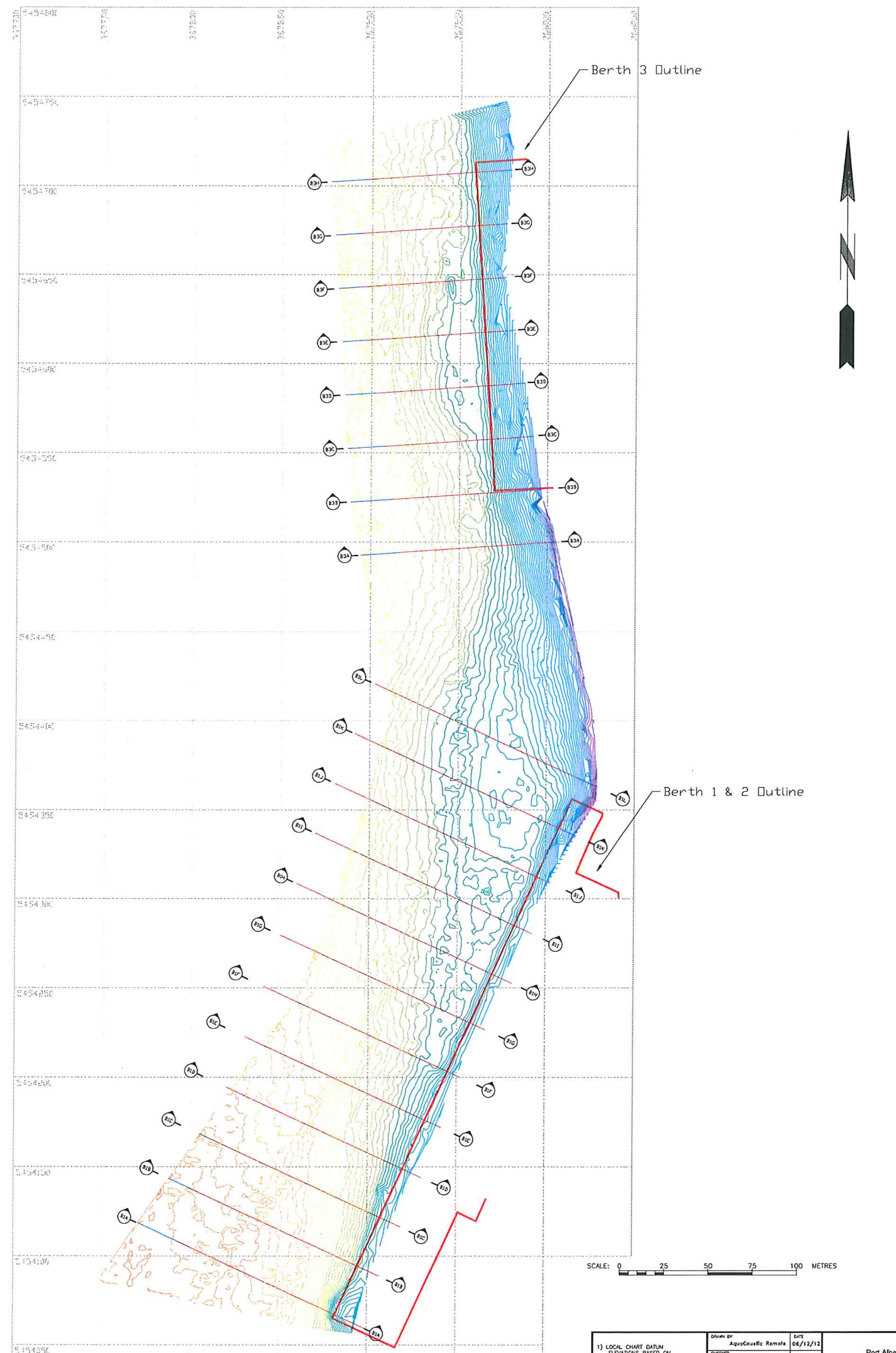
3) ALL MEASUREMENTS IN METRES

DRAWN BY	AquaCoustic	DATE 06/12/12
CHECKED		
ENGINEERING		
QUALITY CONTROL		
PRODUCTION		
PROJECT SUPERVISOR		
APPROVED		

Prepared for:
Port Alberni Port Authority
by
AquaCoustic Remote Technologies Inc

TITLE
Port Alberni Port Berths 1, 2, 3
Bathymetry Re-Survey
Cross-Sections

SIZE A1	DWG.NO. AQC-56001-8		
SCALE 1:250 (1cm = 2.5m)	DRF	SHEET 8 of 8	



1) LOCAL CHART DATUM ELEVATIONS BASED ON TIDE ELEVATIONS NAD83, ZONE 10N

2) BASED ON DATA COLLECTED ON MAY 2006 & APRIL 2012

3) ALL MEASUREMENTS IN METRES

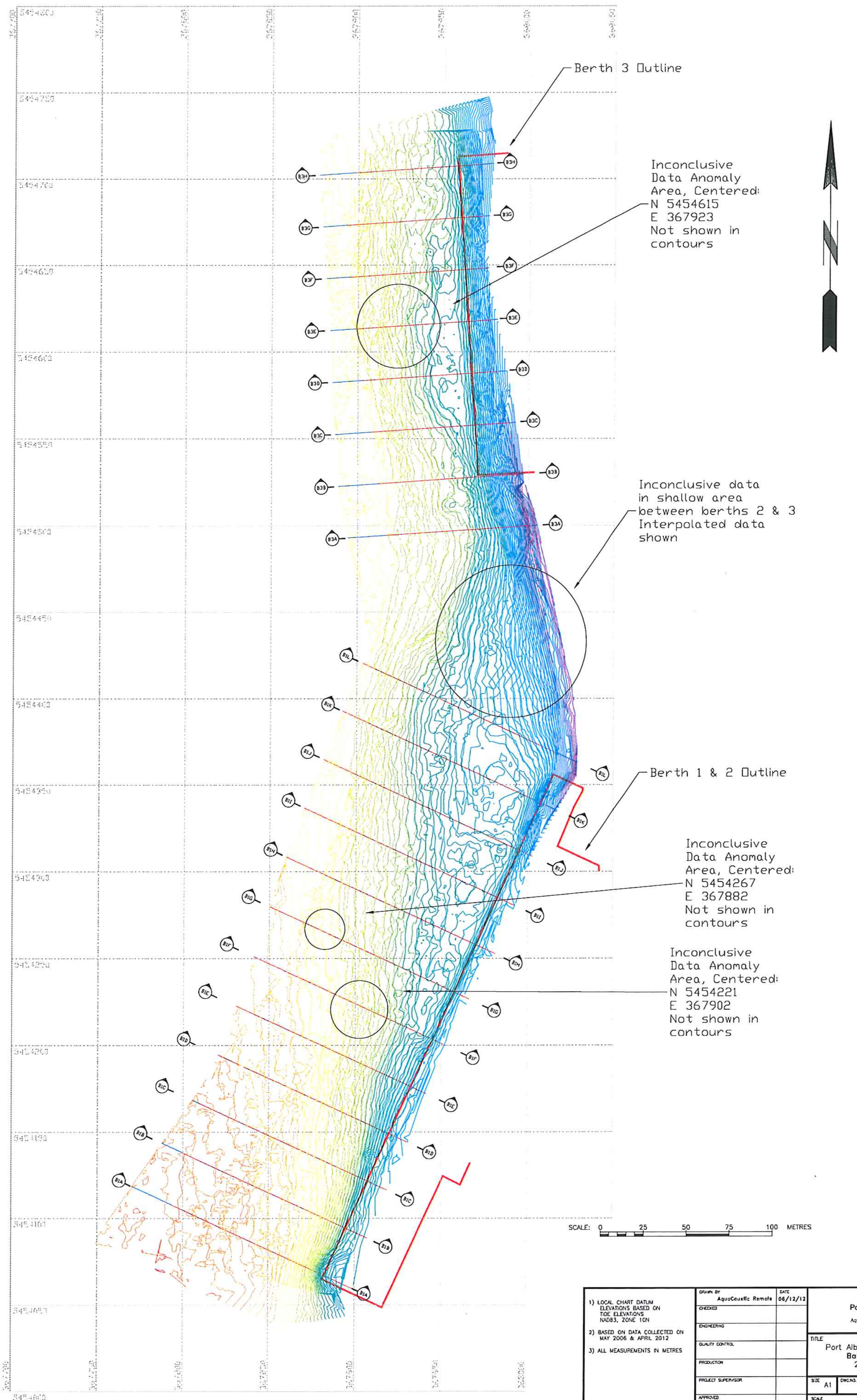
DRAWN BY	AquaCoustic Remote	DATE 06/12/12
CHECKED		
ENGINEERING		
QUALITY CONTROL		
PRODUCTION		
PROJECT SUPERVISOR		
APPROVED		

Prepared for
Port Alberni Port Authority
by
AquaCoustic Remote Technologies Inc

TITLE
Port Alberni Port Berths 1, 2, 3
Bathymetry Re-Survey
2006 Contour Map

SIZE A1 | DWG.NO. AQC-56001-1

SCALE 1:1000 (1 cm = 10 m) | SHEET 1 of 8



1) LOCAL CHART DATUM ELEVATIONS BASED ON TIDE ELEVATIONS NAD83, ZONE 10N

2) BASED ON DATA COLLECTED ON MAY 2006 & APRIL 2012

3) ALL MEASUREMENTS IN METRES

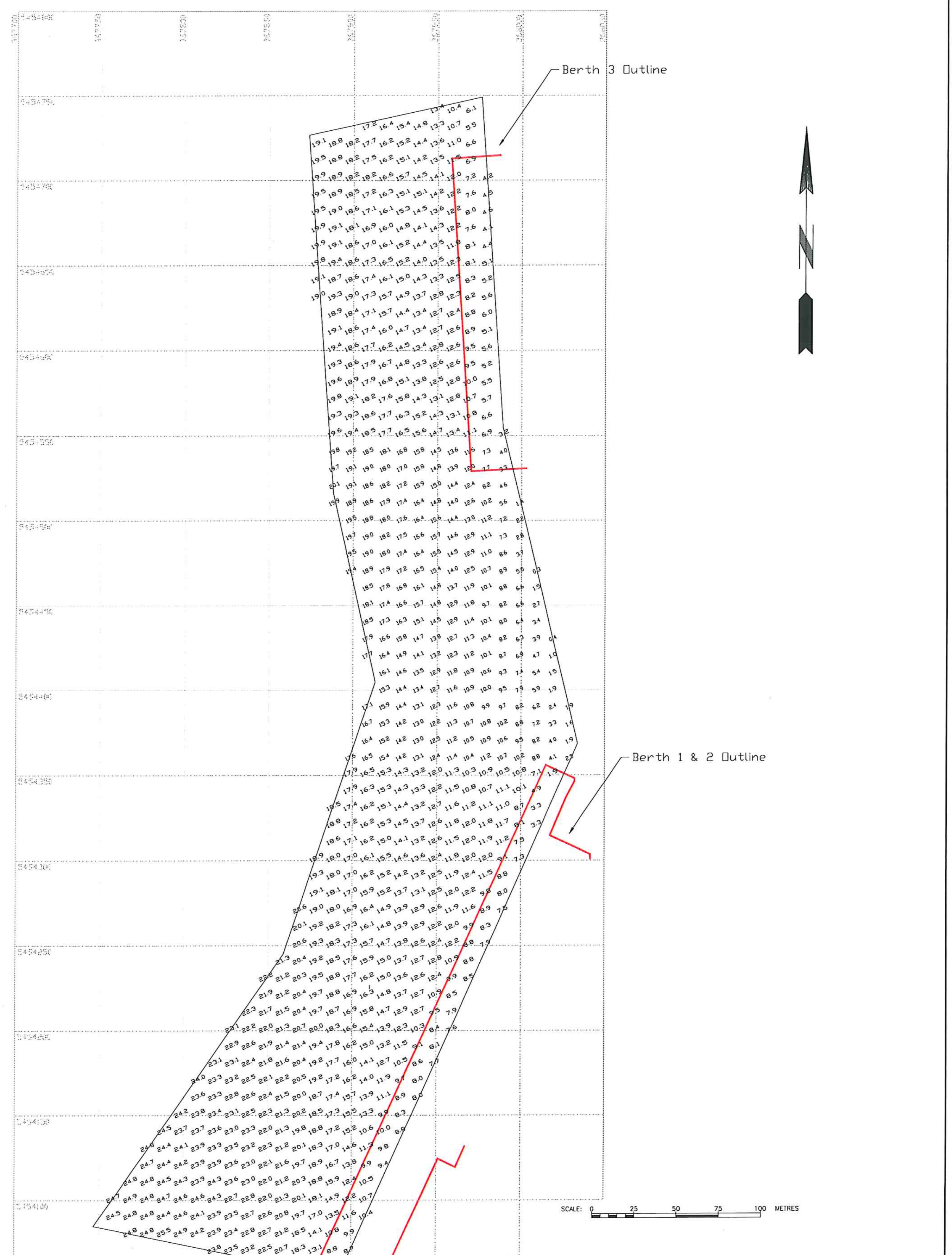
DRAWN BY AquaCoustic Remote	DATE 06/12/12
CHECKED	
ENGINEERING	
QUALITY CONTROL	
PRODUCTION	
PROJECT SUPERVISOR	
APPROVED	

Prepared for:
Port Alberni Port Authority
by
AquaCoustic Remote Technologies Inc

TITLE
Port Alberni Port Berths 1, 2, 3
Bathymetry Re-Survey
2012 Contour Map

SIZE A1 DWG.NO. AQC-56001-2

SCALE 1:1000 (1 cm = 10 m) SHEET 2 of 8



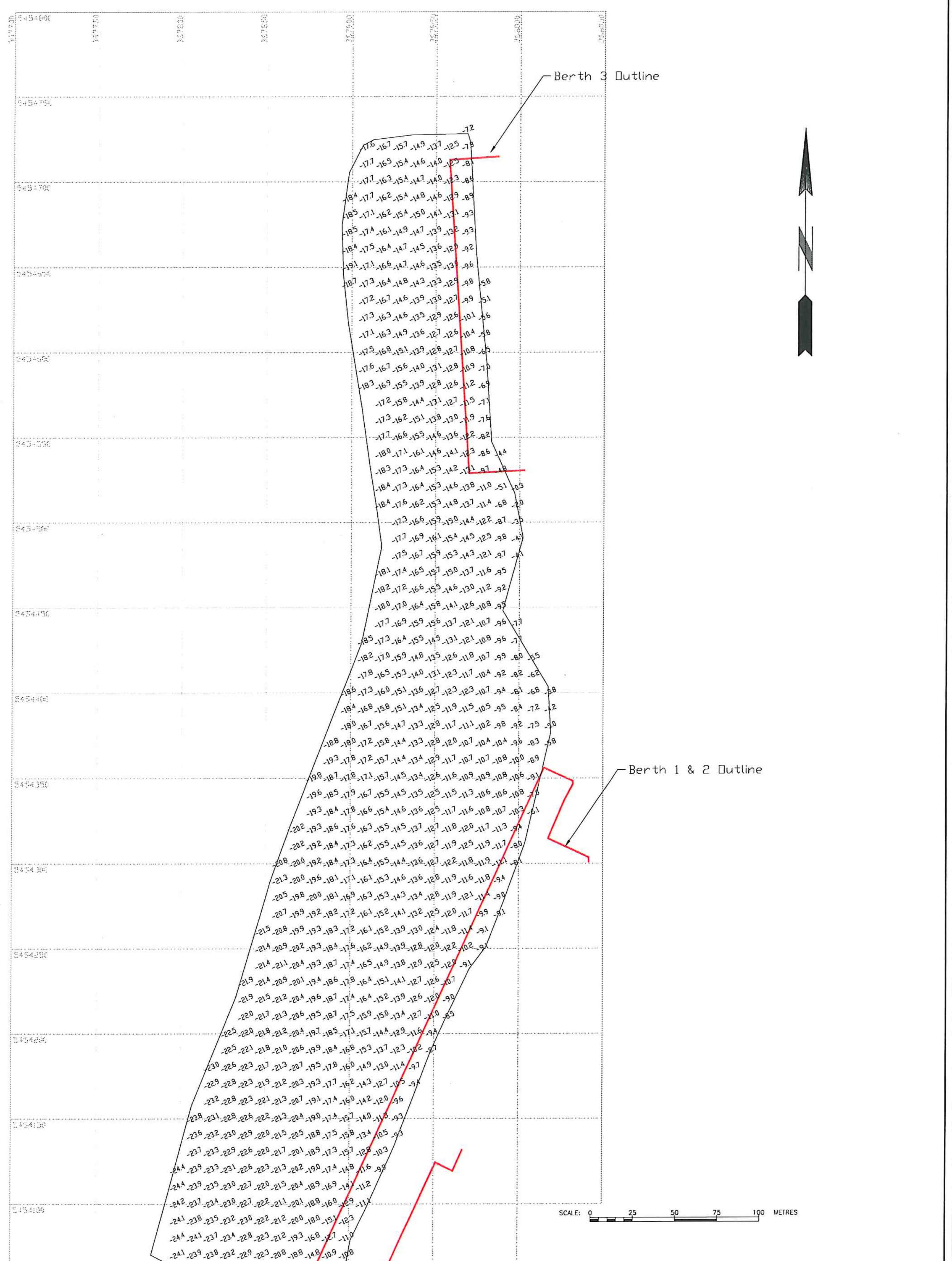
1) LOCAL CHART DATUM ELEVATIONS BASED ON TIDE ELEVATIONS NAD83, ZONE 10N
2) BASED ON DATA COLLECTED ON MAY 2006 & APRIL 2012
3) ALL MEASUREMENTS IN METRES

DRAWN BY	AquaCoustic Remote
DATE	06/12/12
CHECKED	
ENGINEERING	
QUALITY CONTROL	
PRODUCTION	
PROJECT SUPERVISOR	
APPROVED	

Prepared for:
Port Alberni Port Authority
by
AquaCoustic Remote Technologies Inc

TITLE
Port Alberni Port Berths 1, 2, 3
Bathymetry Re-Survey
2006 Data Smooth Sheet

SIZE A1 DWG.NO AQC-56001-3
SCALE 1:1000 (1 cm = 10 m) SHEET 3 of 8



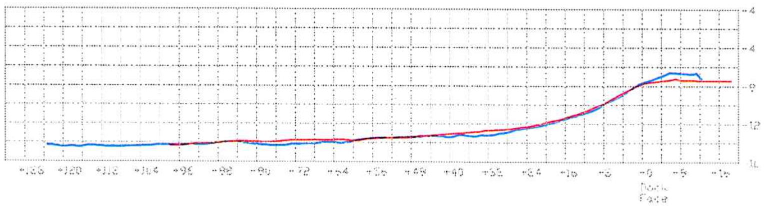
1) LOCAL CHART DATUM ELEVATIONS BASED ON TIDE ELEVATIONS NAD83, ZONE 10N

2) BASED ON DATA COLLECTED ON MAY 2006 & APRIL 2012

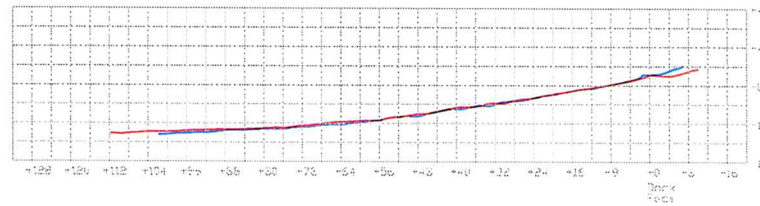
3) ALL MEASUREMENTS IN METRES

DRAWN BY: AquaCoustic Remote	DATE: 06/12/12	Prepared for: Port Alberni Port Authority, by AquaCoustic Remote Technologies Inc
CHECKED		
ENGINEERING		TITLE: Port Alberni Port Berths 1, 2, 3 Bathymetry Re-Survey 2012 Data Smooth Sheet
QUALITY CONTROL		
PRODUCTION		
PROJECT SUPERVISOR		SIZE: A1 — DWG.NO. AQC-56001-4
APPROVED		SCALE: 1:1000 (1 cm = 10 m) — SHEET: 4 of 8

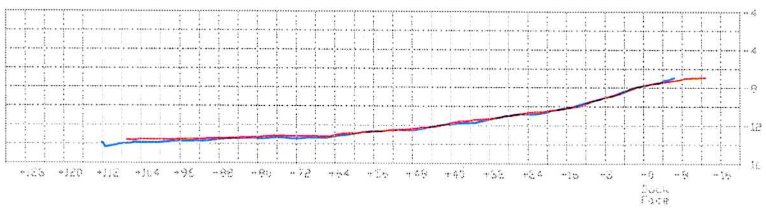
2006 SURVEY
2012 SURVEY



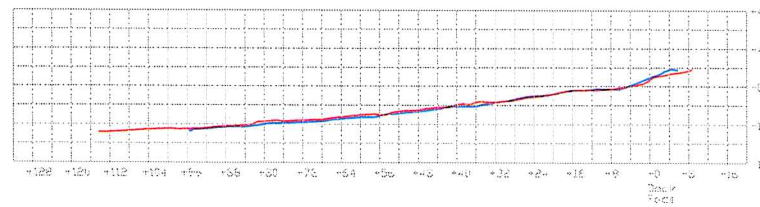
SECTION "B1A"



SECTION "B1D"



SECTION "B1B



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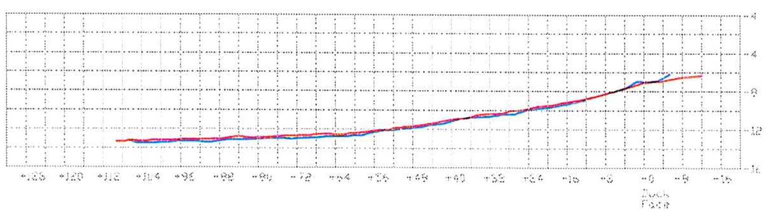

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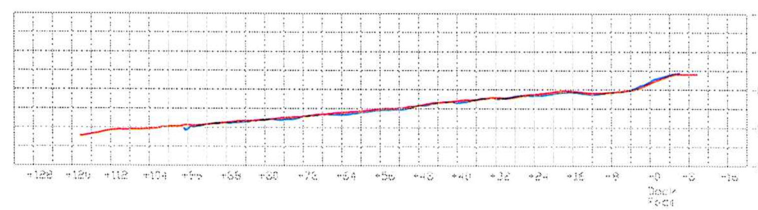


SECTION "B1F"

1) LOCAL CHART DATUM ELEVATIONS BASED ON TIDE ELEVATIONS NAD83, ZONE 10N
2) BASED ON DATA COLLECTED ON MAY 2006 & APRIL 2012
3) ALL MEASUREMENTS IN METRES

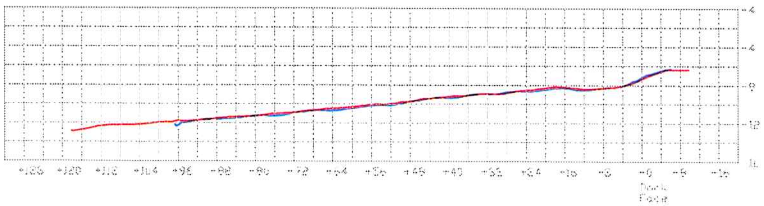
DRAWN BY	AquaCoustic	DATE 06/12/12
CHECKED		
ENGINEERING		
QUALITY CONTROL		
PRODUCTION		
PROJECT SUPERVISOR		
APPROVED		

Prepared for
Port Alberni Port Authority
by
AquaCoustic Remote Technologies Inc

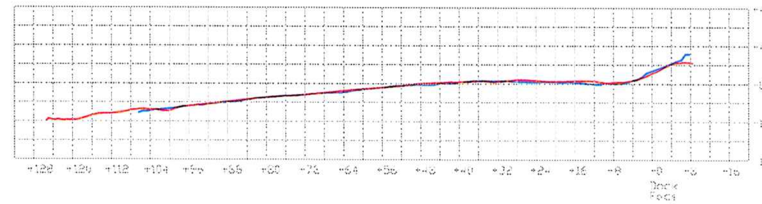
TITLE
Port Alberni Port Berths 1, 2, 3
Bathymetry Re-Survey
Cross-Sections

SIZE A1	DWG.NO. AQC-56001-5		
SCALE 1:500 (1cm = 5m)	DRF	SHEET 5 of 8	

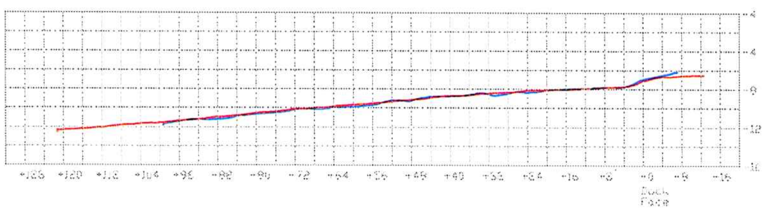
2006 SURVEY
2012 SURVEY



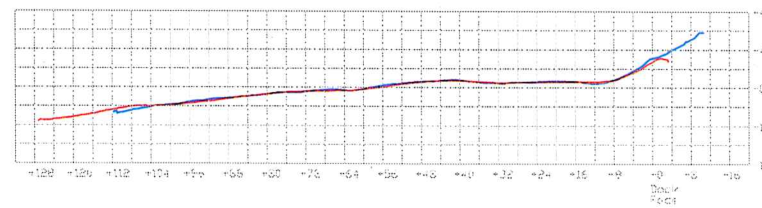
SECTION "B1G"



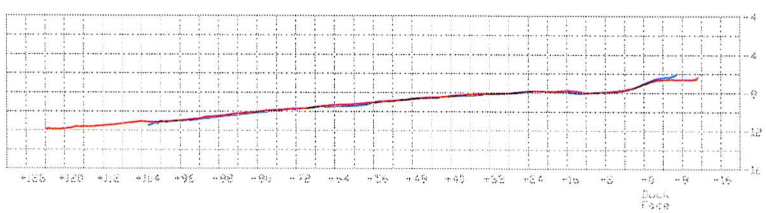
SECTION "B1J"



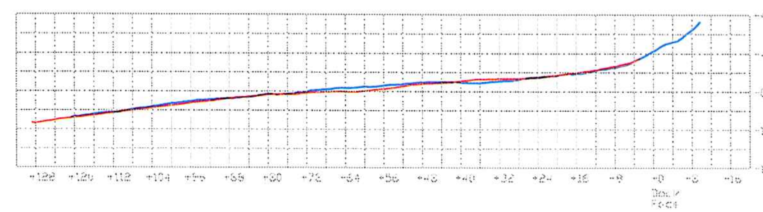
SECTION "B1H



SECTION "B1K"



SECTION "B1I"



SECTION "B1L"

1) LOCAL CHART DATUM ELEVATIONS BASED ON TIDE ELEVATIONS NAD83, ZONE 10N
2) BASED ON DATA COLLECTED ON MAY 2006 & APRIL 2012
3) ALL MEASUREMENTS IN METRES

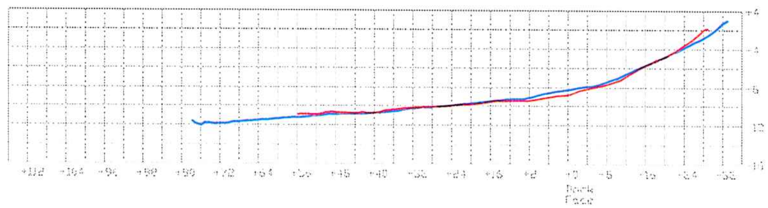
DRAWN BY	AquaCoustic	DATE 06/12/12
CHECKED		
ENGINEERING		
QUALITY CONTROL		
PRODUCTION		
PROJECT SUPERVISOR		
APPROVED		

Prepared for
Port Alberni Port Authority
by
AquaCoustic Remote Technologies Inc

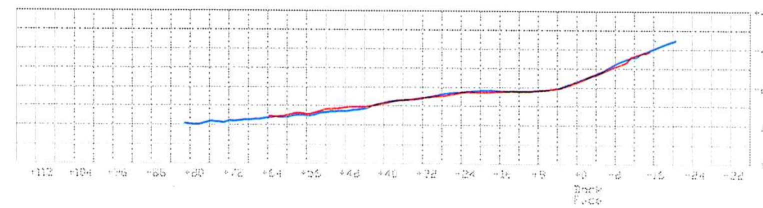
TITLE
Port Alberni Port Berths 1, 2, 3
Bathymetry Re-Survey
Cross-Sections

SIZE	DWG.NO.	
A1	AQC-56001-6	
SCALE 1:250 (1cm = 2.5m)	DRF	SHEET 6 of 8

2006 SURVEY
2012 SURVEY



SECTION "B3A"



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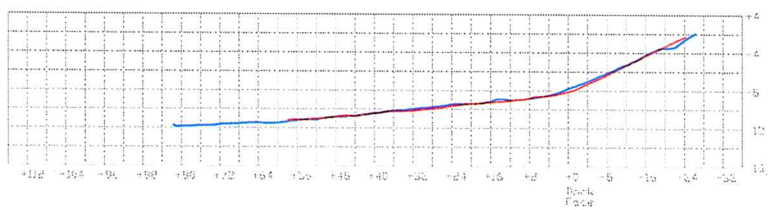
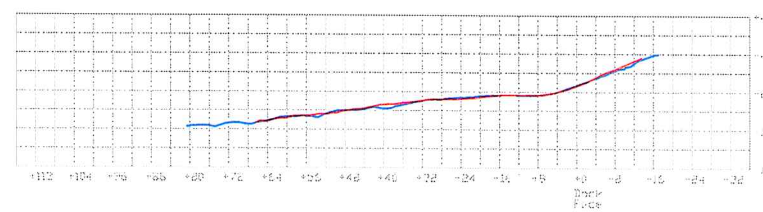


SECTION "B3B



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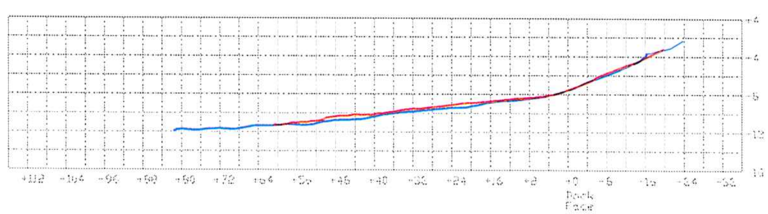
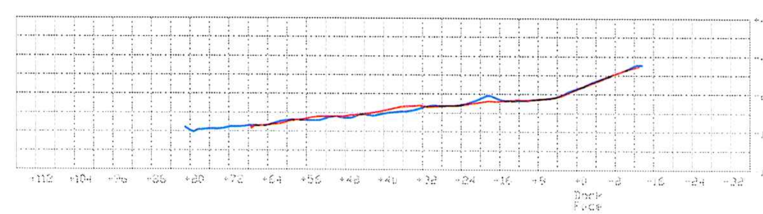


SECTION "B3C"



SECTION "B3F"

1) LOCAL CHART DATUM ELEVATIONS BASED ON TIDE ELEVATIONS NAD83, ZONE 10N
2) BASED ON DATA COLLECTED ON MAY 2006 & APRIL 2012
3) ALL MEASUREMENTS IN METRES

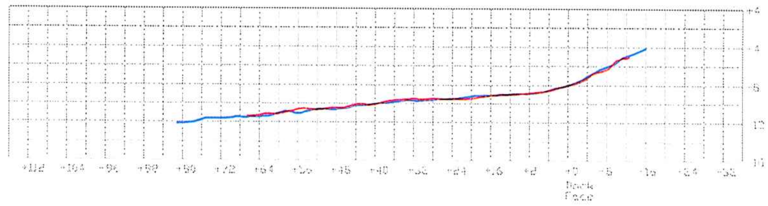
DRAWN BY	AquaCoustic	DATE 06/12/12
CHECKED		
ENGINEERING		
QUALITY CONTROL		
PRODUCTION		
PROJECT SUPERVISOR		
APPROVED		

Prepared for
Port Alberni Port Authority
by
AquaCoustic Remote Technologies Inc

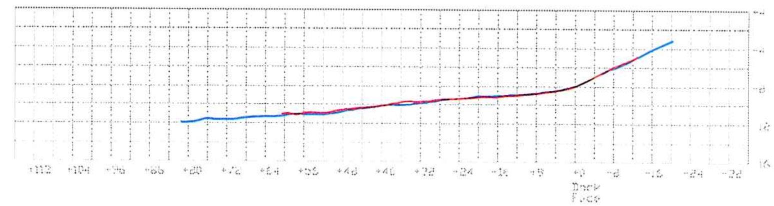
TITLE
Port Alberni Port Berths 1, 2, 3
Bathymetry Re-Survey
Cross-Sections

SIZE A1 | DWG.NO. AQC-56001-7
SCALE 1:500 (1cm = 5m) | DAY | SHEET 7 of 8

2006 SURVEY
2012 SURVEY



SECTION "B3G"



SECTION "B3H"

1) LOCAL CHART DATUM
ELEVATIONS BASED ON
TIDE ELEVATIONS
NAD83, ZONE 10N

2) BASED ON DATA COLLECTED ON
MAY 2006 & APRIL 2012

3) ALL MEASUREMENTS IN METRES

DRAWN BY	AquaCoustic	DATE 06/12/12
CHECKED		
ENGINEERING		
QUALITY CONTROL		
PRODUCTION		
PROJECT SUPERVISOR		
APPROVED		

Prepared for
Port Alberni Port Authority
by
AquaCoustic Remote Technologies Inc

TITLE
Port Alberni Port Berths 1, 2, 3
Bathymetry Re-Survey
Cross-Sections

SIZE A1	DWG.NO. AQC-56001-8		
SCALE 1:250 (1cm = 2.5m)	DWF	SHEET 8 of 8	